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Kaizen Planning, Implementing and Controlling

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Humans take inspiration when they set a goal. To me, my family is my inspiration, which is why I dedicate this book to:
God. I thank Him for everything.
My parents, my life teachers.
My son, Jorge Andres García-Rodríguez, who has taught me how to be a father.
My nine-year-old daughter, Mariana Odette García-Rodriguez, who spent her entire summer vacation by my side in this project.
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My brothers and sisters, who taught me the best lessons at home.

Jorge Luis García-Alcaraz

I first dedicate this book to God. I thank Him for his infinite goodness and mercy, and for helping me come so far and reach all my goals.
Also, I would like to dedicate this work to:
My daughters Celia y Nadelis; they are my source of inspiration and the compass guiding my life.

My parents, who guide my steps from heaven.
My sister, for her wholehearted support. Without her, this work would be much impaired.
My entire family, friends, and colleagues, who always and unconditionally offer me kindness and friendship.

Midiala Oropesa-Vento

I dedicate this book to my family, my colleagues and students. I thank every experience gained and every moment shared with them to accomplish this goal. For the future challenges and the great pleasure to work together.

Aidé Aracely Maldonado-Macías

Foreword

Since the 1960s, Mexico has experienced increased industrialization. Such growth has been supported by the Maquiladora Program and the North American Free Trade Agreement (NAFTA), through which foreign-owned companies, mainly from the United States and Canada, settle in the Mexican territory.

The northern Mexican border became one of the most favored regions. More specifically, in cities such as Tijuana, Mexicali (Baja California), and Ciudad Juárez (Chihuahua) the growth of manufacturing companies—or maquiladoras—skyrocketed. Maquiladoras, also known as maquiladoras, are factories importing a great amount of raw material and equipment and exporting final products around the world.

Maquiladoras arrive in Mexico with high technological and methodological manufacturing tools. One of the most important of these production methods is lean manufacturing (LM). LM is a set of tools for the elimination of waste along the production process, focusing on error detection, cost reduction, and increased efficiency. However, the main issue with LM techniques and methods is their cultural implications.

LM philosophies emerged in Eastern companies; consequently, their application in the Western industry often poses some problems, and sometimes the expected benefits are not obtained. In that sense, Kaizen is an LM tool that has gained more territory during the last years, yet its implementation is still challenging to the Western world. To address this gap for the Mexican industry, this work identifies the critical success factors (CSFs) for Kaizen implementation and associates them with the benefits obtained by Mexican manufacturing companies.

The book contains 13 chapters grouped into five sections. In Chap. 1 we define lean manufacturing, discuss the tools that form the lean production system, and address Kaizen as a LM tool. This chapter is generic, as it briefly describes each LM tool but also aims at relating them. Then, the chapter analyzes past and current works on Kaizen, provides an overview of its main benefits, and discusses the objectives and limitations of this research.

Chapter 2 provides an extensive literature review of Kaizen, where 235 articles are statistically analyzed. The review is addressed from different perspectives. First, we examine Kaizen research per years of publication, highlighting the increasing trend in Kaizen research during the last years. Second, we report the leading journals and magazines in Kaizen publication, and classify research papers based on the country of origin. Similarly, graphs depict the distribution of Kaizen research by considering leading universities, departments, and the most prominent industrial subsectors.

Chapter 3 is one of the most important. It divides Kaizen implementation into three phases: planning, execution, and control. Then, it discusses critical success factors (CSFs) at each phase and examines the type of Kaizen benefits—economic, competitive, and for human resources—that can be obtained from Kaizen implementation. Readers are strongly encouraged to carefully review this chapter since understanding each one of the elements addressed is central for interpreting the models proposed in the last three chapters.

Chapter 4 discusses the research methodology followed in order to develop and test the structural equation models that relate Kaizen critical success factors with Kaizen benefits. The chapter also explains the survey construction and administration processes, as well as the data capture and analysis procedures, including data screening and validation. Then, the chapter briefly explains the information validation process, as well as the descriptive analysis of items. Finally, the last part of this chapter summarizes how structural equation models are evaluated to determine their efficiency

Chapter 5 is the first chapter reporting findings from data gathered in the manufacturing industry of Ciudad Juárez. The descriptive analysis of the sample is summarized by highlighting the surveyed industrial subsectors, as well as the size of companies, the gender of participants, their work experience, and their job positions.

Chapters 6–8 discuss the descriptive analysis of the items at the three Kaizen implementation phases (planning, execution, and control). Each analyzed item shows a median value as the measure of central tendency and an interquartile range (IQR) value, considered as the measure of data dispersion. A similar analysis is carried out to Kaizen benefits in Chap. 9, where benefits are sorted based on their median value. Benefits with the highest median value indicate that they are always obtained in the manufacturing industry of Ciudad Juárez.

Chapter 10 details the validation process of the observed variables. Since these variables are integrated into latent variables, we make use of the Cronbach's alpha index to determine whether they should remain in the latent variables or ought to be removed in order to increase internal consistency of the dimensions. Internal consistency validation is important since models proposed in the following three chapters are based on the analyzed latent variables.

Chapters 11–13 propose a series of models to interpret and assess the relationship between every Kaizen implementation phase and the benefits obtained in the manufacturing sector of Ciudad Juárez, Chihuahua. Every chapter includes three models. The first two analyze four latent variables each, two of them concerning

Kaizen activities at the different implementation phases. However, the third model of each chapter integrates, through a second-order factor analysis, Kaizen implementation latent variables into a single latent variable, depending on the implementation phase studied. The purpose of this integrative model is to provide a general overview of the relationship between every Kaizen implementation phase and the economic benefits.

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Preface

In 1965, Mexico started an industrialization program focused on promoting the establishment of industries in the northern region. Years later, in 1992, Mexico signed the North American Free Trade Agreement (NAFTA) with the United States and Canada. The goal of this agreement was to remove barriers to trade and investment between the involved countries. However, it only came into force in January 1994.

The NAFTA agreement therefore strengthened the Mexican industrialization program, especially in Ciudad Juárez, Chihuahua. As a result, the city currently caters for approximately 326 of the 482 manufacturing companies established in the United States, and 5074 that exist worldwide. In other words, 6.42 % of the world's manufacturing industry is located in the Ciudad Juárez region, making it the seventh manufacturing center in Latin America.

Manufacturing companies in Ciudad Juárez have parent companies located overseas, and such parent companies have brought a series of technologies and tools for manufacturing. Two of the most relevant technologies are lean manufacturing (LM) and Kaizen as an LM tool. Kaizen originated in Japan inside Toyota plants.

The general objective of this book is to identify the main critical success factors (CSFs) for proper Kaizen implementation inside manufacturing companies of Ciudad Juárez. To reach this goal, we divide the Kaizen implementation process into three phases: planning, execution, and control. Similarly, a survey was administered to manufacturing companies in the region to identify Kaizen activities carried out and the obtained benefits. The survey had to be answered using a Likert scale.

Finally, information collected is captured and analyzed using SPSS software. However, to relate Kaizen activities with Kaizen benefits, we propose a series of structural equation models run with WarpPLS software. To interpret relationships, these models show a dependency measure between the analyzed latent variables.

This book is divided into 13 chapters comprised in five sections. Section 1 presents a literature review of Kaizen. In this section, we also discuss Kaizen origins and evolution by proposing a timeline. On the other hand, Section 2 addresses all the Kaizen critical success factors and benefits reported in the literature.

Section 3 describes the research methodology followed to achieve the general objective of this book. We discuss the survey elaboration and administration process, the data capture procedure, and the database population and screening. Similarly, we discuss the factor analysis performed to define the latent variables, the creation of the structural equation models, and the efficiency indices employed.

Section 4 provides a descriptive analysis of Kaizen critical success factors and benefits. Chapters comprised in this section discuss dispersion and central tendency measures used to analyze information from a univariate perspective. Finally, in Section 5 we propose the structural equation models. Three models are developed for each Kaizen phase (planning, execution, control). The first two associate four latent variables, while the third construct is an integrative model developed through second-order factor analysis.

Considering its content, this book mainly aims at company managers who wish to know the quantitative dependence of Kaizen activities on Kaizen benefits. However, we also dedicate this work to academics, researches, and graduate and undergraduate students in engineering and management-related programs who are familiar with the industrial sector.

The advantage of this book over some others is that the structural equation models proposed are grounded in information gathered from an empirical study carried out in one of the most important manufacturing regions in Latin America. We thus hope that this work is useful to our readers and can support their decision-making.

Ciudad Juárez, Mexico

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Aidé Aracely Maldonado-Macías

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Chapter 1
Kaizen and Lean Manufacturing

The purpose of this chapter is to provide the reader a series of important concepts that facilitate the comprehension of this book. We start with the concept and origins of lean manufacturing (LM), as well as its main tools used in the production lines. Then, we address Kaizen as of the foundations of the LM philosophy.

1.1 Lean Manufacturing

In their book "The machine that changed the world," authors (Womack et al. 1990) refer to lean manufacturing (LM) as follows: "Perhaps the best way to describe this innovative production system [LM] is to contrast it with craft production and mass production. The craft producer uses highly skilled workers and simple but flexible tools to make exactly what the customer asks for—one item at a time."

LM thus combines the advantages of craft production and mass production, avoiding high costs of the former and rigidness of the latter. Also, it employs groups of multiskilled workers in every level of the organization and utilizes highly flexible and increasingly autonomous machines to produce a large variety of products. In fact, lean is a term coined by researcher (Krafcik 1988) to describe a manufacturing process that uses less of everything compared with mass production—less human effort, less space, less tool investment, and less engineering to develop a new product in less time.

The lean manufacturing concept has its origins in the Toyota Production System (TPS), and, along with the "Toyota way," it is the double helix of Toyota's DNA (Liker 2005). TPS is the basis of the lean production movement, which has been a trend during recent years. If current manufacturing companies seek to become lean producers, they need to adopt: (1) a new way of thinking, focusing on product flow through uninterrupted processes, (2) a "pull" system based on what the client requests, quickly replacing only what the next operation takes, and, finally, (3) a culture in which everyone works hard to continuously improve.

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Taiichi Ohno is considered the father of TPS and, for that matter, he is also considered the father of lean manufacturing. After his visit to a Ford plant in the United States, the president of Toyota Company asked Ohno to develop a production system that would match the Ford's plant productivity. When Ohno realized that Toyota factory did not have outlines similar to the ones in the American plant (i.e., high cash flow, large domestic and international markets, complete supplier system), he decided to apply the principles that Henry Ford used to lecture everybody but were not employed in his plants. These principles are: continuous material flow, processes standardization, and waste elimination.

In addition to the ideas from Ford's production system style, Ohno developed the concept of a "pull" system inspired by what he saw in American supermarkets: individual items were replaced as they were purchased to avoid excess. Without such a "pull" concept, Just In Time (JIT) would have never been developed.

On the other side, Toyota adopted the Deming quality techniques, while expanding the definition, their definition, of a customer as *the next person in the process*. Deming encouraged Toyota to adopt a systemic approach to problem solving, which later became to be known as the Deming circle: Plan, Do, Check, Act (PDCA). Finally, when Ohno and his team emerged with their production model, it was not only for a particular market or concept; it was rather a new paradigm in manufacturing and services, a new way to see, understand, and interpret what happens in an industrial production process.

Developing a lean manufacturing system in a company is like saving money for retirement. The effort and sacrifice must be made in short term to enjoy the benefits in the future. However, even though this is the first principle of the Toyota Decalogue, many managers refuse to follow it due to their short term vision: if profit is not quickly achieved, managers risk being catalogued as inefficient and getting fired. Thus, they usually do not take risks. Moreover, when benefits are quickly achieved, the person in charge is usually promoted. So, where to begin?

In the book "The Toyota Way Fieldbook," (Liker and Meier 2007) suggested defining the purpose of the company and beginning to live it in the real way. However, as mentioned above, if companies were currently asked about their final goal, many of them would have a word in common: profits. However, Toyota's vision includes perpetuity. Companies are similar to a family, which evolves as a living organism seeking to survive and contribute to society, the community and all their partners (Imai 1997). This approach to company management is one of the most noticeable differences when comparing Eastern and Western businesses.

1.2 Lean Manufacturing Tools

A production process encompasses all those activities aimed at transforming inputs into product or services that satisfy the customer. In order to have efficient processes that generate quality products and can be improved to reach higher standards and the solicited requirements, it is important to have *Lean Manufacturing* systems.

In their work, (Krajewski et al. 2013) define **lean systems** as "Operational systems that maximize the added value of each one of the company's activities, eliminating waste and delays." Lean systems thus include operational strategies, process design, quality management, constraints management, distribution design, supply chain design, and inventory management.

According to (Collier and Evans 2009), the lean systems or tools for increasing quality and productivity and reducing costs are the following:

1. Just In Time (JIT) and the 8 wastes
2. The "pull" system
3. Jidoka
4. Poka-Yoke
5. Kanban
6. 5S
7. Assembly line balancing
8. Standardized components
9. Value stream mapping (VSM)
10. Total Productive Maintenance (TPM)
11. Kaizen.

These lean systems are part of the lean manufacturing pyramid depicted in Fig. 1.1, which shows a base of operational stability with two columns, one associated with the production flow and the other associated with product quality.

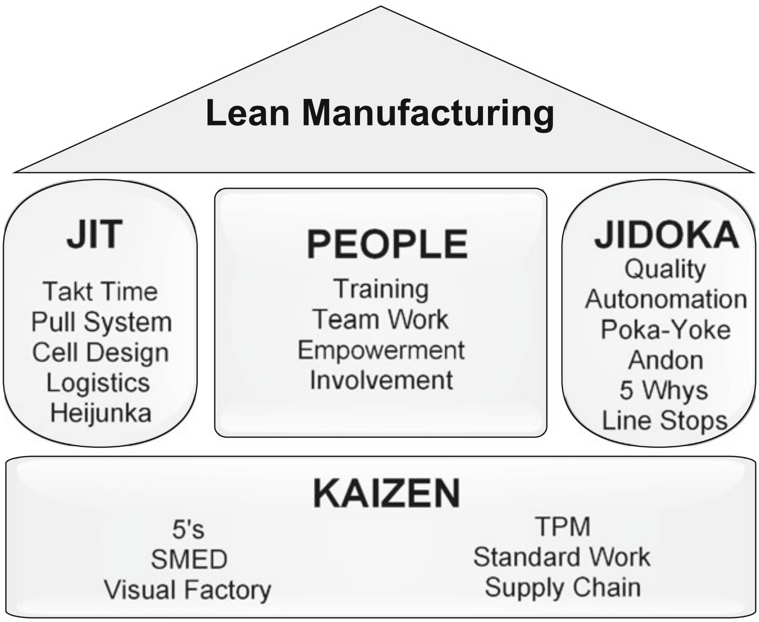

Fig. 1.1 Lean manufacturing pyramid

Thus, only if there is a good operational base, lean manufacturing can be supported by flow and quality techniques.

1.2.1 JIT and the Eight Wastes

JIT is one of the lean systems shown in the pyramid and one of the most known and used in companies. This philosophy considers that waste in processes can be reduced by decreasing inventory capacity, or better yet by eliminating unnecessary inventories and activities that do not add value to the operations (Shnaiderman and Ben-Baruch 2016). Similarly, JIT is a simple but powerful tool that supports material flow at the core of lean manufacturing (Krajewski et al. 2013; Alcaraz et al. 2016).

Also, JIT seeks to eliminate the eight types of waste, as well as to organize resources, information flows, and decision rules that allow the company to obtain the benefit of the system. The eight types of waste posted by (Krajewski et al. 2013; Panchal et al. 2012) can be seen in Table 1.1.

1.2.2 The "Pull" System Work Method

When demand determines how much of a product must be produced (the "pull" approach), production orders are small and adjusted. Therefore, no high costs are generated by inventories, and the risk for product obsolescence decreases, since companies only produce what is to be delivered. Many authors mention that the pull system is a suitable method when competing for innovation and flexibility.

Table 1.1 Eight types of waste proposed by (Krajewski et al. 2013)

Waste	Definition
Overproduction	Manufacturing an item before it is needed, creating excessive delivery times and inventories
Inappropriate processing	Using expensive high precision equipment when simpler machines would suffice
Waiting	Time is wasted when a product is not being moved or processed
Transportation	Excessive handling of material, which damages quality
Motion	Unnecessary work effort such as bending, stretching, reaching, walking, among others
Inventory	Excessive inventory that consumes space, increases lead times, and causes overproduction and waiting
Defects	Quality defects that only increase production costs
Underutilization of employee skills	Failure to learn from and capitalize on employee knowledge and creativity

Implementing the pull system requires quick information from the points of sales (POS), as well as a quick and flexible production system that can make changes from one product to another in the shortest possible time (Vardon et al. 2016). However, this system also has disadvantages; the main one being that companies need to have capacity for peak demand periods, lower economies of scale, and littler transportation than the traditional “push” approach (Hannon et al. 2015). Similarly, the product delivery system ought to focus on small quantities, although logistics costs may increase.

Other disadvantages of the “pull” approach are:

- It requires high coordination among workers responsible for the company global stock, the regulated warehouse stock, and the manufacturing program.
- In times of scarcity, the regulated warehouse stock is used to fulfill the order of the first person who makes the request on the part of the customer. Sometimes, some orders remain unfulfilled and second deliveries must be required.
- Safety stock increases, since sales departments tend to overprotect themselves and accumulate stock in order to fulfill unpredicted orders due to uncertainty.

However, the pull system also offers a series of advantages that should not be ignored, such as is mentioned in next paragraphs (Ohno 2011):

- Better knowledge of the market
- Closeness and proximity to the customer thanks to sales representatives.

In this pull system, products and materials movements are always adjusted to the demand, and nothing is produced until it is requested through a production order from a customer (Antonelli and Gehringer 2015). In other words, the manufacturer will not produce anything unless there is a demand from the market that pulls products from the manufacturing plant. Operationally speaking, the first operation (the demand) provides the production requirements, while the second one (production) makes it possible to manufacture the products.

Finally, pull systems are characterized by the way the warehouses or different POS individually determine their specific needs of stock replenishment, calculating the required amount that is directly ordered to their direct warehouse supplier. The advantages of the pull system, if compared to the push system, turn around the ability to autonomously operate with a better understanding of cause (decision-making in situ) (Guan et al. 2015; Ohno 2011; Sharma and Agrawal 2009; Nelson 2016).

1.2.3 Quality at Source or **Jidoka**

Jidoka is actually a Japanese term used to define automatization with human touch, and it is one of the foundations of the Toyota Production System (TPS), lean manufacturing, and Total Productive Maintenance (TPM) (Nelson 2016). It involves empowerment given to production operators, since they are allowed to stop the production flow. However, empowerment requires a lot of experience and training (de Kogel Ir and Becker Ir 2016).

Jidoka guarantees that defective pieces will not pass to the next work station, and it makes sure that those that pass fulfill the required quality standards, thereby minimizing defects, waste, and overproduction. But the aim is not only to reduce defective production, but to identify the causes that have generated those quality nonconformities, and find ways to eliminate them or reduce them as much as possible (Dhafr et al. 2006).

Jidoka origins are said to date back to the early 1900, when the first loom at Toyota had to be stopped because the thread broke. Thus, the company decided that every time that this happened, the production had to be immediately stopped. Taiichi Ohno is considered as the inventor of this idea, and he describes this tool as one of the pillars of TPS. However, years later, Shigeo Shingo named it production systems pre-automatization (Qian et al. 2011).

This concept seeks that the human factor intervenes as least as possible in the production systems; and because of that, it is considered a pre-automatized system that considerably minimizes errors from the operators. Thus, if a machine detects an error through an algorithm or system, it stops immediately. Common causes of defects are (Takami 2014):

- Inappropriate operating procedures
- Excessive variations in the operations
- Defective raw material
- Machine or human errors.

At this moment, it is worth asking about the causes or reasons of the Jidoka concept. The most frequently reported are (Mostafa et al. 2015):

- Overproduction.
- Time wasted during the manufacturing process.
- Time wasted during the transfer of defective material from one place to another, since material handling does not add value to the product. Moreover, faulty pieces can rarely be recovered, even after reprocessing them.
- Time wasted in reprocessing defective pieces when they can be recovered.
- Waste of inventory.

As mentioned above, the purpose of implementing Jidoka is to detect defects immediately after the line production has been stopped and correct them accordingly. Thus, human judgment on the quality of the piece is minimized, and workers would only be attentive to when the machine stops, instead of being 100 % attentive to inspection. Also, Jidoka helps with the sequential inspection of pieces. In the end, high quality items are produced and production operators are not overloaded in the final inspection phases (Mefford 2009).

Therefore, inspection is made by a machine and when it stops working, the designated or qualified person runs to the machine to solve the problem. However, Jidoka is not an isolated concept within the LM production system, as when looking to minimize errors, defects prevention can be achieved by simultaneously using the poka-yoke technique. Furthermore, Jidoka is effectively used in TPM and LM, since it provides substantial benefits to organizations. The most common include (Kurdve et al. 2014):

- It allows for early problem detection.
- It helps companies become world class organizations.
- Human intelligence is integrated into automatized machinery.
- Defect-free products are produced.
- It substantially increases and improves productivity.

Some of the benefits that can be obtained from Jidoka implementation in the production system are the following:

- Effective use of labor force.
- Products with the highest quality.
- Minimum product delivery.
- Reduced machine failures.
- Increased quality in the final product.

1.2.4 Poka-Yoke

Poka-yoke is a quality technique developed for the Toyota Production System (TPS) in the 1960s. It is attributed to engineer Shigeo Shingo, and the name comes from the combination of two words, *poka* (avoid) and *yokeru* (adverted error), which is literally translated as “error proofing.” The main idea of this technique is to create a production process where it is impossible to make mistakes (Shah and Ward 2003).

Thus, a poka-yoke device is any mechanism that helps prevent errors before they happen, or makes them so obvious that workers can notice them and correct them on time, otherwise the company would produce defective items with subsequent economic losses (Rahani and al-Ashraf 2012).

The aim of poka-yoke is to detect the error before the product is delivered. However, the important thing is not to identify and correct the mistake once the production process has begun. Ideally, the poka-yoke approach is included from the product design stage. Otherwise, companies would not be following the modern quality principles, which state that products should be properly manufactured from the first time in order to avoid additional costs incurred from modifications (Rahman et al. 2013). From this perspective, poka-yoke is often a misunderstood improvement tool, as consultants are called to fix issues that should have been foreseen from early stages.

The types of poka-yoke systems are classified based on a regulatory category depending on the system’s purpose and function, or according to the techniques used. The purpose of these categories is to allow companies to take corrective actions depending of the type of error. Such actions include control and warning methods, among others (Fullerton et al. 2014). The steps to implement a poka-yoke approach are the following, although they can vary from one company to another:

1. Identify the operation or process problem that needs a poka-yoke process. These are the areas that make a large number of errors or where a single mistake represents a high cost.
2. Use the five whys or the cause and effect analysis to get to the root cause of the problem.
3. Choose a type of poka-yoke mechanism to use and a technique to attack the problem.
4. Design the suitable poka-yoke mechanism.
5. Test it to see if it works (avoid high spending before completing this step).
6. Once the poka-yoke type and technique selected, make sure you have the tools, checklists, and software to ensure their functioning.
7. Train everyone on how to use the poka-yoke mechanism.
8. After poka-yoke has been operating for a while, review its performance to make sure errors have disappeared.

1.2.5 Kanban

Kanban is a Japanese word meaning "poster" or "sign." Signs are the key elements of this productive method originated in Toyota as a means to improve its vehicle production process. Kanban divides the manufacturing process in well-defined phases to be correctly carried out in order to move from one to the other, and to ensure a quality product. It is also posited that Kanban is grounded in the ideas of David J. Anderson, who adapts the original philosophy to software development, a process with many points in common with the manufacturing industry. However, both fields differ in terms of implementation phases and work teams. Moreover, in software development, each piece of the program to be created must work correctly and be of the best quality (Xanthopoulos et al. 2015; Tregubov and Lane 2015).

But nowadays, what is Kanban? What does it consist of and where is it used? First, Kanban seeks to achieve the desired final product quality by forcing each phase to be properly executed. This removes chaos and saturation or bottle necks occurring under normal manufacturing conditions, where the most important thing is to meet production orders and not quality (Gong et al. 2014; Rahman et al. 2013).

Four rules or basic principles should be followed to achieve Kanban objectives (Werkema 2012a; Turner et al. 2012):

- Start with what you are doing right now: Kanban is a method applied to the production lines and not a system that tells you how to do the work at the stations. Therefore, Kanban is only a support tool that helps determine if something is being done or not.

- Accept change: Changes are for the better. Even though many production managers say “if something works, do not touch it,” any change with Kanban, if properly implemented, makes improvements. Every production system can be improved with Kanban, and that is one of the premises of several quality philosophies. Thus, companies should rather say “if something does not work, change it” or “if something can work better, improve it.” Changes with Kanban are proposed by managers and employees, and they should be standardized. Thus, the role of human resources in Kanban is essential.
- Respect the ongoing process, roles, and responsibilities of each team member: People are experts on what they do, they know how to do it and when.
- Leadership at all levels: Initiative is the key. Also, correct task and team management is another basic element to consider. It is not about creating pyramidal systems, but about making each member aware of his/her own role and properly do his/her job.

Moreover, Kanban does not guarantee success by itself. Production systems must meet the following requirements to obtain the expected results (Naufal et al. 2012; Lage Junior and Godinho Filho 2010; Rabbani et al. 2009):

- Visualize your work: Companies must identify and track the parts and materials along the process and the people responsible for the workflow. Companies usually struggle at this point. Sometimes the work performed by a team or production process is totally unknown.
- Limit your work in progress (WIP): the most recommended method for limiting WIP is to start a project and fully culminate it. Half-done jobs only increase the material flow, which involves constant machine setups. If something is started, it must be completed.
- Workflow management: Limiting WIP is part of a much larger activity called workflow management. It seeks to identify possible problems in the supply chain.
- Make the rules of the process clear: To correctly apply a method, it must be fully understood. In this sense, both leaders and employees must be familiar with the project to be implemented, including the techniques for its implementation. Thus, just as the 5S methodology, Kanban aims at standardizing work, so rules can be applicable to everyone.
- Team improvement: Kanban success does not come from the efforts of a single person. It is rather the product of improvements made by all company employees. Improving the work environment is a major goal of Kanban philosophy, which is achieved by enhancing teamwork skills and improving the work conditions of such teams.

1.2.6 5S

The 5S methodology comes from the work of the Japanese Dr. Deming more than 40 years ago. It is part of what we know as continuous improvement or *Gemba* Kaizen (Knechtges et al. 2013) and refers to the creation and maintenance of cleaner, more organized, and safer work areas. 5S enhances “quality of life” at work.

While this concept may not be new to companies nowadays, what it really entails surely is something new to be learned. 5S is grounded in five principles followed on daily basis in the Japanese society, although they are not exclusive to a “Japanese culture.” They thus can be applied to any production system. In fact, almost all of us naturally tend to apply 5S in our daily life, even if we do not notice it (Jiménez et al. 2015).

5S means:

- Seiri: sorting, organizing, arranging properly
- Seinton: order
- Seiso: cleaning
- Seiketsu: standardized cleaning
- Shitsuke: discipline.

Considering such principles, the main purpose of 5S can be summarized as: to achieve the most efficient and consistent performance of the people in the work places (Werkema 2012b).

1.2.6.1 Seiri

Seiri, or classifying, consists in removing from the area or workstation all those elements that are not necessary to perform the job. Do not think that this or that element might be useful in another job or for an unexpected or special situation. Experts recommend that if any doubt arises, involved elements have to be discarded.

1.2.6.2 Seiton

Seiton, which means order, implies more than just appearance. Corporate order inside the 5S concept can be defined as organization of the necessary materials in a way that they are easy to use and reach. Each material should be labeled, so it can be easily found, retrieved, and returned to its original storing place. Order follows classification and organization. If items are classified but not organized, there would hardly be any results. Thus, simple rules should be followed. For instance, what is more frequently used should be closer, the heaviest materiel should go at the bottom, the lightest on top, etc.

1.2.6.3 Seiso

Besides cleaning work areas and equipment, Seiso includes designing applications to avoid, or at least decrease, dirt and make work stations safer. Only when the work environment is clean, it is possible to identify some flaws. In a clean space, and without any strange odors, it is easier to detect a fire by the smell of smoke, or the malfunction of an equipment by leaks. Likewise, demarcation of restricted, danger, evacuation, and access areas makes work environments safer and provides employees a sense of security.

1.2.6.4 Seiketsu

Seiketsu, or standardized cleaning, intends to maintain cleanliness and organization achieved. Seiketsu is only obtained when the first three principles are continuously implemented. At this stage or implementation phase (which must be permanent and constant), workers are responsible for designing mechanisms that benefit their work.

Many tools can be used for promoting a Seiketsu culture. One of them is taking pictures of the work area in optimal conditions. Such pictures must be visible from all points. They serve as reminders to workers of what optimal conditions look like in the area where they work. Also, another strategy is establishing rules that specify the responsibilities of each employee.

1.2.6.5 Shitsuke

Shitksuke aims at sustaining already established procedures. Only through discipline and compliance with the norms and adopted procedures, it is possible to enjoy from Shitksuke benefits. Furthermore, Shitsuke is the link between 5S and continuous improvement. It involves periodic control, surprise inspections, employee empowerment, self-respect, and respect for others. All this translates into better quality of life at work.

Disorganized and dirty work areas undoubtedly affect efficiency and decrease motivation. This is why 5S implementation boosts companies' performance in many ways. For instance, it allows for waste elimination and improves industrial safety. Some other 5S benefits include:

- Higher security levels
- Higher employee motivation
- Risk and accidents reduction
- Reduction of losses caused by defective production
- Higher quality
- Shorter lead times
- Fast deliveries

- Increased equipment life span
- Promotes a suitable organizational culture.

1.2.7 Assembly Line Balancing

This is one of the most important tools for controlling the production and material flows. Assembly line balancing helps optimize certain variables that affect process productivity. Some of these variables are product in process inventory, manufacturing time, and partial deliveries (Zacharia and Nearchou 2016; Tapkan et al. 2016).

The main goal of assembly line balancing is to equilibrate work times at all stages. It thus requires judicious data collection from the assembly line, theoretical knowledge of times and motion to determine times for each process activity, materials handling, and even economic investments (problem solutions can be expensive). However, in spite of the advantages of assembly line balancing, certain conditions may limit its scope. That is to say, not every process is worth being studied in terms of time balancing (Lei and Guo 2016; Lam et al. 2016; Chica et al. 2016). Conditions are the following:

Quantity The volume or amount of production has to be enough to justify the preparation of an assembly line. Companies must consider both the cost incurred from preparing the assembly line and the expected savings when balancing it (taking into account the duration of the process). Many techniques help improve setup times, especially Single-Minute Exchange of Dies (SMED).

Continuity Management measures are important to ensure continuous supply of materials, inputs, parts, and subassemblies. Also, it is important to coordinate the maintenance strategy for minimizing equipment failure. Continuity emphasizes on the logistic systems and materials supply. Thus, suppliers play a very important role in ensuring the required raw materials in the warehouses. Total preventive maintenance systems are also emphasized.

Hence, for a lean system to work better, it is important that daily loads in individual work stations be relatively uniform or equal. However, assembly line balancing is not exclusive to production systems, since it can also be employed in the service industry. Hospitals are a suitable sector, where surgeries are scheduled on time in order to have the equipment and installations ready for when it is needed.

Fortunately, several methods are currently used to improve assembly line balancing. Some of them are heuristic-based methods, the ranked positional weights method, and the largest candidate rule method, among others. However, note that there is no standard method to assembly line balancing. It is rather about adapting the one that best suits the company. Besides, neither of them is totally accurate; they only propose tentative solutions. Thus, there should be a cost-benefits analysis before their implementation (Bautista et al. 2016; Alavidoost et al. 2016; Riggs et al. 2015).

1.2.8 Standardized Components

Once a production system has been balanced, the next step is to standardize components in each production operation. This helps operators to always perform the assembly using the same tools. As a result, they become experts in product assembly (Kwok and Wang 2014). Without standardized components, product assembly may have many errors, even if operators are noticeably flexible and have knowledge on the matter. Nowadays, a same component type can be of different forms and might come from different suppliers, even though its function remains the same. Therefore, assembly needs may vary, especially in terms of time (Wahab et al. 2013).

Having standardized components offers the following advantages (Kull et al. 2014):

- Assembly line balancing is simplified.
- Operations require approximately the same amount of time to be performed.
- Operators become experts in assembling standardized components.
- Time is reduced in product assembly processes.

However, some disadvantages of always having standardized components can be the following (Sundar et al. 2014):

- Every time there is a change, operators need to adapt to the new components in order to perform the assembly.
- Mistakes during the assembly may not be detected on time.
- Assembly activities take more time, since the operator cannot become an expert due to the constant changes.

1.2.9 Value Stream Mapping

Value Stream Mapping (VSM) is a tool based on seeing and understanding a process in order to identify waste. VSM seeks to both detect unnecessary activities that should be removed and focus on those that add value to the product. Many companies have gained visible competitiveness thanks to faults avoided in their production processes. Furthermore, VMS allows operators to understand the company's standardized language (Jeyaraj et al. 2013).

There are many ways for identifying error-prone areas. Some of the most common are based on statistical quality control (SQC). Thus, in a value stream map, we determine the sequence of production activities, starting with those having the greatest impact on added value, which are consequently the most important to companies (Jeyaraj et al. 2013; Singh et al. 2010).

Similarly, VSM techniques can be reduced to drawing a map or a flowchart to identify the flow of information and resources needed to complete a product. In this case, we consider from raw materials arrival in the warehouse to the final product delivery.

Fortunately, VSM has gained the interest of many academic and industrial researchers. As a result, several VMS forms are available. SIPOC is perhaps the most spread among organizations. Its name is an acronym for Supplier Input Process Output Customer (Atieh et al. 2015). Thus, based on this sequence, value stream mapping starts by identifying the material suppliers. They can be either internal or external. Then, VSM identifies the raw materials entering the process and the results or products that should come out. Finally, SIPOC includes significant internal/external customers to the process (Forno et al. 2014).

When mapping a value stream, it is possible to identify the following aspects in the evaluated production system (Paciarotti et al. 2011):

- Economic conditions of the production line that has the greatest impact on revenue.
- The revenue structure can be modified by developing a product line—within the range of processes managed—having great impact on the current market.
- Other notable aspects for the organization.

1.2.10 Total Productive Maintenance (TPM)

TPM emerged in Japan thanks to the efforts of the Japan Institute of Plan Maintenance (JIPM). It was conceived as a system aimed at eliminating the so called <six big losses> in order to ease Just in Time implementation. Thus, TPM is a maintenance philosophy that seeks to eliminate production losses caused by equipment or machinery breakdowns. The general objective of TPM is to maintain the equipment at sound condition to produce the maximum amount of items with the expected quality without unprogrammed stoppages (Konecny and Thun 2011).

TPM objective aims at achieving perfect production by ensuring (Chlebus et al. 2015):

- No breakdowns
- No small stops or slow running
- No defects

However, there seems to be and eternal battle between equipment maintenance and the production system, for they are often analyzed independently. Hence, TPM emerged as a need to integrate maintenance and operation or production departments in order to improve productivity and availability. In a company where TPM has been implemented, all the organizations work on maintenance and equipment improvement.

Similarly, TPM is grounded in five fundamental principles, which are described below (Ahmad et al. 2012b):

- Participation of the whole staff: From the senior management to plant operators. Collaboration from each of them guarantees TPM's success.
- An organizational culture achieving maximum efficiency in production systems and in equipment/machinery management. Companies must seek global effectiveness, not only in one department.
- Implementing production plant management systems to eliminate losses before they are produced.
- Implementing preventive maintenance as a basic tool for achieving zero losses through teamwork and the support from autonomous maintenance.
- Applying management systems to all production aspects, including product design and development, sales, and direction.

When TPM is not implemented, machines rarely work at 100 %. This may lead to the six great losses (Kinney 2006):

1. Equipment failure: This is an availability loss. It refers to any significant period of time in which the equipment is scheduled for production but is not running due to breakdowns or other failures.
2. Set up and adjustments: This is also an availability loss. It refers to any significant period of time in which the equipment is scheduled for production but is not running due to a changeover or any other adjustment.
3. Idling and minor stops: This is classed as a performance loss. It refers to time when the equipment stops for a short period of time due to misfeeds, obstructed product flow, material jams, periodic quick cleaning, inspections, blocked or misaligned sensors, equipment issues, etc.
4. Reduced speed: This is another performance loss. It occurs when the equipment is not working at full capacity and runs at a slower pace than the ideal cycle time.
5. Process defects: They are viewed as a quality loss. They account for defective parts during steady-state production. Process defects include scrapped parts and parts that can be reworked.
6. Reduced yield: It is categorized as a quality loss. It refers to defective parts during warm-up, start-up, or other early production.

1.3 Kaizen as a LM Tool

After World War II, Japan and its economy were left in devastating conditions. However, certain methodologies and techniques eventually allowed this country to become a global economic power (Maarof and Mahmud 2016). Contrary to what is usually believed, Japan's success does not have to do precisely with technology and production processes. It was rather the result of a very cultural aspect. Japanese understood and accepted that the world was changing and could always be improved. Such an idea of improvement was exactly what Masaaki Imai, the father of Kaizen philosophy, embraced. As a result, Kaizen has become the competitive advantage of the Japanese in many technology areas (Machikita et al. 2016a).

1.3.1 Kaizen Concepts

Kaizen means continuous improvement, which can be applied to steadily enhance our personal, family, social and work lives. When applied to the workplace, Kaizen means continuous improvement for all human resources, managers, and workers alike (Imai 1997). From a strategic point of view, Kaizen is a systematic and long-term action aimed at accumulating improvements and savings in order to beat competition in terms of quality, productivity, costs, and delivery times. Kaizen has received many definitions during its development phase; however, they all in essence express this notion of continuous improvement.

The word Kaizen comes from two Japanese ideograms: *kai*, which means "change," and *zen*, meaning "to improve" (Imai 1997). Kaizen is thus commonly known as continuous improvement or as the principle of continuous improvement (Lillrank 1995). Authors such as (Paul Brunet and New 2003) define Kaizen as: "A pervasive mechanism of ongoing activities, where the people involved play an explicit role in identifying and ensuring impacts or improvements that contribute to organizational goals."

Meanwhile, (Suárez-Barraza and Ramis-Pujol 2008) conceive Kaizen as a management philosophy that generates changes or small incremental improvements in the method of work (or work processes). Kaizen reduces waste and, consequently, improves work performance, leading the organization to a spiral of increased innovation. Finally, Kaizen is also understood as a quality management element (Deming 1986; Ishikawa and Lu 1985; Juran et al. 1990). Thus, as can be seen, Kaizen is a still evolving term, leading to different meanings depending on the time and organizational context where it has appeared (Tozawa y Bodek 2002).

1.3.2 Kaizen

Continuous improvement was implemented in Japan because it was a cheap way to improve production and reduce costs in a period of acute shortage of resources, and also due to the pressure of the authorities, who used continuous improvement methods to accelerate the country's reconstruction after World War II. In 1949, the US military thus signed a contract with Training With Industry (TWI Inc.) with the aim of developing training programs for Japanese companies (Baril et al. 2016). The fundamental idea of these programs was to train people in standard methods, and then have them train others (i.e., train the trainer).

Although the Japanese used quality circles and suggestion systems as a regular part of their quality management, continuous improvement became more appealing during the 1973 oil crisis. Kaizen thus was used as a method for costs reduction without making heavy investments (Higuchi et al. 2015b). This is how, that same year, Toyota automaker received six times more suggestions than in 1970. Meanwhile, Canon, another leading company in Kaizen implementation, launched a campaign to be a world leader, allowing the company to save 200 million USD in direct costs thanks to the continuous improvement system implemented.

Such profits earned by Japanese companies were well regarded by Western businesses. Thus, in the 1980s, before the invasion of Japanese products in the American market, American companies resumed with more impetus the development of continuous improvement systems. Consequently, companies such as Xerox, Motorola, Harley Davidson, and General Electrics obtained the most noticeable results.

In 1984 within General Motors (GM) old facilities located in California, GM along with Toyota established a joint participation company called NUMMI (New United Motor Manufacturing Inc.). A GM plant had been previously closed due to labor conflicts, poor quality, and low productivity. To resolve this, NUMMI introduced the Just In Time (JIT) system and set a new agreement with the United Automobile Workers (UAW) union to improve quality, increase productivity levels, and improve the work environment through Kaizen implementation. Kaizen involved JIT, quality circles, and suggestion programs. In order for this new approach to work, UAW agreed to reduce job classifications, from 64 categories to 4, as long as employers did not dismiss employees due to productivity increases.

In conclusion, contrary to common beliefs, Kaizen is not a new philosophy. The origins of a continuous improvement approach date back to the mid-twentieth century, as explained by the Japanese author Masaaki Imai in his book "Kaizen: The Key to Japanese Competitive Advantage" (Imai 1997). However, it is impossible to deny that the term Kaizen, as we now know it, first originated at the Toyota Motor company (Nemoto et al. 1987).

Kaizen literature outstands in the research environment, with many case studies reported worldwide. Among those Kaizen studies developed in Japan, the work of (Cheser 1998b) in two manufacturing plants concludes that Kaizen increases motivation and generates a positive change in employee attitude. Meanwhile, (Aoki 2008) concludes that Kaizen implementation is feasible in countries with a different culture than the Japanese, as long as they manage to implement the basic Kaizen principles: customer focus, continuous improvement, openly recognize problems, create work teams, develop self-discipline, constant in-training to employees, and foster employee development.

1.3.3 Kaizen Benefits

If we consider the quantitative impact of Kaizen, (Howell 2011) posits that companies can obtain the following benefits from implementing the philosophy:

- Inventory reduction: 30–70 %
- Operating space: approximately 50 %
- Process time reduction: 40–80 %
- Productivity improvement: 20–60 %
- Delivery times reduction: 70–90 %
- Walking distance reduction: 40–90 %.

Benefits addressed in the literature have been strongly pursued by company managers, since they translate into efficiency and effectiveness, and this increases profits. In this sense (Garza 2005), points out the following reasons why companies implement Kaizen:

- Waste reduction: inventory, waiting times, transport, and motion
- Employee skills improvement
- Increased productivity and improved quality
- Space utilization improvement
- Increased and improved communication among administrative departments in companies.

1.3.4 Successful Kaizen Implementation. Reported Cases

As an invitation to read Kaizen literature, in this section we review some case studies worthy of discussion. These cases best illustrate the benefits of successful Kaizen implementation (Knechtges and Decker 2014a; García et al. 2014b). However, note that some companies do not report economic benefits gained from any tool implemented, as this is usually considered confidential data. Consequently, literature may lack important information to make inferences.

1.3.4.1 Lincoln Industries

In 2007, Lincoln Industries held 27 Kaizen events and identified over $630,000 USD in savings (Suárez-Barraza and Miguel-Dávila 2014). A year later, Lincoln industries held more than 35 Kaizen events and saved more than $1.630.000 USD, this is one million dollars more than in the previous year.

1.3.4.2 Barnes Aerospace

Barnes Aerospace is an international manufacturer of precision metal parts for aircraft. In 2012, the company joined Kaizen implementation amid their need for improving profitability by reducing operational costs. Consequently, Barnes Aerospace improved productivity by 24 %, increased inventory by 3.8–5.5 %, and reduced delivery times by 61 %. As a result, the company became more competitive, which allowed it to sign several contracts with government institutions and private companies.

1.3.5 Kaizen Traditional Process Implementation

The goal of Kaizen is to eliminate the great eight wastes without making investments. Such a goal is achieved by taking small but constant steps to increase productivity and gain strategic advantage by continuously enhancing processes, products, and services through improvements in costs, quality, design, security, response time, and customer service (Knechtges and Decker 2014a; García et al. 2014b). However, Kaizen also achieves its goal by improving attitude and skills and knocking down obstacles, which allows for a powerful and authentic work team that seeks common good and safety (Tetteh 2012; Glover et al. 2011b).

Kaizen is grounded in four key principles (Flohr-Rincon and Tucker 2012b):

- Positive constraints: It refers to creating constrains that prevent generation of defective products. Clear examples of these constraints are: ZERO inventories, JIT deliveries, and production stoppages due to abnormalities. On one hand, both zero inventories and JIT deliveries avoid generation of poor-quality products, since there are no inputs or finished products to replace the ones that are defective. Thus, inventory elimination or significant reduction is a constraint forcing products and materials to be received and delivered according to specifications. On the other hand, since production stoppages cost time and money, companies are forced to get to the root cause of every defect in order to avoid future production disruptions.
- Negative constraints: It accounts for elimination of material jams that disrupt or slow down production.
- Focus: Every organization has limited resources. The best way for optimizing resources is by allocating them in those activities in which the organization is more competitive. Knowing and identifying weaknesses is important for analyzing whether it is better to separate activities via outsourcing and concentrate resources on the company's strengths.
- Simplify: Tasks, activities, and processes should be simplified through poka-yoke, robotic process automation (RPA), and business process reengineering, among others.

Kaizen works under these four principles. Quality improvement can overcome constraints and improve process and equipment layout in terms of quality, productivity, and time. Likewise, quality enhancement avoids material jams, reduces setup and changeover times, and simplifies reengineering and processes, since resources are allocated in those activities and processes that bring strong competitive advantages. Competitiveness is vital to survive in today's globalized market.

1.4 Objective and Limitations of the Book

Nowadays, companies in developing countries need to meet quality standards for competing in a demanding market. Therefore, they ought to seek continuous improvement, achieve customer satisfaction, and implement process control and standardization. In this case, it is thus important to identify those activities that are key to obtaining competitive advantages and pursue their continuous improvement. Nevertheless, research has found that companies struggle to make and maintain such improvements (Prajogo and Sohal 2004a).

Various authors emphasize on measurement and information systems as two ways of sustaining improvement systems. Measuring the achieved improvements ensures a learning process that can later be transferred to the rest of the organization (Chen et al. 2004b; Kaye and Anderson 1999). Likewise, indicators used to monitor the improvement system support the maintenance of such a system (Bateman 2005).

Most of Kaizen research focuses on describing the benefits of this philosophy if properly implemented. Similarly, over the last few years, other studies have paid special attention to the critical success factors (CSFs) for Kaizen implementation. Unfortunately, the impact of such CSFs on the benefits to be obtained still remains unclear. Therefore, to address this gap, new investigations need to analyze how CSFs of Kaizen implementation influence the performance indicators of companies, since such indicators contribute to the success and sustainment of Kaizen events.

The research disseminated in this book is justified by the following aspects:

- First, this book provides a systematic literature review on Kaizen implementation. Such a review contributes to the body of knowledge of Kaizen. It is important to periodically evaluate current and past studies on any discipline (Gattoufi et al. 2004b). The recently growing use of Kaizen has attracted many scholars and academics, and, as a result, the number of related publications has increased. Although other studies have previously proposed reviews of Kaizen literature (Glover et al. 2014; Kosandal and Farris 2004), no other works have provided it in a systematic way. This book thus offers, through an extensive analysis, an evaluation of each Kaizen publication by considering the classification framework proposed by (Nissen 1996). Then, information is stored in a database that helped assess, among other aspects, the maturity of the Kaizen event research stream.
- Second, the book contributes to identifying Kaizen CSFs, benefits, and characteristics that support its sustainment and results. Likewise, in this research we test Kaizen sustainment through working hypotheses and structural equation models. This work is considered the first study to test the causal relationships between Kaizen sustainment and its CSFs in Mexico.
- Third, through this work, we intend to contribute to improvements and changes in the Mexican manufacturing industry. Research results can be applied to sustainability of other continuous improvement activities, introducing additional areas for future research.

- Finally, this research makes contributions to the fields of industrial engineering, engineering management, and operations management, since it addresses improvements in systems composed of human resources, materials, information, equipment, and energy. These individual systems are the keys to the models proposed in the last three chapters, and their improvement contributes to economic benefits resulting from decreased equipment failures, reduced setup and changeover times, increased customer satisfaction, reduced errors and waste, and improved economic-financial balance.

1.5 Conclusions

The cornerstone of Kaizen success is managerial commitment. As it will be seen in the following chapters, this variable has an important direct and positive impact on the economic and human resources benefits obtained from Kaizen implementation. Also, human resources development must be carefully planned in order to guarantee Kaizen implementation results. In fact, continuous improvement in the production process is impossible to reach without proper training and education. Thus, human resources development has a direct and positive impact on Kaizen economic benefits. Therefore, company managers and administrators must focus their efforts on training supervisors and production operators, since they are the real change agents.

Chapter 2
Literature Review

For a better understanding of Kaizen trends, this chapter provides a literature review of Kaizen in the industrial sector. Databases consulted are Sciencedirect, Web of Science, Ebscohost, Ingenta, Springer, SCIRUS, Emerald, and ELSEVIER in a period between August 15, 2013 and May 12, 2014. Keywords for the search include *Kaizen*, *continuous improvement*, *critical success factors*, *sustainability*, and *benefits*. In total, 235 articles were identified after an extensive search process. Exclusion criteria considered were proposed by (Bateman 2005). Two examples of these criteria are:

- The research is not mostly related to Kaizen sustainability and its critical success factors (CSFs).
- Duplicate papers and quotations previously found in other research papers.

Collected articles were evaluated to meet quality standards. In terms of research quality, authors (Neely et al. 2005) suggest to explore the scientific report or paper using the citation branch technique for building an analysis network. In this book, we do not include a citation or a co-citation analysis, due to a lack of current academic literature addressing Kaizen sustainability. However, as regards the most suitable classification method, we employed the approach proposed by Nissen (1996). The author classifies publications into magazines and specialized articles, case studies, academic research, empirical studies, and experience in Kaizen methodologies. Finally, we avoided articles that did not provide analyzed data or followed a single theory. That is to say, we focused on practical and industrial Kaizen applications.

In order to simplify the literature analysis, a database was constructed on SPSS 21®. This piece of software easily records and analyzes information. Moreover, it makes descriptive inferences based on the research's needs. In the database, each row represented an analyzed article, while columns included the variables to be analyzed, such as first author's family name, year of publication, first author's country of origin, first author's university and department of origin, journal or magazine where the article was published, industrial sector of application, CSFs

J.L. García-Alcaraz et al., *Kaizen Planning, Implementing and Controlling*,
Management and Industrial Engineering, DOI 10.1007/978-3-319-47747-3_2

identified, and benefits obtained (see Appendix 1). Afterward, research tendencies were examined and information was summarized in contingency tables and bar graphs to simplify its interpretation.

In total, 235 Kaizen-related articles were found relevant to this book, and they were categorized as Fig. 2.1 shows. As can be seen, 76 articles came from specialized journals, which represent 32 % of the total. Similarly, 60 research papers (26 %) included Kaizen-related case studies. The least cited categories include Kaizen empirical studies and application experiences. Thus, it is concluded that practical research on Kaizen is scarce.

2.1 Category: Years of Publication

As Fig. 2.2 shows, there has been a growing interest in Kaizen during the last 20 years. This is demonstrated by the linear trend red line appearing as a positive slope. Also, note that in 2007 and 2013 Kaizen research prominently increased with 26 and 21 published articles, respectively. This may not be surprising, since the 2007 and 2013 financial crises greatly impacted on the industrial sector, especially the automotive industry, which is responsible for most of the published research. Kaizen is usually an indispensable tool in the automobile sector, which has been severely affected by the high-priced fuels as a consequence of high oil prices since 2004. Consequently, sales of sport utility vehicles decreased, and this is the main focus of three big automobile manufacturers: General Motors, Ford, and Chrysler.

The literature analysis also shows that several works, especially during 1993 and 1994, sought to implement Kaizen philosophy in the USA but failed to obtain the expected benefits. However, in the same years, 1998 Japanese studies concluded that Kaizen was a real tool for increasing motivation and improving the attitude of Japanese workers, which was not achieved by Western industries. It thus seemed that Kaizen was specially related to cultural aspects.

In 2008, research carried out by (Aoki 2008) concluded that it was feasible to implement Kaizen in countries with a different culture to the Japanese, as long as

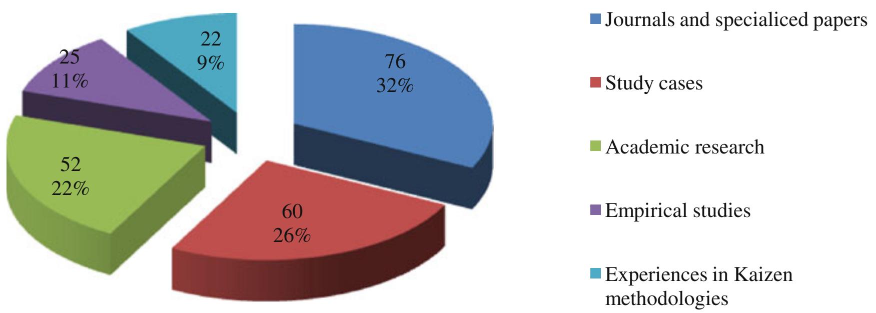

Fig. 2.1 Kaizen research analyzed. *Source* Prepared by authors

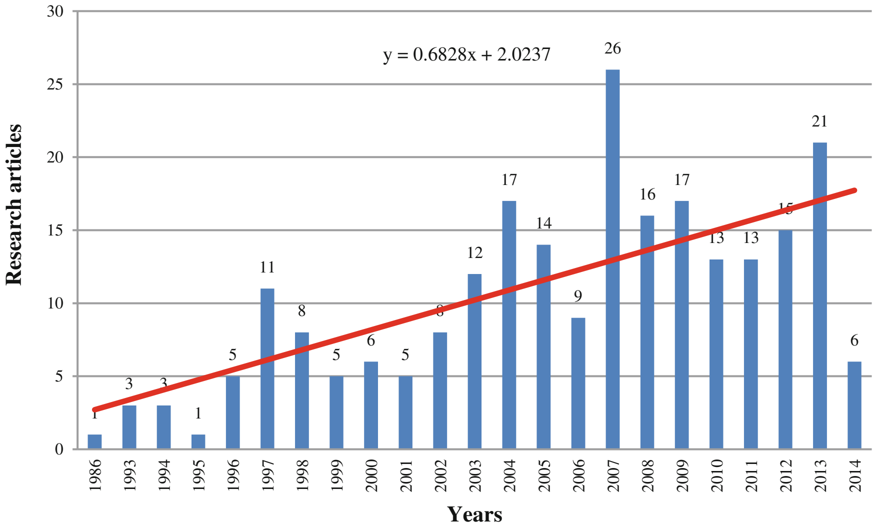

Fig. 2.2 Kaizen research published per year. *Source* Prepared by authors

they managed to implement the basic principles of Kaizen, which are, from the author's perspective: employee initiative in making improvements, functional and interdepartmental communication, self-discipline, and standardized work in order to eliminate waste (*Muda*).

2.2 Category: Journals

A total of 160 journals have published some type of Kaizen research, including its CSFs and benefits. Figure 2.3 shows that the majority of research articles (12 of them) were published by the Engineering Management Journal, while the International Journal of Operations and Production Management has printed 11 research papers, and nine are part of the Industry Week magazine. Similarly, Quality Progress has published eight articles, seven were issued by the Journal of Manufacturing Technology Management, and six by Industrial Engineer. In addition, both Works Management and the Journal of Production Economics have issued five Kaizen-related works, whereas IIE Solutions and Procedia Engineering have published five. Finally, four papers come from the Journal of Organizational Excellence, and the Journal of Production Manufacturing and Automotive Manufacturing and Production.

Note that 18 more journals have published two Kaizen research works each, while 102 have issued no more than one. These journals are not shown in Fig. 2.3 but can be found in Appendix 2.

Fig. 2.3 Journals with published Kaizen research. *Source* Prepared by authors

2.3 Category: First Author's Country of Origin

The 235 collected papers originate from 25 countries, four of these countries account for 77.87 %—183 publications—of the total publications. The United States leads Kaizen research with 57.6 % of the papers found. Most of these 136 works have been published by academics. Similarly, the UK holds the second place with 21 publications (8.9 %), while Mexico is only responsible for 7.2 % (17 articles). Also, as surprising as this may be, Japan ranks fourth in the list with 9 (3.8 %) publications.

Figure 2.4 reports countries with three or more Kaizen publications. However, two of the analyzed research works originate from Germany, and two more from Sweden. Countries such as Malaysia, Rumania, Denmark, Nigeria, Singapore, Holland, Norway, Greece, and Thailand were only found in one article each (see Appendix 3).

Note that the four leading countries in the graph are the most industrialized. These governments strive to strengthen their economy, as their commercial policies seek to benefit the industrial activities and provide a suitable environment for competition and economic development. Similarly, these countries construct appropriate infrastructure to promote and simplify commercialization of their products. Moreover, with strong capital investments, they maintain a constant search of new developments, which promotes research, thereby ensuring their industrial position vis-à-vis other nations.

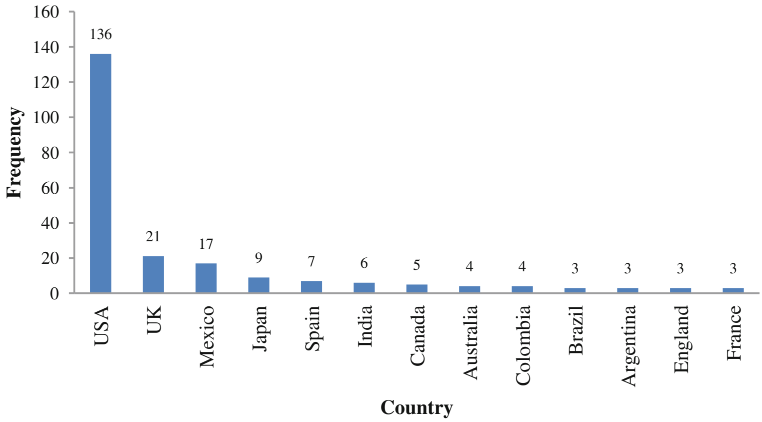

Fig. 2.4 Kaizen research by country. *Source* Prepared by authors

The United States has been the first world economy since 1872, when the United Kingdom was left behind. However, the American economy was the first one to suffer the consequences of the 2009 financial crisis. It became the highest recession since the crisis of 1930, with an economic contraction of 2.6 %. Fortunately, a year later the United States recovered, although they struggled to elevate. As a result, companies started to seek tools to improve their performance, and Kaizen became relevant.

As regards the United Kingdom, authors (Readman and Bessant 2007) assessed a continuous improvement survey administered to 1,000 UK companies. Findings showed that decision-making and infrastructure widely simplified and supported continuous improvements. These two elements are the keys to implementing Kaizen initiatives through a dynamic improvement framework.

Finally, even though Kaizen originated in Japan, the United States usually appears as the leader in research related to this philosophy. Their reported case studies and results from Kaizen adoption and adaptation are very common in the automotive industry, one of the most prominent industrial sectors in the USA with three major automobile manufacturers: General Motors, Ford, and Chrysler.

2.4 Category: Universities and Research Groups

Figure 2.5 depicts Kaizen research distribution according to leading universities and research institutions. Note that the figure shows only entities with at least three published Kaizen research works.

A total of 163 universities and institutions worldwide have shown interest in the Japanese continuous improvement system. Among the top four entities, we can observe the Tech University in Lubbock, Texas, leading Kaizen research with a

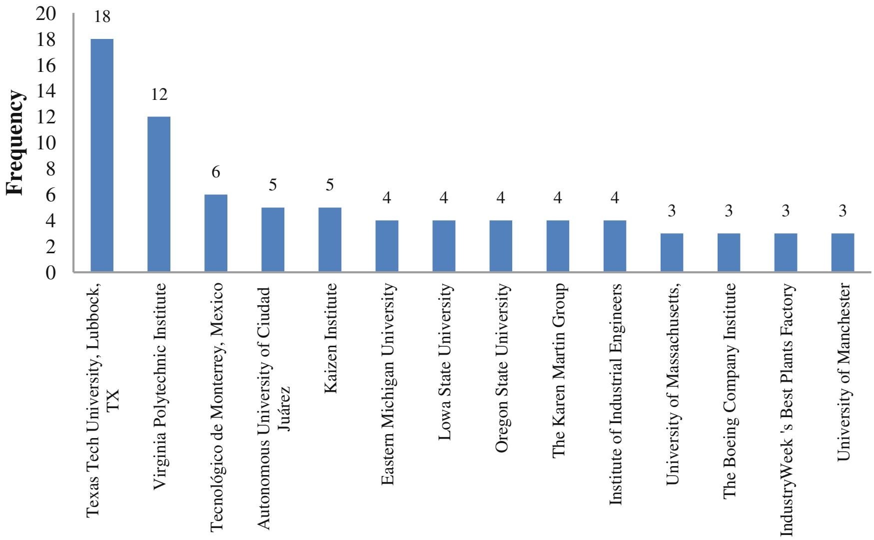

Fig. 2.5 Kaizen research by universities and institutions. *Source* Prepared by authors

total of 18 published works, which represents 7.6 % of the total analyzed articles. The Virginia Polytechnic Institute and State University, in Blacksburg, VA, holds the second place with 12 publications, while the Tecnológico de Monterrey, in Mexico, is ranked third with six research articles. Finally, the Autonomous University of Ciudad Juárez has issued five publications on the continuous improvement philosophy. Appendix 4 lists universities and organizations having published no more than two research works about Kaizen.

Also, 49 areas have been associated with Kaizen research at least once. As Fig. 2.6 shows, the majority of the research has been carried out under engineering and management approaches. That is, note that the three leading research areas are Industrial and Systems Engineering (25.1 %), Management (11.06 %), and Total Quality Management (8.05 %). Less prominent include Construction, Environment, Logistics, Mechanics and Industrial Engineering, Business Organization, and Information Systems. Academic areas with no more than two publications about Kaizen are listed in Appendix 5.

2.5 Kaizen by Implementation Sectors

Implementation sectors are also relevant to this book and study. The analysis identified 16 different sectors where Kaizen is implemented. With 136 publications, the manufacturing industry reports most of Kaizen industrial applications, especially in the automotive industry, which caters for 57.87 % of all the analyzed

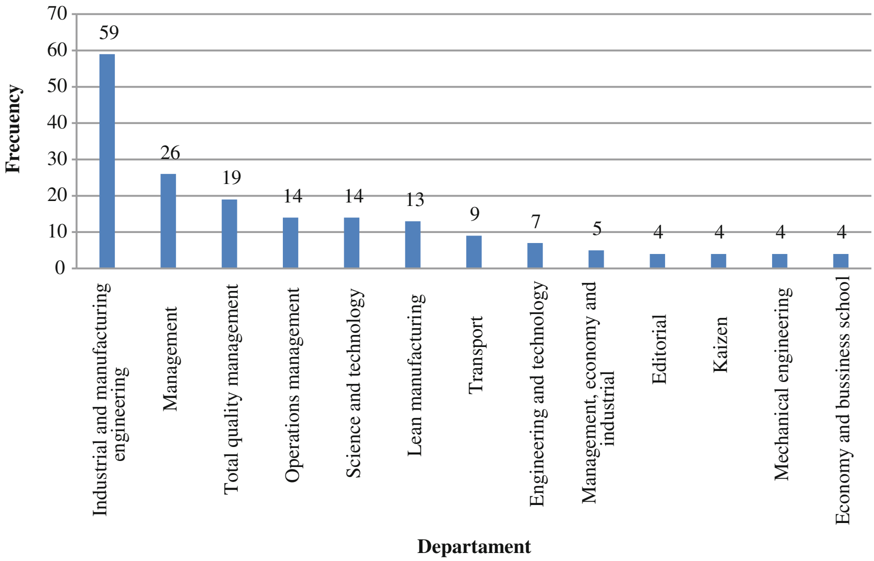

Fig. 2.6 Kaizen research by academic department. *Source* Prepared by authors

works. This shows that continuous improvement is widely implemented in highly automated processes. Figure 2.7 introduces sectors with at least four published Kaizen applications.

However, less prominent areas include the textile industry, reported in two works, and furniture construction, military, and ceramics, all reported in one article each. From these findings, it is therefore concluded that Kaizen is expanding to

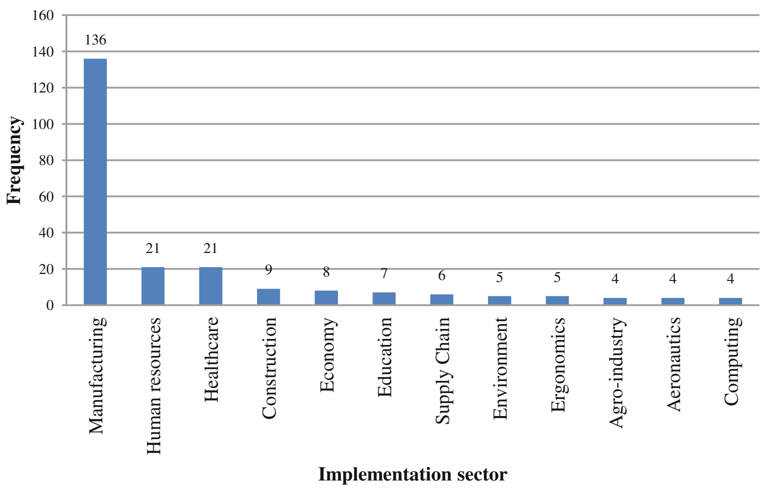

Fig. 2.7 Kaizen research by implementation sector. *Source* Prepared by authors

other domains, not only within the industrial sector. These new domains include human resources training, the healthcare sector, and construction, where errors from employees have serious consequences (Adamson and Kwolek 2007; Martin and Osterling 2007; Suárez Barraza 2009). Similarly, Kaizen is becoming important to the public sector (Robinson et al. 2014; Suárez Barraza 2009) as a means to improve educational programs. In this case, governments are commonly in charge of improvements, which demonstrate their interest in enhancing educational systems and administrative processes.

As can be observed, there has been a growing interest in Kaizen during the last 10 years, especially from Western countries. Kaizen research line is still young. Findings were first published in 1993. Moreover, case studies bringing specific knowledge to fully understand Kaizen and its sustainability are scarce. In fact, 67 % of published works are nonacademic (Glover 2010). However, salient efforts from academic research involve authors such as (Alukal and Manos 2006; Bateman 2005; Farris et al. 2009a), whose works propose a series of variables, models, and methods to explain in detail this continuous improvement philosophy.

Relevant Kaizen exploration has also been carried out by (Burch 2008; García et al. 2013c; Glover 2010; Marin-Garcia et al. 2009; Suárez-Barraza and Ramis-Pujol 2008). Unfortunately, empirical research is still scarce, although additional models and methodologies published may demonstrate higher maturity of the Kaizen event research stream. Finally, it seems that qualitative approaches have been the leading methodologies, which is why further research is needed from a quantitative perspective in order to study continuous improvement phenomena and their impact on benefits gained by companies.

2.6 Conclusions

The literature review of Kaizen as a lean manufacturing (LM) tool allows us to propose the following conclusions:

- Kaizen is a relatively new tool emerged in Japan; however, it is being implemented by an increasing number of Western companies. Unfortunately, no research has clearly defined the critical success factors for Kaizen implementation.
- In this chapter, we identified 235 articles addressing Kaizen as their main topic. Most of these publications are scientific papers and case studies.
- Kaizen is a tool that successfully supports problem solving. Interestedly, the amount of Kaizen research increased during 2007 and 2013, when the worldwide economic crisis emerged.
- There are three leading journals in Kaizen publication:
  - Engineering Management Journal
  - International Journal of Operations and Production Management
  - Industry Week.

- As regards leading countries, our analysis demonstrates that the USA is the main representative of Kaizen research. Two of the foremost institutions are:
  - Texas Tech University (Lubbock, TX)
  - Virginia Polytechnic Institute.
- Kaizen is an interesting tool to both engineering and management. This is demonstrated by the amount of Kaizen literature published from industrial engineering and manufacturing departments around the world.
- The manufacturing industry leads Kaizen implementation, due to its work dynamics. However, Kaizen is also applied to human resources.

Chapter 3
Adopting Kaizen

This chapter addresses Kaizen as an important tool adopted by the industrial sector.

Aspects covered include the following:

- Activities at the Kaizen planning phase
- Activities at the Kaizen implementation phase
- Activities at the Kaizen control phase
- Kaizen benefits
- Conclusion and references.

3.1 Kaizen Adoption

The accelerated technological advancements, reduced product lifecycles, changing customer needs, and the unstoppable global competition that each day demands a wider variety of products with the highest possible quality at faster delivery times, are some of the challenges that companies face nowadays. These challenges require efficient methods to be faced.

As a total quality management and continuous improvement technique, Kaizen outstands, thanks to its simplicity and practicality. It is a harmonious tool that can be applicable to all levels, including our social and personal lives and, of course, businesses. In the business context, Kaizen promotes a culture where all employees —from the cleaning staff to the chief executive officer—are encouraged to contribute. This continuous improvement method was developed in Japan after World War II.

Adopting Kaizen means assuming a continuous improvement culture that focuses on waste and spillovers elimination in production processes. Kaizen implies a constant challenge to improve standards. In fact, the expression "a long journey begins with a small step" clearly depicts the sense of Kaizen. Every process of change must be progressive and start with a decision, and there is no turning back.

J.L. García-Alcaraz et al., *Kaizen Planning, Implementing and Controlling*,
Management and Industrial Engineering, DOI 10.1007/978-3-319-47747-3_3

Kaizen retakes the quality control techniques developed by Edgard Deming and incorporates the idea that our lifestyle deserves to be constantly improved. The message of the Kaizen strategy is that everyday must be an improvement day, in the social context, in our personal lives, or at work. Similarly, being a conformist is the enemy of Kaizen. As in Just In Time (JIT), time in Kaizen is of strategic importance, and in the business environment, it incorporates management and process development, emphasizing on customer needs in order to detect failures and maximize time.

The success of this continuous improvement philosophy in the industry comes from its ability to improve standards in quality, costs, productivity, or waiting times. In fact, it helps reach the highest standards. Since 1980, Japanese firms such as Toyota, Hitachi, or Sony have become infallible examples of continuous improvement of production processes.

Similarly, Kaizen development and application are amalgamated with techniques of operation management, industrial engineering, organizational behavior, quality, costs, maintenance, productivity, innovation, and logistics, among others. In this sense, researchers often speak of "the Kaizen umbrella," which is a set of interrelated lean manufacturing tools and methods such as total quality control, quality circles, suggestion systems, automation, total productive maintenance (TPM), Kanban, quality improvement, just In Time (JIT), zero defects, small group activities, new product development (NPD), productivity improvement, discipline, and cooperation between human resources and administrative staff, among others.

3.1.1 Time: A Strategic Resource

To Kaizen, time has the value that it deserves, since it is considered as a strategic resource. Time is one of the scarcest elements in any company, yet it is often and largely wasted. Only by exercising control over this valuable resource, companies can launch other administrative tasks and grant them the attention level that they deserve. Moreover, time is the most critical and valuable resource. It is the only irrecoverable asset that all companies have in common; when it is consumed, it never returns.

Companies may recuperate many other assets, and they may use them for any alternative purpose if their initial usage was unsuccessful. Unfortunately, this is not possible with time, yet it is often wrongly or carelessly managed. This may be why time does not appear in the balance sheet or the income statement, since it is something intangible that seems to be for free. However, time is definitely a manageable asset, and Kaizen does not forget this.

Inefficient use of time leads to stagnation. Materials, products, information, and documents remain inactive without adding any value. In production processes, temporary waste takes the form of inventory. In the office work, issues are pending and documents wait over the desks and on the computers for a signature or confirmation. Stagnation leads to spillover. Similarly, waste (also known as *Muda*) is a loss of time, which is why the workplace (*Gemba*) must always be organized.

If time is wasted, plans may be compromised. Nevertheless, when carefully used and managed, time makes tasks management more efficient and less worrying. In theory, it is always possible to earn more money and hire more people, but time must be wisely used. Once it is consumed, no one has a second chance to reuse it.

This type of *muda* is very common in the service sector. By eliminating time bottlenecks that add no value to the work, this sector must be able to substantially increase its efficiency and customer satisfaction rates. Likewise, since time has no cost, it is one of easiest ways for companies to improve their operations. The single thing to do is to observe the workplace (*Gemba*), recognize the *muda*, and take the necessary steps to eliminate it. Finally, as any other tangible asset, time can be managed to achieve optimal use.

In conclusion, Kaizen systems must include a systemic view of those companies that actively participate in production processes and commercial and financial planning. This implies using a series of engineering strategies in which statistical management and the use of information and communication technologies (ICT) enable to increase and give flexibility to the production capacity.

3.2 Activities at the Kaizen Planning Phase

Companies would be unable to survive or succeed without planning. At this stage, sales are organized, registered, and processed, raw materials are purchased, and personnel is hired and trained. Similarly, research and analysis are carried out, legal issues and regulations are checked, and the company's policies and procedures are transformed (Valencia Patiño 2014).

To organize, maintain, and expand any continuous improvement system throughout the whole organization, the first essential element is **Managerial commitment** to implementing organizational changes and facing new challenges (Sutari 2015). Second, companies must **Organize work teams** in order to guide employees through quality tools, teamwork techniques, and other skills that would help them detect and solve problems (Aoki 2008; Jørgensen et al. 2003). Finally, another important element is **Human resources training**. They must be provided with necessary knowledge to actively participate in the continuous improvement system. This increases confidence at work and helps the company face the new changes (Aoki 2008; Jørgensen et al. 2003).

3.2.1 Managerial Commitment

Becker (1960) defines managerial commitment from the perspective of the social exchange theory. The author thus describes commitment from managers as the link established between the individual and his/her organization, which is the result of small investments (side-bets) made over time. This variable is composed of the following items.

3.2.1.1 The Management Department Plans the Acquisition of All the Resources Needed for Improvement Programs (Financial Resources, Physical Space, Time)

Acquisition primary refers to planning and distributing the resources among the different parts of the organization. Here managers must define which usage will be assigned to each production factor and in what amount they will be used in the different activities (Rapp and Eklund 2002). Among the many activities carried out at the planning stage, managers must investigate and analyze situations and revise legal issues and regulations to transform them into business policies and procedures (Valencia Patiño 2014). Similarly, financial support is obtained at this stage, accounting is carried out, issued checks are recorded and received checks are deposited, benefits are determined, and complaints are addressed (Saad et al. 2006).

3.2.1.2 The Company Sets Policies, Objectives, and the Structure of Kaizen Events

Usually, managers do not feel concerned with the way in which relationships are established between management departments and the rest of the organization (Watson and Sallot 2001), even though such relationships can positively influence the attitude of employees. However, strategic processes—including their development, implementation and monitoring—are critical factors. Moreover, policies, objectives, and the structure of Kaizen events reflect the characteristics of a true leader (Rodríguez 2002).

3.2.1.3 Customers' Opinions are Taken into Account When Making Changes

Customer satisfaction is one of the most critical factors to any company willing to outstand and obtain positive business results (Landa 2009). That said, managers must have a new perspective and new expectations for the organization, seeking for long-term relationships with employees. A new managerial behavior is in fact an efficient management tool, where closeness and confidence between the management department and the rest of the organization can increase the commitment to reaching objectives of a given strategy (Dale et al. 2007; Yuan and Shen 2011).

3.2.1.4 The Company Develops a Continuous Improvement Culture

Continuous improvement means adopting a philosophy that promotes a share vision of the organization, so that all individuals participate as a social force to boost changes and improvement. Kaizen is the basis of a strong work ethics that ensures an organizational culture where individuals are promoted, motivated, and rewarded once changes and improvements are achieved (Lareau 2003; Lu 1987; Mika 2006).

3.2.1.5 The Company Has a Structure to Detect Failures

Control systems to detect failures may be simple, such as checklists or material tagging systems, or complex, including food temperature control systems or information systems. The ability of these control methods to detect process errors depends on their determination (Lillrank and Kanō 1989; Macpherson et al. 2015b; Montabon 2005).

3.2.2 Work Team Organization

Garcia-Sabater and Marin-Garcia (2009) argue that active employee participation in improvement tasks is significantly related at the intermediate level to the continuous improvement efforts made by companies. This participation includes suggestion groups or semi-autonomous groups.

3.2.2.1 Suggestions Groups (e.g., Quality Circles) are Organized to Improve Products and Processes or to Solve Problems

Companies use different tools for encouraging employees to participate in the continuous improvement process. Two of the most common tools are individual and group suggestion systems (Marin-Garcia et al. 2009; Mika 2006) and quality circles (Imai 2012; Jaca Garcia et al. 2010; Kumiega and Van Vliet 2008a). Similarly, many studies advocate success of continuous improvement programs based on the amount of ideas generated or implemented and the amount of employees actively involved in the process (Marin-Garcia et al. 2008).

3.2.2.2 Improvement Groups are Committed and Motivated

Bateman (2005) and Dale et al. (2007) point out that commitment is how each person sees their job, while motivation is the incentive to carry it out.

3.2.2.3 Improvement Groups Set Goals to Comply with Improvement Programs

It is important to define clear goals to be attained in order to direct efforts and evaluate processes by identifying and measuring the achieved progress (Jørgensen et al. 2003).

3.2.2.4 The Company Has Groups to Support Kaizen Execution

Kaye and Anderson (1999) consider support groups as highly enthusiastic teams. Group members are eager to contribute with their peers, subordinates, and superiors to their work performance, always seeking collective interests.

3.2.2.5 Improvement Groups are Heterogeneous

Improvement teams should not include more than six members. Similarly, participants must be directly involved in the problem to be solved or the improvement solution (Landa 2009; León Lefcovich 2003; Modarress et al. 2005b).

3.2.3 Human Resources Training

In addition to providing necessary knowledge to actively participate in continuous improvement systems, training is important since it increases confidence in the organization and helps face changes (Romero Hernandez and Nieto Lara 2011). This variable includes the following items.

3.2.3.1 Production Operators and Administrative Staff are Trained

The management department must train employees through quality tools and teamwork techniques, among others. These skills will help human resources detect and solve problems (Aoki 2008; Jørgensen et al. 2003).

3.2.3.2 The Management Department is Trained in Teamwork and Problem-Solving Skills

To be prepared for their jobs, managers must be trained in assessment techniques and quality improvement methods (Tapias and Correa 2010). The type and amount of training that executives receive greatly vary from one company to another.

However, managers' training usually includes information on evaluation methods, problem-solving analyses (fishbone diagrams and Pareto analysis), process management, and quality standards and indicators (Suárez Barraza 2009).

3.2.3.3 The Company is Seen as a Learning Organization

According to Aramburu Goya (2000), "learning is associated with both a change in the organizational behavior and a knowledge base that supports this behavior." Similarly, the author considers that learning is the process by which knowledge, skills, and attitudes are integrated to achieve behavioral changes or improvements. Therefore, learning is an action that takes knowledge as input to generate new knowledge (output).

3.2.3.4 Members of Improvement Groups are Skilled and Experienced

Continuous improvement group members must have the appropriate skills and experience in sharing ideas and feelings. They must be able to successfully show trust, confidence, acceptance, and support for all team members. Likewise, they must take advantage of the abilities, knowledge, experience, and capabilities of the team and ought to be familiar with and properly apply decision-making and problem-solving procedures (Francisco 2007; Garza 2005; PERRY et al.; Suárez-Barraza 2008).

3.3 Activities at the Kaizen Execution Phase

The Kaizen execution phase is the fieldwork of a continuous improvement system. In this phase, solutions are proposed; then prioritized improvement measures are quickly implemented. Variables at this stage include **Successful implementation of proposals, Human resources integration,** and **Customer focus.**

3.3.1 Successful Implementation of Proposals

According to Valles et al. (2009), this variable refers to the ability to effective and concretely carry out something. In this case, it is related to all the activities that employees can skillfully and resourcefully perform. Experience allows for improvement. This variable is composed of the following items.

3.3.1.1 Managerial and Departmental Leadership

It refers to the amount of commitment from managers toward employees, customers, suppliers, and shareholders. Authors (Upton 1996; Saad et al. 2006) point out that, to companies, a solid leadership is the cornerstone for implementing any idea.

3.3.1.2 5S is Implemented as a Kaizen Strategy

Production management includes diverse tools and approaches, such as quality control, just in time production, and 5S (Howell 2011; Kobayashi et al. 2008; Park et al. 2012; Suárez-Barraza and Ramis-Pujol 2012).

3.3.1.3 Kanban is Implemented as a Kaizen Strategy

A fundamental practice in Kaizen is total quality control (TQC). In TQC, the first and most important concern is waste elimination. Simultaneously, this allows for the implementation of Kanban, another Kaizen strategy (Aramburu Goya 2000; Rodríguez 2002).

3.3.1.4 Restrictions to Implement Proposals

Kaizen adoption in Western countries has demonstrated that the main issues with its implementation are cultural-related, including employees' personal convictions and the organizational structures of companies (Jaca Garcia et al. 2010; Salgueiro 1999; Suárez Barraza 2008).

3.3.1.5 Collaborators Eagerly Contribute to Continuous Improvement Changes

Kaizen members discuss together the company's business programs, opportunities, strengths, and weaknesses, always taking into account competition and the market sought to reach in the following 5 years (Mika 2006; Oropesa et al. 2016b).

3.3.1.6 An Internal or External Facilitator Helps Effectively Coordinate the Improvement Program

According to authors (Martin and Osterling 2007; Romero Hernandez and Nieto Lara 2011), facilitators coordinate the improvement program and guide the team toward successful Kaizen implementation. Due to their responsibilities, facilitators are strongly dedicated to the project development.

3.3.1.7 Improvement Groups Include Representatives of Different Disciplines

Members inside Kaizen groups must represent all disciplines involved in the continuous improvement changes. Therefore, these Kaizen groups must be multi-functional and self-regulated teams that incorporate continuous improvement actions into their responsibilities (Liu et al. 2015a; Modarress et al. 2005b).

3.3.1.8 The PDCA Cycle (Plan-Do-Check-Act) is Used as a Kaizen Strategy

Bateman (2005) and Dale et al. (2007) see the PDCA cycle as a highly important tool for continuous improvement. The *Plan* stage involves planning not only the activities to be performed, but also the kind of communication to establish, the scope of the plan, the benefits to be obtained, and the implementation of each improvement proposals. At this stage, companies must define customer needs. Similarly, it is important to identify the problems to be solved and their causes, set goals, establish a work plan, and collect necessary data.

The *Do* stage means implementing the improvement or plan, while at the *Check* stage it is necessary to verify whether corrective actions are properly working; and if they are not, it is important to find the cause. Finally, at the *Act* stage, companies maintain the improvement actions or standardize processes. This stage is vital, and without it, all the other stages are useless.

3.3.2 Human Resources Integration

Integration refers to employee participation in Kaizen events. Cooperation from human resources is key to any improvement system. That is, the business success is strongly related to the way employees are involved in the organization (Bhuiyan and Lucas 2007). This latent variable includes the following items.

3.3.2.1 Employees are Committed and Motivated

It is important to promote a sense of belonging to the company, so workers feel committed and more motivated to do their jobs. This is one of the basis of Kaizen success (Cheser 1998a; Cheser 1998b).

3.3.2.2 Kaizen Group Members are Acknowledged for Their Achievements and Efforts in Kaizen Events

Some of the psychological needs that must be met in a corporative environment: recognize employees for their efforts and achievements and create a sense of belonging (Caswell 1998; Gondhalekar and Karamchandani 1994; Imai 1986).

3.3.2.3 Human Resources are Integrated

Human resources participation is key to the success of improvement systems. Proper implementation and maintenance of such systems depend on how and to what extent employees are involved in them (Bhuiyan and Lucas 2007).

3.3.2.4 The Company Has a Well-Defined Organizational Culture

Companies must modify their organizational culture, since this precedes results. Every company must seek to integrate its employees and manage to adapt to the external environment (Caswell 1998).

3.3.2.5 Administrative Staff and Operators are Self-disciplined

In response to Kaizen culture, companies must develop an improvement method. It ought to be a discipline technique that promotes and ensures organization, tasks and time analysis, work planning, teamwork, organizational restructuring, research on Kaizen, and the use of computer resources and diagnosis systems.

The purpose of improvement methods is to increase quality, productivity, and response times in order to progressively and systematically reduce waste from administrative work. Very often this kind of support tasks add or have no value to processes (Gallegos 2007).

3.3.2.6 Job Rotation is Promoted

Knowledge expansion in the organizational group allows companies to have a trained and motivated workforce. This helps reduce employee turnover, increases flexibility, and generates value to processes, thus maximizing a company's competitiveness (Şendoğdu et al. 2013; Weber 2015b).

3.3.2.7 Employees are Skilled and Experienced

Kaizen does not necessarily needs a sophisticated technique or advanced technology. To implement this improvement system, companies can rely on simple, conventional resources, such as quality control tools (Bessant et al. 1993).

3.3.2.8 The Intelligence and Creativity of Workers are Used in a Productive Way

Companies are halfway through producing high-quality products and services when they manage to train quality staff. Building quality in people means helping them become aware there is a need for continuous improvement. New habits must be acquired through knowledge, skills, and will (Farley 1999; Francisco 2007; Juran et al. 1990; León Lefcovich 2003).

3.3.2.9 There is Communication Across Departments

To keep human resources integrated into the objectives of the companies and individuals who work there, interdepartmental communication must be fluid and constant, and prompt (Şendoğdu et al. 2013). Such characteristics are usually attributed to and demanded from horizontal relationships, while vertical communication must also possess these qualities (Deering et al. 2011). In fact, interdepartmental conflicts are quite common. The problem is that they only compromise improvement made (Birdsall 1980).

3.3.3 Customer Focus

It refers to identifying and addressing customer needs (Suárez-Barraza 2009). This variable comprises the following items.

3.3.3.1 The Company Has Methodologies to Understand Customers

Understanding and investigating customers' needs are means to avoid failures or unsatisfactory results. Definitely, a product or service exists only because customers want to purchase it (Suárez-Barraza and Miguel Dávila 2011; Womack and Jones 1996).

3.3.3.2 The Company Follows a Standard Operating Procedure (SOP)

Lefcovich (2007) defines SOP as a set of practices that companies carry out to improve quality in staff and products.

3.3.3.3 The Company is Customer-Focused

Customer needs constantly change, which is why companies must create a flexible structure that allows employees to increase abilities and skills according to the new exigencies of clients (Oropesa et al. 2016a).

3.3.3.4 The Company Focuses on Critical Processes That Definitely Influence Kaizen Sustainability

To implement Kaizen, companies must thoroughly analyze critical processes and the current use of resources. Likewise, it is important to look for alternatives to improve these processes and improve resources consumption (Salgueiro 1999; Suárez Barraza 2009; Suárez Barraza and Ramis-Pujol 2008).

3.3.3.5 The Improvement Approach is Consistent with the Organizational Culture

Executives must always be familiar with the cultural values needed of their organizations, so such values can be promoted and strengthened through action plans. Once this is accomplished, it is important to identify the cultural aspects that need to be changed in order to determine the strengths and weaknesses of the organizational culture (Caswell 1998).

3.3.3.6 Internal Processes are Efficient in Checking the Effectiveness of Proposed Solutions

Bateman (2005) and Dale et al. (2007) emphasize on the importance of collecting relevant information regarding the improvement project. Companies must make sure that measuring tools, including measuring instruments and assessment questionnaires, are effective. Some of the most used tools include the cause and effect matrix, process capacity, competitive analysis, failure mode and effect analysis, and the repeatability and reproducibility measurement system.

3.3.3.7 The Company Relies on a Quality Management System to Achieve Customer Satisfaction

Quality is always the best way to customer satisfaction and during Kaizen implementation, the programs related to guarantee quality must be always prosecuted as a goal (Suárez Barraza et al. 2013). Fortunately, there are some research that associate the quality process and its methodologies with Kaizen, and there is enough evidence (Saleem et al. 2012).

3.4 Activities at the Kaizen Control Phase

Nowadays, many companies do not have a rigorous control over waste in production lines. Administrative costs are not always considered as relevant, which is a mistake, since even the smallest saving is a gained benefit. Therefore, managers must make the whole organization aware of costs and implement a proper organizational culture.

Variables at the Kaizen control phase are **Communication, documentation, and evaluation processes** and **Organizational Culture.** Each one of them includes different items described below.

3.4.1 Communication Process

It refers to the exchange of ideas, opinions, and information among employees (Berlo 1969). It comprises the following items.

3.4.1.1 Managers Inform Operators of Their Work Performance

Managers must permanently support employee professional development. Employees must be informed of their performance and must be rewarded and recognized for their good job. These are requisites for successful Kaizen implementation and maintenance (Garcia-Sabater and Marin-Garcia 2009; Jaca Garcia et al. 2010).

3.4.1.2 Employees are Interviewed to Identify Their Needs

Management changes cannot be handled only by the senior management. Managers can coordinate with human resources professionals to achieve organizational improvements by guiding, interacting, and listening to employees. Several tools and techniques are available to identify the voice of the organization. It is only a matter of recognizing the significance of supporting employees. It increases productivity and performance, while human resources simultaneously feel happy to be part of a company that considers their needs (Adamson and Kwolek 2007; Hair et al. 2013; Oropesa et al. 2016b; Whitehead 2007).

3.4.1.3 Interdepartmental Communication is Successful

According to authors (Kaye and Anderson 1999; Romero Hernandez and Nieto Lara 2011), the ability to harmoniously work and relate with both superiors and peers (to listen and to be listened) is one of the pillars for continuous and successful improvement changes.

3.4.2 Documentation and Evaluation

The assessment process must include employees' cooperation skills, knowledge, contributions to the process and quality improvement, and new initiatives proposed. That said, evaluations are intended to promote job skills and development of employees (Sherman et al. 1994).

3.4.2.1 Activities are Periodically Assessed Through Performance Evaluation Systems

To ensure Kaizen sustainability, it is important to continuously monitor the system's status through performance indicators (Bateman 2005).

3.4.2.2 Forms and/or Control Records are Used to Assess Activities Performance

Companies must find a way of properly registering activities carried out by the different departments, including the human resources, procurement, finances, engineering, facilities management, legal issues, and top management departments (Paul Brunet and New 2003).

3.4.2.3 The Company Applies Appropriate Control and Monitoring Techniques

By processes control and monitoring techniques, authors (Kaye and Anderson 1999) refer to the instruments that explain the behavior of such processes.

3.4.2.4 The Company Has an Organizational Structure to Detect Failures

One way of achieving significant productivity is by removing unaccountable or defective activities. When managers stop wasting time on intractable problems, it is surprising to see how many opportunities for improvement they can find. Simplicity in the workplace is a virtue (Farris et al. 2009a).

3.4.2.5 Value Streams are Mapped

Mapping activities carried out inside of the company is an effective means to identify steps taken to make improvements. Value stream mapping (VSM) helps remove unnecessary actions, modify their structure, or create a different way to ensure improvements (Anderson et al. 1994; Dean and Bowen 1994; Eisenhardt and Graebner 2007; Kotabe et al. 2007).

3.4.2.6 Pending Issues are Documented and Monitored

Once all the pending issues are documented, they must be properly and timely monitored. To achieve this, continuous improvement groups must construct an organizational chart to define the role of each member in the continuous improvement process. Each person must be in charge of a particular task, but someone must coordinate the whole procedure (Oropesa et al. 2016b).

3.4.2.7 Organizational Culture

A company's organizational culture implies individual and collective satisfaction and well-being, always balancing the system's interests, so that results obtained are ideal (Caswell 1998).

3.4.2.8 Progress Toward the Objectives is Continuously Measured

It is important to measure the performance of Kaizen events, as well as to constantly measure the progress achieved. This allows companies to see objectives as realities already attained (Adamson and Kwolek 2007; Aramburu Goya 2000; Barraza et al. 2009; Bisgaard 2007; Broadbent 1994).

3.4.2.9 The Company Has Safety Programs

Safety programs are necessary for Kaizen implementation, not for tackling future damages or economic losses, but because every company has a social responsibility. Organizations must ensure their employees' safety (Suárez-Barraza et al. 2012).

3.4.2.10 Processes are Standardized and Measured

Another key element to Kaizen success is resources management. Such resources include workforce, machinery and equipment, information, and materials. Efficient resources management demands standardization. Every time a problem or abnormality arises, managers must investigate and identify the root cause, reconsider current standards, and perhaps implement new ones (Macpherson et al. 2015b; Paul Brunet and New 2003; Savolainen 1999; Valles et al. 2009).

3.4.2.11 Managers are Committed Until the End

Becker (1960) defines managerial commitment from the perspective of the social exchange theory. The author thus describes it as the link established by the individual with his organization, which is the result of small investments made over time.

3.4.2.12 Enhancers Take Kaizen Philosophy to the Level Sought

Resources optimization is achieved through a continuous improvement philosophy adopted as a new life and work style, and which provides outstanding results. This philosophy is adopted as a means to improve and redesign processes, converting weaknesses into strengths, expenses into savings and investments, and deficits into surpluses. These are the system's enhancers (Adamson and Kwolek 2007; Audenino 2012; Berger 1997).

3.5 Kaizen Benefits

Authors (Alukal and Manos 2006) have distinguished between quantitative and qualitative Kaizen benefits. As the work suggests, the former can be quantified, and they include economic benefits, time saving, reduced distances for material's handling, less staff, reduced waiting times and cycle times, reduced steps in processes, and reduced inventory. Variables identified as Kaizen benefits include

Economic benefits, Competitive benefits, and Human resources benefits. Items of these variables are addressed below.

3.5.1 *Economic Benefits of Kaizen*

Economic benefits are results that can be quantified. They can be measured, and they generate profits. The most common include time saving, reduced distances for material's handling, less staff, reduced waiting times and cycle times, reduced steps in processes, and reduced inventory (Alukal and Manos 2006).

3.5.1.1 Fewer Defective Products

Kaizen noticeably reduces the percentage of defective products in the production lines. Remember that this philosophy is associated with other lean manufacturing tools, including total quality control (TQT), which seeks to reduce waste and setbacks, thus resulting in fewer defective products (Knechtges and Decker 2014c).

3.5.1.2 Unit Manufacturing Costs Reduction

Companies can significantly reduce product design times by employing appropriate technologies and software. Similarly, prototypes simulations can help reduce errors in the manufacturing process (Rof 2011).

3.5.1.3 Order Lead Times Reduced as Close as Possible to Zero

This benefit is the result of proper use of advanced manufacturing technologies in each department or area. AutoCAD®, for instance, is a piece of software used to quickly generate final product prototypes (Salleh et al. 2012).

3.5.1.4 Increased Work Productivity

In economic terms, productivity encompasses logistics systems for materials handling, since unnecessary motions add no value to the product. In this sense, companies always seek the minimum investment possible in materials handling. (Krajewski et al. 2013; Farris et al. 2009b; García et al. 2013a).

Another Kaizen benefit is adequate utilization of human resources skills and experience, since they are often incorrectly organized. That is, employees may be responsible for tasks that are not appropriate for them, because they either lack of skills and experience or are able to carry out more complex jobs (Glover et al. 2011a; García et al. 2014a).

3.5.1.5 Compliance with Product Delivery Times and Quantities

This is a consequence of successful coordination between the continuous improvement philosophy adopted and quality programs. Delivery times are a priority for Kaizen as a LM tool (Milgram et al. 1999).

3.5.1.6 Material Handling

It results from properly organizing production machinery and equipment. Nowadays, cellular manufacturing and technology groups are efficient ways of grouping a set of activities or a series of machines depending on the activities carried out, which reduces distances in the process (Mizuno et al. 2012a; Ikuma et al. 2011).

3.5.1.7 Waste Reduction (Inventory, Waiting Times, Transport, and Operator's Movements)

Kaizen diminishes waiting times, transport, movements, and inventory that results from malfunctioning machinery or poor planning from the part of human resources (Higuchi et al. 2015b).

3.5.1.8 Fewer Production Process Steps

This benefit is the result of the basic Kaizen principles, since the philosophy aims at improving each and every one of the production process steps. Such improvements lead to elimination of unnecessary activities that add no value to the product. To achieve this, Kaizen relies on many tools, including value stream mapping (Visuwan et al. 2010).

3.5.1.9 Maximized Profits

It is the result of continuous improvement. Profits are maximized along the supply chain, but especially in the production lines and systems. When companies eliminate errors and waste, savings are traduced into profits. In this sense, some Indian companies are clear examples of successful Kaizen implementation (Arya and Jain 2014).

3.5.1.10 Reduced Equipment Failure

This benefit is strongly related to total productive maintenance (TPM) processes that companies implement in their production processes. TPM seeks to identify all possible errors or causes of failures in machinery or equipment that may affect the production flow (Prabhuswamy et al. 2013).

3.5.1.11 Increased General Productivity

Productivity is the result of the rational measurement of a company's input and outputs, which indicates the amount of material required to generate a product. Increased productivity implies that the company makes efficient use of available resources (Radharamanan et al. 1996).

3.5.1.12 Short Design and Operating Cycles

This is achieved through the use of proper technologies for design and operating activities (Knechtges and Decker 2014b).

3.5.1.13 Improved Cash Flow

Cash flow is improved when productivity increases savings, waste in the production process is removed, and companies have a better performance in new products design and processes. This benefit is the first objective of any LM tool. Cash flow aims at generating higher dividends for shareholders (Visuwan 2010).

3.5.1.14 Increased and Improved Economic Stability

Economic stability is the difference between the company's income and expenses. If a company does not produce anything, fixed expenses will remain. If a company runs a production, variable expenses will depend on the amount of product generated. Such a product can be sold and, thus, profits will appear (Farley 1999).

3.5.2 Competitive Benefits of Kaizen

The greatest competitive benefits of Kaizen are change in the organizational culture, flexibility and agility to respond to customers' orders without generating final product inventory, reduced operating costs up to 40 %, waste reduction up to 80 %, increased cash flow, and maximum 3.4 defect parts per million (3.4 PPM) opportunities in the production process (Berriman et al. 2005).

3.5.2.1 The Company Has the Tools to Meet Customer Needs

Thanks to a set of techniques and activities, Kaizen allows companies to quickly and precisely identify customer needs to translate them into product/service characteristics and attributes (Ujimoto 1993).

3.5.2.2 New Products are More Often Introduced into the Market

This benefit is directly associated with the technologies used for product design and prototyping. Both are interactive processes where sale agents identify customer needs and communicate them to product designers, who then create a 3-D or 2-D product design (Huenteler et al. 2016; Song and Sakao 2016).

3.5.2.3 Improved Product Quality

High quality products are the result of activities such as 5S and Kanban. The former seeks to ensure clean and safe work spaces, so that workers can rapidly identify the required materials (Gupta and Jain 2014). Kanban is a signaling system for supporting the management and flow of materials along the production line. It allows for faster delivery times, speeds manufacturing technologies employed in the process, and helps meet the product quality sought (Singh and Kumar 2013).

3.5.2.4 Customer Needs are Met

Kaizen helps address the growing and always changing customer needs, but also, it supports proper resource utilization in order to achieve the established goals and objectives (Carrillo and Zárate 2009).

3.5.2.5 Improved Employee Skills

Kaizen is not only process-focused, since it also aims to improve the performance and lifestyle of people, especially human resources. Therefore, this competitive advantage is the result of the many Kaizen activities and techniques that provide education and training to employees. If employee performance is enhanced, production processes are consequently improved (Paraschivescu and Cotirlet 2015).

3.5.2.6 Reduction of Changeover Times

This benefit is the result of many activities at the Kaizen planning and execution stages. One of these activities is TPM (Prabhuswamy et al. 2013), which forces companies to properly schedule maintenance sessions, checkups, changeovers, or other stoppages in production machines and equipment (Sachit and Pardeep 2014).

3.5.2.7 The Company Adopts a Systemic and Holistic Vision

Kaizen allows for the creation of multidisciplinary workgroups to solve problems arising in production systems. These workgroups make sure that issues are addressed from different perspectives, thus meeting the interests of the whole organization (Stone 2010; Medinilla 2014c).

3.5.2.8 Process-Oriented Thinking

Competition nowadays is not merely attentive to production processes, since companies have adopted a rather holistic view of the supply chain. Kaizen promotes process-oriented thinking as a successful strategy, because quality is generated in the manufacturing process, and mistakes and accidents usually occur in the plants. Many LM tools have been developed as a result of process-oriented thinking, including statistical process control and total productive maintenance (Dass and Fox 2011).

3.5.2.9 Improved Product Designs

This benefit is directly related to the technologies used for product design and prototyping. Both are interactive processes where sale agents identify customer needs and communicate them to product designers, who then create a 3-D or 2-D design (Huenteler et al. 2016; Song and Sakao 2016).

3.5.2.10 Global Competition

Kaizen ensures improvements along the whole production system. Since employees' capabilities and skills are correctly identified, managers can easily detect opportunity areas in human resources. When such areas are improved, they become a competitive advantage and allows for early entrance to different globalized markets (Sandoval-Arzaga and Suárez Barraza 2010; Magnier-Watanabe 2011).

3.5.2.11 Strategic Advantage

This benefit is the result of proper managerial leadership. Managers must supervise and direct the abilities and skills of workers to be able to identify problems and promote continuous improvement (Tsao et al. 2015).

3.5.2.12 Experience in and Knowledge of Organizational Processes

This is the result of effective human resources training programs and rewards. When workers are acknowledged for their efforts and achieved improvements, they are more likely to remain in the company, which in turn is able to retain an experienced and skilled workforce (Hadjimarcou et al. 2013).

3.5.2.13 Internal Barriers Easily Removed and Authentic, and Powerful Work Teams Emerge

This is only achieved through collaborative work. Group members usually belong to different areas and departments, which allows for addressing and tackling issues from different perspectives (Olsen et al. 2014; Glover et al. 2011b; Oropesa-Vento et al. 2015b; Liu et al. 2015c).

3.5.2.14 Continuous Adaptation to Sudden Market Changes

This is especially associated with supply chain agility. Two of the most important sources of agility are information and communication technologies implemented in the supply chain. Similarly, companies must pay attention to their production flexibility (Narasimhan et al. 2006; Kisperska-Moron and de Haan 2011).

3.5.3 Human Resources Benefits of Kaizen

Kaizen offers several advantages to human resources: higher self-esteem and personal motivation, reduced customer attrition and employee turnover, improved attitude, improved skills to achieve continuous improvement changes, and increased work and customer satisfaction. The latter are influenced by the economic benefits obtained as the result of the company's ability to respond to sudden market changes (Garza 2005).

3.5.3.1 Increased Customer Satisfaction

Continuous improvement groups must aim at tackling production problems whose solutions can be translated into customer benefits. However, managers' practices must also be customer-focused (García et al. 2013a; García et al. 2014a).

3.5.3.2 Increased Employee Motivation

Motivation at work depends on many Kaizen activities. However, the most crucial factors are associated with leadership and managerial commitment. Managers and leaders must provide employees, especially continuous improvement groups, all the necessary tools and materials (Kumashiro 2011).

3.5.3.3 Improved Attitude and Work Skills of Operators

One of the most important advantages of Kaizen is its ability to integrate human resources in the continuous improvement process. Since Kaizen interacts with employees, they can easily perceive their personal growth, and this influences their work attitude (Choi 2011). In that sense, one of the most important personal goals for workers is the acquisition and development of new work skills and abilities. Kaizen provides such a benefit (Dusi et al. 2014; Weber 2015b).

3.5.3.4 Increased Employee Self-esteem

Professional self-esteem depends on knowledge and experienced gained at work over time. Hence, managers have to promote an appropriate learning environment where employees are recognized as an important part of the company, and their work skills are highly valued (Dwivedula and Bredillet 2010).

3.5.3.5 Fewer Cumulative Trauma Disorders (CTDs) Derived from Ergonomic Problems

Employees, especially production operators, care about their safety and their peers'. Undoubtedly, problems associated with occupational hazards may cause severe accidents or CTDs, which is why ensuring safety is a top priority to continuous improvement groups (Vieira et al. 2012b).

3.5.3.6 Increased Participation

This benefit is one of the most visible outcomes of successful Kaizen implementation. Participation brings interesting benefits to human resources and influences on the financial performance of companies (Doolen et al. 2008).

3.5.3.7 Improved Communication Among Administrative Levels

To achieve this benefit, companies must ensure successful integration among all administrative levels and seek for consensus in any decision to be made, including those related to the business' direction (Magnier-Watanabe 2011).

3.5.3.8 Positive Influence on Individuals

With Kaizen, employees feel capable of tackling and solving any arising problem (Mizuno et al. 2012b). However, obtaining positive should not be a goal exclusive to improvement group leaders. Executives must be equally involved and committed, since the survival of these groups depends on them (Suárez-Barraza and Ramis-Pujol 2010; Stone and Kerno 2010).

3.5.3.9 Decreased Customer Attrition and Employee Turnover

Since employees become highly skilled in their jobs, they are able to successfully recognize arising problems and solve most of them on their own (Brunet and New 2003). These problem-solving skills thus become an added value translated into knowledge, and such knowledge may be lost if employees are removed from their positions and asked to hold another one with different tasks to be learned.

3.5.3.10 Improved Attitude and Skills of Managers and Executives to Address Continuous Improvement Changes

Relationships among improvement group members usually extend beyond work to social and personal contexts. These people thus interact outside the work place, which improves integration in all aspects (Dhurup et al. 2016).

3.5.3.11 Participation and Collaboration to Build a New System

Within improvement groups, participation is always collective and focuses on improving not only the involved area, but the entire production and administrative systems (Koide et al. 2007). Thus, participation and contribution from every group member allows for the whole system to be improved.

3.5.3.12 Attention is Paid to the Most Important Issues

Kaizen provides employees, especially improvement group members, the tools and skills necessary for identifying the most important opportunity areas of the company. Problematic events can usually be measured in economic terms, by the amount of customer complaints, or by analyzing employees' safety and health (Glover et al. 2014).

3.5.3.13 Increased Employee Responsibility and Commitment

Continuous improvement groups are multidisciplinary in nature. In every project that is undertaken, every member has his/her own responsibilities according to a work plan. These activities must be accomplished and reported to the group leader (Maarof and Mahmud 2016; Higuchi et al. 2015b).

3.6 Conclusion

This chapter discusses activities to be carried out in every Kaizen implementation stage, and the benefits that the philosophy can offer to companies. Even the smallest improvement is significant, and those little changes always make a difference. Employee performance is a great contribution to the company. It is a means to increase benefits (from improved quality), have a skilled and experienced workforce, and guarantee financial growth.

Also, current conditions have shown that more than a simple relationship among its three stages, Kaizen success relies on the interaction among all elements and activities performed within the company. In the end, all together generate permanent benefits and become a tool to face any challenge.

Furthermore, the market as it is today, saturated and full of changing and exigent customer needs, social issues, and environmental laws and regulations, forces companies to re-evaluate their performance. Now more than ever companies must rethink their vision, redesign or optimize their processes, take advantage of modern end technologies, and construct appropriate and competitive organizational structures. Work without strategies is a synonym of unproductivity. Dynamism is the key to competitiveness.

Joint efforts, shared benefits, teamwork, disposition to learn and change, flat organizational structures, breaking barriers, and effective communication are some of the new rules in today’s global economy. The most common reasons why many improvement changes fail are because human resources are not truly taken into consideration or they fail to adapt to changes in the production process.

Chapter 4
Methodology

The methodology of this book is divided into eight main sections, depending on the activities carried out. Aspects covered by this chapter are associated to different activities:

- Survey structure
- Scales used to respond the survey
- Survey administration
- Data capture and screening processes
- Indices used for the descriptive analysis of the sample and variables from the survey
- Data validation process
- Integration of latent variables
- Hypotheses validation to associate Kaizen activities with Kaizen benefits (structural equation model)

4.1 Stage 1. Questionnaire Design

The questionnaire is divided into different sections considering the variables to be measured and studied during Kaizen implementation in companies. For its construction, we carried out an exhaustive search of the state of the art of Kaizen. Databases consulted include those mentioned in Chap. 2. The search enabled to identify Kaizen implementation activities and benefits. Similarly, such information represents the questionnaire's rational validation (Tanur 2015).

The preliminary questionnaire is then submitted to validation with a panel of judges. The panel is composed of 15 continuous improvement leaders and eight well-known academics, who are familiar with the industrial sector in Mexico. The purpose of the validation is to guarantee that items included in the questionnaire effectively reflect the context of the manufacturing industry in Ciudad Juárez, since

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Kaizen research has been carried out overseas and results reported thus apply to foreign countries and different sectors (Lohr 2015).

Even though no items were added after the survey validation process, many of them were reformulated to ensure a proper translation (Calinescu et al. 2013; Wagenaar 2005). This method has been employed by previous studies in the same industrial context (Avelar-Sosa et al. 2014; Alcaraz et al. 2014). In the end, the final version of the questionnaire contains different well-structured sections discussed in the following pages. Similarly, the survey can be consulted in the Appendix section, at the end of the book.

4.1.1 Section 1. Introduction

The first section of the survey introduces the project and the aim of the instrument. Similarly, a paragraph defines Kaizen and its role in the industrial sector. The survey also emphasizes on information confidentiality, and participants are asked whether they wish to receive a copy of the survey's final report, since the research is financially supported a public national institution.

This section of the survey also describes the Likert scale used to rate the items. The scale includes numerical measurements (values) and their respective qualitative definitions (Grootendorst et al. 1997). Also, instructions are provided to ensure questions are properly understood and answered. Likewise, participants are asked not to rate a single item twice (i.e., chose two values).

Finally, the last part of this section features a short glossary of the most used terms in the survey. Participants are encouraged to consult the glossary in case of questions regarding a word or abbreviation. Entries especially include terms related of Kaizen CSFs and benefits (Bonnel et al. 2015).

4.1.2 Section 2. Demographic Information

The survey is administered in the manufacturing sector of Ciudad Juárez, Chihuahua. Since this city caters for many types of industries, participants are asked to specify the type of manufacturing company where they work. This information helps identify the differences in Kaizen implementation in the different industrial subsectors (Teagarden et al. 1992; Vargas and Johnson 1993).

Another important question asked in this section is the size of the company. To classify companies into small, medium, and large organizations, we use the criteria established by the Secretariat of Economics of Mexico, which are based in the number of employees. Additionally, it is important to be familiar with the job positions of respondents (Raafat et al. 1992; Howell et al. 2003). This information helps identify the kind of decisions that each employee must make and his/her responsibilities. Finally, the survey also requests genre and seniority (Wilson 2002; Mollick 2009).

4.1.3 Section 3. Kaizen Implementation Stages

Kaizen implementation is divided into three stages, briefly explained in the following sections.

4.1.3.1 Kaizen Planning Stage

Before implementing a continuous improvement or Kaizen system, companies must plan such an implementation (Recht and Wilderom 1998). This section of the questionnaire includes 14 activities associated with the Kaizen planning stage. The aim is to identify, for each company, the current state of the production system, the training system implemented to support Kaizen, and the amount of managerial commitment. Likewise, this section identifies the established goals and investigates on the improvement strategies implemented, such as quality circles and mail boxes for suggestions and complaints (Moore 2007).

4.1.3.2 Kaizen Execution Stage

After analyzing the current system's status and having developed a continuous improvement plan for it, the following step is to execute the plan (Kumiega and Van Vliet 2008b). This section of the survey includes 24 Kaizen execution activities. The aim is to identify how improvement groups work, how the training system is being implemented, the disciplines participating in continuous improvement changes, and how and to what extent Kaizen is being combined with other lean manufacturing (LM) tools, such as total productive maintenance (TPM) and quality policies (Glover et al. 2011b).

4.1.3.3 Kaizen Control Stage

Any implemented system or philosophy must be monitored to ensure its perpetuity. Therefore, it is important that companies develop a control plan to maintain and continue improving the quality standards reached with Kaizen. This section of the questionnaire includes 12 questions regarding the activities that should be executed at the Kaizen control stage, after its implementation process (Knechtges and Decker 2014a).

Some of the most important activities have to do with the way in which companies document and save information on the different improvement projects implemented, and what measures they take after analyzing these reports or informs (Maarof and Mahmud 2016). An example of another instrument that explores the Kaizen control stage is the questionnaire developed by Tsao et al. (2015), which measures the level of Kaizen culture achieved by different Chinese companies today.

4.1.4 Kaizen Benefits

Since the main objective of this book is to propose causal models to identify the impact of Kaizen activities, it is necessary to explore the benefits that can be obtained (Machikita et al. 2016a). This survey section comprises three subsections, each one of them addressing different types of benefit gained after the implementation process.

4.1.4.1 Economic Benefits

If a production philosophy does not offer any benefit, its implementation lacks justification and surely should be abandoned or rejected by managers. Undoubtedly, the whole set of benefits obtained with Kaizen must be greater than costs derived from its implementation.

This subsection of the questionnaire includes 14 items or questions regarding economic benefits, such as maximized profits, improved economic balance, and unit costs reduction (Higuchi et al. 2015b). The objective of this subsection is to identify the economic benefits that manufacturing companies in Ciudad Juárez obtain with Kaizen implementation. References supporting each benefit can be consulted in Appendix A.

4.1.4.2 Competitive Benefits

This subsection has 14 items or questions, which seek to identify Kaizen competitive benefits gained in manufacturing companies of Ciudad Juárez. These benefits are mostly related to product and quality improvement and fast response to changing customer needs. However, perhaps the most important benefit of Kaizen implementation is a new continuous improvement culture within the organization (Breese et al. 2015; Machikita et al. 2016a).

4.1.4.3 Human Resources Benefits

Kaizen benefits also reflect on human resources, especially on those who are directly responsible for the improvement changes. This subsection is thus composed of 13 items, including reduced occupational accidents, improvement groups integration, and interaction between these groups and other departments (Farris et al. 2009a; Baril et al. 2016). Likewise, other items assess employee attitudes and skills developed to address issues under a continuous improvement approach (Radharamanan et al. 1996; Recht and Wilderom 1998).

4.1.5 Measurement Scale

The survey is answered with a five-point Likert scale for subjective assessments. This means that items are rated according to the experience and knowledge of participants. Since subjective scales are straightforward and reliable, they have been employed in previous studies, especially in the manufacturing environment (García-Alcaraz et al. 2012; García et al. 2013b). Table 4.1 shows the scale values and their corresponding definitions (Likert 1932; Wuthrich and Bates 2005; Friborg et al. 2006).

4.2 Stage 2. Survey Administration

The final version of the survey is administered to manufacturing industries located in the Mexican state of Ciudad Juárez during a year; form May 2014 to May 2015.

4.2.1 The Sample

Ciudad Juárez, caters for 324 manufacturing companies registered as export industries, according to criteria established by the Mexican Secretariat of Economics. To define the sample for this study, the first step is to identify all companies with well-developed continuous improvement system. Then, the following inclusion criteria are considered (Wilson 2013):

- Companies must have at least ten completed improvement projects.
- Companies must be registered as maquiladoras.
- Companies must have a properly established production process.
- Production operators must be familiar with the Kaizen implementation system.

To reach the ideal companies, we asked for the support of IMMEX (Mexican Export Maquiladora Industry, for its acronym in Spanish), which is an institution having direct relationship with all senior and administrative managers of

Table 4.1 Scale used

Value	1	2	3	4	5
Description	The activity is never carried out	The activity is rarely carried out	The activity is often carried out	The activity is very frequently carried out	The activity is always carried out
	The benefit is never obtained	The benefit is rarely obtained	The benefit is often obtained	The benefit is very frequently obtained	The benefit is always obtained

manufacturing companies in the region. IMMEX organizes frequent meetings with representatives of these manufacturing companies, and during one of such meetings, IMMEX allowed us to present the project and its objectives. Finally, participating companies later answered the survey in one of the three ways described below.

4.2.2 Personal Interviews

To carry out the interviews, improvement group leaders are reached by email and invited to participate in the study. The invitation also proposes different dates and times to schedule the interview (Wilson 2013). After 2 weeks, leaders are reached again in case they did not reply the first email.

We attend appointments with managers who agreed to participate after three invitations (Hou and Chu 2015). In some cases, we schedule a second appointment, since participants unexpectedly postpone the meeting. However, after three unsuccessful attempts, another group leader is interviewed, or the case is discarded, since the process becomes time-consuming.

4.2.3 Survey Administration via Email

If managers have little time to meet, they request the survey be email. The questionnaire is thus sent in a Word or editable PDF format to be responded. In these cases, an institutional letter is attached to the questionnaire, which explains the objective of the research (Spark et al. 2015).

4.2.4 Survey Administration via Electronic Platform

The third way to administer the questionnaire is an electronic platform specialized in survey administration. All participants are emailed with the link in case they prefer to answer the survey online. The platform is available during a year (Spark et al. 2015; Mohorko and Hlebec 2016).

4.3 Stage 3. Data Capture

Data gathered are captured in a database with SPSS 21® software, which is an easy tool to process information and authors are familiar with it (Plume 2003). Each column of the database represents an item from the questionnaire (Kaizen activity or benefit), whereas each row stands for a case or questionnaire administered. The size of the database thus equals the number of items multiplied by the number of cases or surveys administered (Jouve et al. 2012; Nooraee et al. 2014).

4.4 Stage 4. Data Screening

Before analyzing and discussing information, data must be screened to detect and correct errors. As little as they may be, data errors can affect results and conclusions drawn.

4.4.1 Missing Values

Missing values are unanswered items (Kharin and Voloshko 2011). Sometimes participants are not familiar with the item or answer, they do not have enough knowledge to provide an opinion, or the simply wish not to answer. In this study, many items were not answered. However, surveys are valid and can remain in the analysis only if they contain less than 10 % of missing items (Lin et al. 2015; Sovilj et al. 2016). In this case, a missing value is replaced with the median value of the item, since data is obtained with an ordinal scale, and not through interval or ratio scales (Ketkar et al. 2012).

4.4.2 Extreme Values or Outliers

An outlier is a value that lies at an abnormal distance or outside the overall pattern of distribution of data (Bouguessa 2015). For instance, if one of the cells in the database shows a value such as 33, we are surely dealing with a capture error, since the value is outside the scale range. This screening process is carefully and meticulously carried out, since outliers can severely compromise results of the proposed models. These models are based on partial least squares (PLS) algorithms, and missing values can deviate coefficients estimation (Chen et al. 2015).

To identify all outliers, every variable or item (Kaizen activity or benefit) is standardized. To achieve this, all values obtained for a same item are divided into the standard deviation of data of that variable (Ru et al. 2016). Values above 3 and below −3 are considered outliers. Also, a same case or questionnaire must not contain more than 5 % of outliers; otherwise it is discarded.

Also, box-and-whisker plots are constructed with software SPSS 21®. This is the same program used to create the database, but in this case it helps identify the questionnaires that contain outliers. In the box-and-whisker plots, the interquartile range (IQR) is the width of the box, and it is obtained from the difference between the third and the first quartile. Also, whiskers represent the first and the last quartiles

(Sugiyama 2016). Outliers always appear outside the analyzed quartiles, and once they are found, they are replaced with the median value of the item involved.

Finally, note that the aforementioned procedure is a univariate analysis. Thus, in order to perform a multivariate analysis of extreme values, we use the Mahalanobis distance.

4.4.3 Zero Variance

Sometimes respondents assign a same value to all items of a survey (Kaizen activities and benefits, in this case). To detect and solve this problem, we obtain the variance of every analyzed questionnaire. If all questions (items) were assigned the same value, data variance is 0. Similarly, if there is little variation among values, variance is close to 0 (Kock and Lynn 2012). In this study, the minimum acceptable variance is 0.5 for a case to be considered as reliable. Therefore, questionnaires with variance below 0.5 are discarded.

Also, in this process we use statistical software Microsoft Office, Excel. Unlike SPSS, Excel obtains variances by analyzing a whole set of cells. Remember that items or variables in the SPSS database are represented by columns; however, we are interested in the variance of cases (rows), which is why Microsoft Excel is preferred.

4.4.4 Normality Test

As previously mentioned, this book seeks to propose causal models to demonstrate the relationships between Kaizen activities and benefits in the manufacturing industry of Ciudad Juárez. Such relationships between variables are based on PLS, which require normal distribution of data. All variables are thus tested to measure their normality (Jönsson 2011). In this case, we use the same piece of software that is employed to analyze the causal models (Lee and Ng 2011).

- Statistical bias: skewness in each variable must have a value ranging from −1 to 1 in order to prove that there is no difference from normal distribution. However, to improve precision of results, we set a confidence interval, which includes a limit inferior and a limit superior. If values obtained are lower than −1 or higher than 1, the item does not have normal distribution, and it thus requires some transformation. A quick way of identifying statistical bias is through a normal distribution or bell curve graph. We construct one graph for the data set of each variable. Curves showing skewness left or right indicate bias (Stehlík et al. 2014; Galvao et al. 2013; Cheng et al. 2011).
- Kurtosis: Kurtosis is a measure of whether data are heavy-tailed or light-tailed. Mesokurtic distribution is desired, since it is similar to the kurtosis of a normally

distributed data set. In this research, we look for values close to 1 and estimate kurtosis distribution of each data set. On the one hand, kurtosis values above 1 indicate leptokurtic distribution of data. That is, a large and thin curve peak, and thus a relatively small standard deviation. On the other hand, values below 1 show platykurtic distribution and a larger standard deviation of data from the mean (Mudholkar et al. 2002; Foss et al. 2011).

4.4.5 Homoscedasticity Test

Homoscedasticity is central to linear regression models. It means having the same standard deviation in different data sets. To test data homoscedasticity, we employed the techniques listed below (Baltagi and Yang 2013; Lee and Ng 2011), which also help detect outliers that could not be found in the first test.

- Residual standard deviation plots are used to examine normality of distribution. Plots must not show any pattern or trend, since it would indicate that the residuals are not independent. In this case, the amount of residuals below and above 0 should be similar.
- Data of a same variable are divided in two groups. In both cases we first calculate the data variance; then the Chi-squared (X^2) test is performed to find whether both groups had the same variance.

4.4.6 Multicollinearity Tests

Multicollinearity occurs when two or more predictor variables are highly correlated. This means that one can be linearly predicted from the others (Pasternak et al. 2001). In this research, we followed the steps listed below to detect multicollinearity:

- Correlation matrices are used to identify correlation coefficients among variables. Values higher than 0.9 indicate that one variable could explain others or another variable (Sarkar 1996).
- The variance inflation factor is estimated for each latent variable. Values above 10 denote multicollinearity problems, and they occur when any item included in a latent variable can be predicted from other latent variables (Vu et al. 2015).
- We perform the condition number test by analyzing eigenvalues from the correlation matrix of items included in the latent variables. Values higher than 100 are indicators of multicollinearity (Chennamaneni et al. 2016).

4.5 Stage 4. Descriptive Analysis of Data and the Sample

Once the database is screened and outliers and missing values are removed, we perform a descriptive analysis of the sample. This analysis examines demographic data of respondents and participating companies.

4.5.1 Descriptive Analysis of the Sample

Information on the sample is presented in crosstabs and pie charts (Rossi and Mirtchev 2016). Contingency tables are used to picture the interrelation of two variables. In this research, we analyze the types of industries surveyed and their size, based on the number of employees that they have. Likewise, we associate the percentage of female and male participants with years of work experience. Finally, we analyze the job positions of respondents to determine accuracy of data.

4.5.2 Descriptive Analysis of Items

Items analyzed are those included in the administered survey. As previously mentioned, they account for Kaizen activities and benefits. The descriptive analysis of these items or variables highlights the importance of a well-screened database, otherwise, inferences and conclusions would not be accurate. Results from this evaluation are measures of central tendency and data dispersion.

4.5.2.1 Central Tendency Measures

As previously discussed, the survey is answered with a five-point Likert scale for subjective assessments. Since this is an ordinal scale, we consider the median as the measure of central tendency of items (Silver 2007). In other words, arithmetic mean should not be used in ordinal scale variables. Other studies have also relied on the median as a measure of central tendency, especially in supply chain and continuous improvement environments (García-Alcaraz et al. 2014a, b).

In this research, values of the median should range from 1 to 5. Therefore, according to (Clark-Carter 2010):

- High values indicate that a Kaizen activity is always carried out or a Kaizen benefit is always obtained.
- Low values indicate that a Kaizen activity is never carried out or a Kaizen benefit is never obtained.

In this sense, we seek to obtain the highest values in Kaizen benefits, because they would imply better performance of companies. However, low values would denote failure to implement Kaizen philosophy in the production lines. As regards Kaizen activities, note that not all of them must be carried out to ensure benefits. In fact, companies seeking process optimization aim at obtaining the maximum amount of benefits by performing the least amount of activities.

4.5.2.2 Measures of Data Dispersion

In addition to the measure of central tendency, the measure of data dispersion is also important to know the distribution of data. This research estimates the interquartile range (IQR) as a measure of dispersion, which is often used in continuous improvement research. IQR is the difference between the upper and the lower quartiles, and it can be observed through box-and-whisker plots (Pérez-Vicente and Expósito Ruiz 2009). The following interpretations can be provided for IQR values (Batchvarov and Malik 2000) obtained in this work:

- All values should range between 0 and 4.
- High values imply great dispersion of data, and thus little consensus among respondents regarding the median value of an item.
- Low values are desired, since they reveal consensus among survey respondents regarding the median value of an item. For instance, if the IQR value of an item is 0, it means that all respondents rated the value equally.

4.6 Stage 5. Data Validation

The measures of central tendency and dispersion discussed above correspond to a univariate analysis of items. In this section we discuss the multivariate analysis performed to the same items. However, before performing such an analysis, data must be statistically validated. The following tests are used for the validation process.

4.6.1 Internal Validity, Cronbach's Alpha

The Cronbach's alpha (α) is a coefficient of reliability. It is a measure of the existing correlations among variables or items that pertain to a same construct or latent variable (Cronbach 1951). Statistically, the Cronbach's alpha is obtained from estimations of the variance—known as the traditional Cronbach's alpha—or from the correlations of items—known as the standardized Cronbach's alpha (Norman et al. 1997).

In this book, the Cronbach's alpha coefficient is used to measure internal consistency of the analyzed dimensions or latent variables. Likewise, it is viewed as the lower bound estimate of reliability, since it is a multivariate measurement. The value of the Cronbach's alpha must range from 0 to 1, since it is the ratio of two variances. Therefore, values close to 1 are desirable. A commonly accepted rule for describing consistency with the Cronbach's alpha is the following (Adamson and Prion 2013; Christmann and Van Aelst 2006):

- $\alpha \geq 0.9$: excellent
- $0.9 > \alpha \geq 0.8$: good
- $0.8 > \alpha \geq 0.7$: acceptable
- $0.7 > \alpha \geq 0.6$: questionable
- $0.6 > \alpha \geq 0.5$: poor
- $0.5 > \alpha$: unacceptable

In this research, we require a reliability of 0.70 or higher. However, the value of the Cronbach's alpha can be affected by factors such as sample homogeneity, time, survey size, and objectivity of responses (Leontitsis and Pagge 2007). Thus, in cases where reliability is lower than 0.70, we make modifications to the latent variables. In other words, using SPSS 21 software, we run simulations to identify items that should be removed to increase the Cronbach's alpha value. An item is removed from a latent variable when it might pertain to another latent variable. Thus, since the item was initially assigned to an incorrect dimension, its correlation with the other items is low (Adamson and Prion 2013).

4.6.2 Convergent and Discriminant Validity, Average Variance Extracted

Convergent and discriminant validity are considered as two subcategories of construct validity, also known as internal validity, which is measured by the Cronbach's alpha. While convergent validity demonstrates that constructs related are really related, discriminant validity (or divergent validity) shows that constructs that should *not* be related are actually *not* related (Hoyos and Riera 2013).

In this research, if data have both convergent and discriminant validity, the constructs have excellent internal validity. If any research proves both types of validity, its construct or constructs have outstanding internal validity (Scrima 2015).

On one hand, we use the average variance extracted (AVE) to determine convergent validity in each latent variable. AVE is computed using WarpPLS 5 software, and we require values equal to or higher than 0.5 (Fernández-Calderón et al. 2016). On the other hand, for discriminant validity, we compare the square root of AVE with the correlation coefficients of latent variables. Then, the square root of AVE must be higher than any correlation coefficient of latent variables, checked by row and column (Scrima 2015; Kock 2013). Software WarpPLS 5 is also used to estimate discriminant validity.

4.6.3 Predictive Validity, Correlation Coefficients

Since the objective of this book is to propose a set of structural equation models to understand the dependence between Kaizen activities and benefits, this dependence must be measured in order to know to what extent one activity explains a benefit (van den Besselaar and Sandström 2015). This research relies on three indicators to measure dependence between latent variables. They are known as indices of predictive validity and are listed below:

- *R*-squared (R^2): A latent variable that can be explained by another latent variable is considered a dependent latent variable. Every dependent latent variable shows an R^2 value to indicate to what extent it is affected by independent latent variables. R^2 is a measure of parametric predictive validity, and in this research we require values above 0.2 (Peters et al. 2015).
- Adjusted *R*-squared: this is another measure of parametric predictive validity. Unlike the R^2, it considers the sample size. The difference between the *R*-squared and the adjusted *R*-squared should not be greater than 5 %, otherwise there is a problem with the sample size (Zongo et al. 2016).
- *Q*-squared (Q^2): this is a measure of non-parametric predictive validity. *Q*-squared values should be similar to *R*-squared and adjusted *R*-squared values. If these three indexes have similar values, which are also above 0.2, we can conclude that latent variables analyzed have enough predictive validity (Gartlehner et al. 2016).

4.6.4 Dillon–Goldstein Rho Index, Composite Reliability

Although the Cronbach's alpha is traditionally used as a measure of internal validity, several observations have been made to its reliability. To increase the quality of the study, we thus employ the Dillon–Goldstein index to support estimations (Evans et al. 2016). As in the Cronbach's alpha, we require Dillon–Goldstein values higher than 0.7.

4.7 Stage 6. Latent Variables Modeling

Through this book we talk about latent variables, but so far we have not provided an appropriate definition of them. Statistically speaking, latent variables are known as dimensions, although they can be also referred as constructs. Latent variables are formed by a set of observed variables (Schulze et al. 2015; Spirtes 2015). For instance, if we seek to assess managerial commitment as a latent variable, we must first assess other variables. The same thing occurs when studying factors such as the intelligence quotient, when different elements must be first observed.

Similar latent variables are integrated in the structural equation models that we propose in the final chapters, and such latent variables can be constructed through different methods. If we take the example of the Kaizen planning phase (see survey attached in the Appendix section) although we report 14 Kaizen planning activities, we still do not know how many of these items will remain in the latent variable. Therefore, in order to identify the items to be integrated into the different latent variables, we perform a factor analysis. In this sense, we base our research on the work of (García et al. 2013a).

For every Kaizen implementation phase (i.e., planning, execution, control), we perform a factor analysis of items reported in Chap. 3 using software SPSS 21. The aim of this analysis is to reduce the number of observed variables (items) included in every phase, which is reported by (García et al. 2013a). Thus, if Kaizen planning phase initially consisted of 14 items, the factor analysis would reduce the number of these items without decreasing variability. In other words, factor analysis aims at identifying latent variables that can explain the whole process with the minimum amount of variables (Chen and Gan 2014). The main advantage of this method is that we do not need to monitor all the observed variables, since only those identified as essential require our attention. For this reason, factor analysis is often referred as a technique for dimensionality reduction.

The following methods are used to assess the efficiency of factor analysis in this research (Haidari et al. 2016):

- Correlation matrix: We calculate the correlation matrix of all items included in the three Kaizen phases. Items showing high correlation are generally integrated in a single latent variable.
- Determinant number of the correlation matrix: Since the matrix has values close to 0, a determinant close to 1 indicates that the correlation matrix is similar to an identity matrix, where correlations among items are low.
- Kaiser-Meyer-Olkin (KMO): It is a measure of sampling adequacy, and its value ranges from 0 to 1. This research seeks KMO values equal to or higher than 0.8 (Rostami et al. 2016) for a satisfactory factor analysis to proceed. A KMO value around 0 means that items analyzed are not correlated; thus, the factor analysis is not feasible.
- Bartlett's test of sphericity: It compares the correlation matrix with an identity matrix (Jung 2013). If the identity matrix equals the correlation matrix, the factor is not feasible. However, since hypothesis tests are validated through a Q^2 distribution, we can associate a p value to each test.
- To perform the factor analysis, this research also follows the procedure described below (Kock 2013):
  - Promax rotations are used, since the latent variables must be integrated into the structural equation models. We thus seek correlation among them, which does not occur in Varimax rotations.
  - As extraction method, we use the maximum likelihood estimation (MLE), due to the scale used to assess the survey items.
  - The correlation matrix is analyzed, since it simplifies interpretation of data.

– To determine the number of factors or latent variables composing each Kaizen implementation phase, we took eigenvalues higher than 1.

As previously mentioned, the factor analysis process is not discussed in the result section, since it has been previously reported in the work of (García et al. 2013c; García et al. 2014a). Therefore, we use the latent variables and their observed variables in the way they are described in Chap. 3, where each Kaizen implementation phase is divided into latent variables.

4.7.1 Stage 7. Hypotheses and Models

Once latent variables have been integrated, hypotheses to relate Kaizen activities with Kaizen benefits can be proposed. Since these latent variables are composed of observed variables, we employ the structural equation modeling (SEM) technique. A structural equation model is a multivariate analysis technique, where multiple variables explain other multiple variables. For this reason, SEM is considered a third generation regression technique (Inman et al. 2011).

The three main components of a path diagram with SEM are (Su and Yang 2010):

- Ellipses: They indicate latent variables (i.e., constructs or dimensions)
- Rectangles: They indicate an observed variable. Several observed variables form a latent variable
- Arrows: They show association, point in one direction, and indicate direction of prediction (hypotheses).

Figure 4.1 depicts a structural equation model associating two latent variables through an arrow, which indicates the direction of the prediction or hypothesis. Such an hypothesis can be stated as:

H_1 The independent latent variable has a direct and positive impact/effect on the dependent latent variable.

Note that structural equation models developed in this book are not as simple as Fig. 4.1. They are more complex, since they associate four latent variables. To ensure their understanding, Fig. 4.2 introduces a more elaborated model associating three latent variables. In this case, note that latent variable 2 is both dependent and independent. On one hand, it depends on latent variable 1. On the other hand, it explains latent variable 3.

Figure 4.2 also illustrates four hypotheses. Three of them are depicted as solid arrows, while the fourth is a dotted line. Dotted lines indicate that one latent

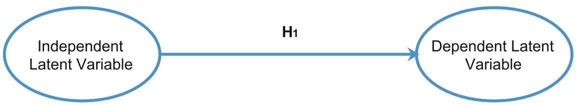
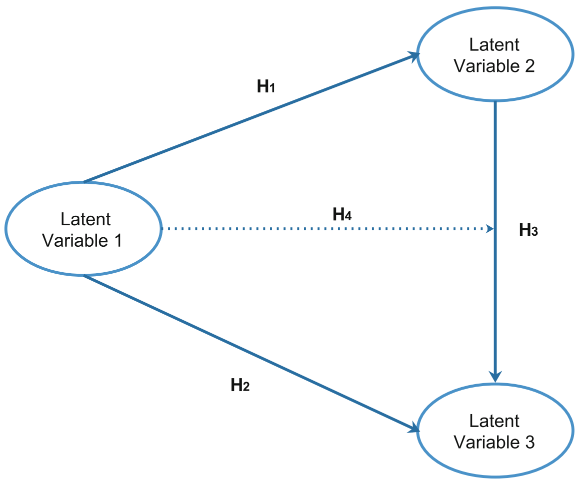


Fig. 4.1 SEM with one hypothesis

Fig. 4.2 Complex SEM



variable acts as a moderator and alters the causal relationship between two latent variables. As can be observed, there are many effects between latent variables. First, latent variable 1 has a direct effect on latent variable 2 and latent variable 3. However, there is also an indirect effect between latent variable 1 and latent variable 3 caused by latent variable 2 (mediator variable) (Lee 2016). Likewise, latent variable 1 is a moderator in the relationship between latent variables 2 and 3. From this we can conclude that different types of effects can occur among latent variables:

- Direct effects: represented by the hypotheses
- Indirect effects: caused by a mediator variable
- Total effects: sum of direct and indirect effects between two latent variables
- Moderator effect: one latent variable affects the causal relationship between two other latent variables.

4.7.2 Direct Effects

As their name suggests, direct effects occur directly from one latent variable to another, and they serve to represent the proposed hypotheses (Effendi and Kusmantini 2015). For instance, Fig. 4.1 shows only one direct effect between the independent and dependent latent variables. Nevertheless, we can observe three direct effects among latent variables in Fig. 4.2.

In order to construct model hypotheses, it is important to follow certain rules, such as timing and cause-consequence of events (Chikaraishi et al. 2015). If we take the example of market acceptance, we must know what comes first and what comes later, or what came before. This implies being strongly familiar with the theoretical and empirical literature of our research. Therefore, in the case of market acceptance, it depends on product quality and price. Another example is the impact of human resources development on product quality. First, there is training; then, the product is generated. This type of analysis is important, since it helps determine the sequence of events and the direction of hypotheses.

Each direct effect shows a beta value (β). In fact, β is a regression coefficient, and it indicates how much of a difference in latent variable 2, results from a one unit difference from latent variable 1 (Chikaraishi et al. 2015; Ellis et al. 2012). Thus, if we find $\beta = 0.5$ in any direct relationship, it means that very time latent variable 1 increases its standard deviation by one unit, the standard deviation of latent variable 2 increases by 0.5 units. To validate the β coefficient of every hypothesis, we perform statistical hypothesis tests. In this research, each β value is associated with a p value, which is always analyzed to test the null hypothesis, where β equals 0, versus the alternative hypothesis, where β is different from 0, (Inman et al. 2011). These hypotheses can be statistically expressed as: H_0: $\beta = 0$ y H_1: $\beta \neq 0$.

P values can be either positive or negative. Positive values mean that every time latent variable 1 increases its standard deviation by one unit, the standard deviation of latent variable 2 also increases. Negative values indicate the opposite. That is, if latent variable 1 increases its standard deviation by one unit, the standard deviation of latent variable 2 decreases (Lu et al. 2007).

Finally, hypotheses proposed and validated are statistically significant at a 95 % confidence interval. This means that we require p values lower than 0.05 in order to consider one hypothesis as statistically valid (Fornell and Larcker 1981). Note that the confidence interval and the significant level together must sum 100 %.

4.7.3 Indirect Effects

Indirect effects between two latent variables occur through a third latent variable known as mediator variable (Rouquette et al. 2015). As we have previously discussed, Fig. 4.2 shows a direct effect from latent variable 1 on latent variable 3 (see the solid line). However, the two latent variables are also related through latent variable 2, although in this case, two arrows or segments are needed. The product of the direct effects of both segments is known as indirect effects.

Indirect effects can involve two or more segments, depending on the model's complexity. Some indirect effects occur through up to five latent variables, which means six segments (Copriady 2015). When many latent variables are involved in an indirect effect, such an effect is often statistically not significant. However, two or three latent variables can provide a statistically significant indirect effect (MohammadZadeh and Saghaei 2009).

This research makes inferences on indirect effects based on a 95 % confidence interval. Thus, as in the previous section, we require p values lower than 0.5 in order to consider an indirect effect between two latent variables as significant.

4.7.4 Total Effects

Total effects can be easily interpreted, since they are the summation of direct and indirect effects between two latent variables. As in the previous cases, total effects are also validated with the hypothesis test associated with each β value. Therefore, p values for total effects must be lower than 0.5. Finally, total effects equal direct effects when indirect effects do not occur in the relationship, or when they are not statistically significant. However, it is also possible for total effects to equal indirect effects when direct effects are statistically insignificant.

4.7.5 Moderator Effects

Figure 4.2 depicts a moderator effect through a dotted arrow coming out of latent variable 1 and pointing at the middle of the arrow that connects latent variables 2 and 3. As previously mentioned, latent variable 1 alters the causal relationship between latent variables 2 and 3. In other words, the presence of latent variable 1 influences on the magnitude and direction of the β parameter associated with the relationship between latent variables 2 and 3 (Lin et al. 2005; Swink 2000).

β values from a moderator effect can be either positive or negative. Positive values indicate that the moderator variable increases or strengthens the relationship between two latent variables. Negative values, on the other hand, imply that the moderator latent variable decreases or weakens such a relationship (Rouquette et al. 2015; Goodhue et al. 2012).

To validate hypotheses regarding moderator effects, we perform the statistical hypothesis test with the p value. As in all previous cases, relationships must be significant at a 95 % confidence level, which is why we require p values lower than 0.05.

4.7.6 Effects Size

In every dependent latent variable, it is possible to estimate its amount of variance. The variance of a dependent latent variable depends on one independent latent variable or more (Goodhue et al. 2012), and it can be estimated with a R^2 value, which is a measure of explained variance.

In Fig. 4.2, latent variable 2 is explained by only one independent latent variable: latent variable 1. Thus, R^2 must not be decomposed. However, note that latent variable 3 is explained by both (independent) latent variables 1 and 2, since the two have a direct effect on it. In this case, the R^2 value must be decomposed in order to estimate to what extent each independent latent variable is responsible for the variance. Each portion of explained variance in a dependent latent variable is known as an effect size (Cohen 1988). The sum of all effect sizes in a same dependent latent variance equal its R^2 value.

If we assume, as an example, that latent variable 3 is 68 % explained by latent variables 1 and 2, and latent variable 1 can explain 40 % of the variance; then, latent variable 2 is responsible for the remaining 28 %. Decomposing the variance is important for identifying which independent latent variable is more important for explaining a dependent latent variable. The more one independent latent variable explains the variance of a dependent latent variable, the higher the effect size and the β value are.

4.8 Model Efficiency Indices

Before interpreting the structural equation models, it is important to make sure that values obtained are valid. Since SEM is a third generation regression technique, several indices are employed to measure the efficiency of models. This research runs the models using software WarpPLS 5. The model efficiency indices used are the following (Kock and Lynn 2012):

- Average path coefficient (APC): This research establishes a 0.05 criterion for the p values. APC represents the average value of all β values associated with the direct effects between latent variables in a model.
- Average R-squared (ARS): We also establish a 0.05 criterion for p values in ARS. This coefficient represents the average value of the variance explained in latent variables.
- Average adjusted R-squared (AARS): It has a similar interpretation to ARS. Nevertheless, it is sensitive to the sample size. Between ARS and AARS, the difference should not be higher than 5 %, otherwise we might be working with a small sample.
- Average block VIF (AVIF): It is used to measure lateral collinearity. Its value increases every time new latent variables are added to the regression model. It is widely advised to accept AVIF values lower than 3.3. However, those close to 5 are also acceptable.
- Average full collinearity VIF (AFVIF): It is similar to AVIF, and its value is also altered when adding new latent variables to the model. AFVIF is used to measure multicollinearity. As in AVIF, values lower than 3.3 are recommended, although those close to 5 are equally acceptable.
- Tenenhaus GoF (GoF): It is known as the goodness of fit index and is used to measure the model's explanatory power. Tenenhaus GoF is based on the communality of items. Values higher than 0.36 are recommended, while values lower than 0.1 are not acceptable.
- Sympson's paradox ratio (SPR) = 1.000: This phenomenon occurs when a trend appearing in different groups of data disappears when such groups are combined. This may be due to an incorrect direction of the dependence when the

hypothesis is incorrectly constructed. 0.7 is an acceptable SPR value, although 1 is the ideal value.

- R-squared contribution ratio (RSCR): This index measures whether the model is free from negative R-squared contributions, which are also associated to the SPR index. RSCR values must be higher than 0.9, while the ideal value is 1. If the value is lower than 0.9, we need to reconsider the direction of the dependence in the hypotheses.
- Statistical suppression ratio (SSR): It indicates whether the model is free from statistical suppression. Statistical suppression occurs when the absolute value of the β coefficient is higher than the correlation between two associated latent variables (Tanur 2015). The ideal SSR value is 1, while those below 0.7 are acceptable.
- Nonlinear bivariate causality direction ratio (NLBCDR): This is the last index assessing the model's efficiency. It indicates whether the β coefficients associating two latent variables vary when using non-linear algorithms for their estimation, considering the direction and sense of hypotheses, since β coefficients are higher in one sense. The ideal NLBCDR value is 1, while values below 0.7 are acceptable.

Chapter 5
Descriptive Analysis of the Sample

As mentioned in the previous chapter, one important part of this research is the descriptive analysis of the sample's characteristics. This chapter presents a set of contingency tables that detail the main characteristics of the studied companies. Information here provided is obtained from the demographic section of the survey.

A descriptive analysis of the sample is important for finding patterns and trends that may be specific to a single type of industry, since as it is known, the manufacturing sector in Ciudad Juárez comprises many industrial subsectors, including automobile and the electronics industries, the two most prominent. Results provided in this chapter come from a screened database containing information gathered during a year. Details about the sample are provided below.

5.1 Surveyed Industries

As previously mentioned, this research studied different types of manufacturing industries. Table 5.1 compares the surveyed industrial subsectors with the size of companies, considering the number of employees that they have. Similarly, the third column includes the frequency percentage, while the fourth one stands for the cumulative percentage.

As can be seen, 423 participants are interviewed. Note that 211 surveys are administered in the automobile industry, which represents 49.9 % of the sample. Likewise, the machinery industry ranks second with 69 surveys provided, representing 16.3 % of the sample. Similarly, the logistics sector includes the packaging industry, which, in this study, represents 14.7 % of the sample, with 62 collected surveys. These three sectors account for 80.9 % of the total sample, which reflects the distribution of companies located in Ciudad Juárez.

Less prominent subsectors include textile, electronics, and plastics industries. However, this does not diminish their significance to the economy of the region. In this study, these three industrial subsectors account for 19.1 % of the total sample.

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Table 5.1 Industrial subsectors analyzed

Subsector	Frequency	Percentage	Cumulative percentage
Automotive	211	49.9	49.9
Machinery	69	16.3	66.2
Logistics	62	14.7	80.9
Electrical	44	10.4	91.3
Plastics	29	6.9	98.1
Textile	8	1.9	100.0
Total	423	100.0	

5.2 Size of Companies

In Mexico, the number of employees is the most important classification to determine the size of a company. Table 5.2 shows the size of industries surveyed. The first column of the table includes the classification criterion, while the second one indicates the number of companies that belong to this category (frequency). Similarly, the third column includes the frequency percentage, whereas the fourth one shows the cumulative percentage.

According to the table, most employees work in large companies, since 259 reported this information, which represents 61.2 % of the sample. Also, note that 71 (16.8 %) participants belong to companies that have between 201 and 500 employees. Thus, it can be concluded that the majority of the companies studied are large, and they account for 78 % of the total sample. Similarly, only 40 surveys (9.5 %) belong to organizations having less than 50 employees. Finally, to improve interpretation of data, Table 5.3 shows the size of companies for each one of the industrial subsectors. As in the previous section, the automobile industry outstands thanks to the 185 large companies surveyed, which is the highest recorded frequency and represents 43.73 % of the total sample.

Table 5.2 Size of surveyed companies

Criterion	Frequency	Percentage	Cumulative percentage
Less than 50	40	9.5	9.5
Between 51 and 100	13	3.1	12.5
Between 101 and 200	40	9.5	22.0
Between 201 and 500	71	16.8	38.8
More than 500	259	61.2	100.0
Total	423	100.0	

Table 5.3 Size and subsector of companies

Category	Subsector						Total
	Textile	Automotive	Electrical	Plastics	Machinery	Logistics	
Less than 50	2	8	1	0	2	27	40
51–100	1	1	1	5	0	5	13
101–200	3	3	10	2	8	14	40
201–500	0	14	13	17	21	6	71
More than 500	2	185	19	5	38	10	259
Total	8	211	44	29	69	62	423

5.3 Genre and Years of Experience

It is important to validate reliability of information by considering the experience of participants. Table 5.4 introduces results obtained regarding the sample's genre and years of experience in their current job positions. The table shows that 110 respondents are female, while 313 are men, representing 26 and 74 % of the sample, respectively.

As regards work experience, the majority of the sample has between 2 and 5 years, while the second place is held by 125 participants who have between 5 and 10 years. Both categories account for 60.75 % of the total sample. Thus, it is concluded that information has been gathered from participants who are experienced enough in Kaizen implementation and continuous improvement. Finally, note that 93 respondents have more than 10 years of experience, while 73 have no more than two, representing 21.98 and 17.26 % of the sample, respectively.

5.4 Work Positions

The positions of respondents are important to ensure a homogenous sample, which must comprise all the areas involved in continuous improvement groups. Executives are not the only responsible for Kaizen implementation. Improvements require leadership from engineers, who know the production problems, operators, who transform the raw materials, technicians, administrative staff, and department managers. Table 5.5 shows the job position of respondents for each industrial subsector.

Table 5.4 Genre and years of experience

Experience	Female	Male	Total
Less than 2 years	22	51	73
2–5 years	38	94	132
5–10 years	34	91	125
More than 10 years	16	77	93
Total	110	313	423

Table 5.5 Surveyed positions and subsectors

Job Position	Textile	Automotive	Electrical	Plastics	Machinery	Logistics	Total
Engineer	1	46	12	5	10	13	87
Technician	2	44	5	8	20	6	85
Operator	1	46	6	5	2	8	68
Supervisor	2	33	7	0	12	8	62
Manager	2	17	4	5	14	11	53
Administrative staff	0	17	9	6	6	7	45
Overseer	0	8	1	0	5	9	23
Total	8	211	44	29	69	62	423

Despite their different jobs, all participants are continuous improvement group leaders. As can be observed from the table, engineers and technicians account for 40.66 % of the sample, with 87 and 85 respondents, respectively. Similarly, 45 participants hold administrative positions, while 53 are company managers. Leadership from managers in improvement groups denotes their commitment to improving the organization.

Finally, note that due to constant employee turnover and promotions, 23 companies do not have an official name for the position that leads a certain area. In these cases, respondents reported themselves as "overseers."

5.5 Conclusion

This chapter analyzes the main characteristics and attributes of the sample. Results from this analysis conclude the following:

- In total, 423 participants responded the survey. All of them work in the manufacturing sector.
- The automotive industry is the most prominent industrial subsector, representing 49.9 % of the sample.
- The machinery industry is the second most prominent subsector.
- Most surveyed companies are large. In this sense, 259 participants work in organizations that have more than 500 employees.
- Despite the efforts made toward gender quality at work, most respondents are men. In total, 313 are male participants, while 110 are female.
- Participants have enough experience in Kaizen and continuous improvements. In total, 132 participants have from 2 to 5 years of experience, while 125 have 5–10 years. Also, 93 participants have more than 10 years of experience leading improvement groups in production lines.
- As regards work positions, engineers and technicians are the most prominent jobs, since these workers commonly supervise production operators.

Chapter 6
Descriptive Analysis of Items: Kaizen Planning Stage

As previously mentioned in Chap. 4, Kaizen implementation is divided into three stages: planning, execution, and control. This chapter addresses the descriptive analysis of the 14 survey items reported at the planning stage. Measures of central tendency and deviation are also presented to discuss the frequency at which Kaizen planning activities are carried out in the manufacturing companies of Ciudad Juárez.

As regards the measure of central tendency, the median value of each item is estimated, since we deal with ordinal data. Thus, the arithmetic mean cannot be used. Similarly, the interquartile range (IQR) is used as a measure of data dispersion. IQR is the difference between the 75th percentile and the 25th percentile.

Table 6.1 shows the 14 items included at the Kaizen planning stage. They are ranked in descending order according to their median values (second quartile). Also, the last column includes the IQR values.

Based on the indicators obtained, the following section describes these activities in terms of their frequency of implementation in the manufacturing industries surveyed.

6.1 Improvement Groups Set Goals to Comply with Improvement Programs

This activity ranks first according to its median value (4.079), which is higher than 4. This means that companies frequently establish goals to be achieved with Kaizen implementation. This result is not surprising since it is impossible to improve something without having in mind what needs to be changed and to what extent. Thus, it is important to establish goals that can be clearly and quantitative measured, linking the company's environment and the current situation with the variables that are being monitored. It is the only way to successfully set an improvement goal (Cheser 1994; Bond 1999).

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Table 6.1 Descriptive analysis of items—Kaizen planning stage

Activities	Percentiles			IQR
	25th	50th	75th	
Improvement groups set goals to comply with improvement programs	3.180	4.079	4.806	1.625
The company is seen as a learning organization	3.184	4.078	4.795	1.611
The company sets policies, objectives, and the structure of Kaizen events	3.136	4.063	4.797	1.661
Customers' opinions are taken into account when making changes	3.007	4.040	4.812	1.805
Members of improvement groups are skilled and experienced	3.225	4.033	4.738	1.513
Suggestion groups are organized in order to improve products and processes or to solve problems	3.145	4.028	4.776	1.631
The management department plans the acquisition of all the resources needed for improvement programs (financial resources, physical space, time)	3.071	3.983	4.769	1.697
The company develops a continuous improvement culture	3.065	3.983	4.755	1.690
The company has a structure to detect failures	3.118	3.960	4.722	1.605
The company has groups to support Kaizen execution	2.889	3.956	4.764	1.876
Production operators and administrative staff are trained	3.006	3.910	4.722	1.715
The management department is trained in teamwork and problem-solving skills	2.964	3.862	4.679	1.715
Improvement teams are heterogeneous	2.812	3.774	4.642	1.830
Work teams are committed and motivated	2.809	3.726	4.600	1.791

Also, for each goal companies must assign a person in charge of monitoring the involved variables and parameters and schedule a due date to present results. Setting goals is perhaps the most critical step of the Kaizen planning phase, as it can determine the company's future (Suárez-Barraza and Miguel-Dávila 2014; Suárez-Barraza1 and Lingham 2008). Therefore, improvement group leaders and managers must offer strong leadership, although they will eventually delegate some authority to improvement and work teams. Unfortunately, if goals are not established, work teams may waste their time and energies to reach objectives that, in the end, will not be approved by the top departments (Martin and Osterling 2007; Jeff 2005).

6.2 The Company is Seen as a Learning Organization

To improve, organizations need knowledge of their past experiences to establish goals, thus avoiding failures and unfavorable situations (Hussein et al. 2016). This activity has a median value of 4.078. Note that it is only one thousandth of a unit lower than the previous item. Therefore, if the analysis considered only two decimal digits, both item 1 and item 2 would be tied.

It is not easy for companies to promote a learning community. Limitations and obstacles mainly include social and cultural variables. Moreover, employee turnover ought to be as little as possible to ensure employee retention (Peters et al. 2016; Hussein et al. 2016).

A company that does not learn or has no memory reflects a serious administrative problem. It means that there is high level of employee turnover, or even managers often leave/change their positions. Unfortunately, when this happens, goals change very frequently (Sujan 2015), and the issue worsens amid turnover of production operators, since they are the experts in the production lines that generate the desirable product.

Also, companies with high levels of employee turnover lose knowledge that can be transformed into value added to products (Gagnon et al. 2015; Dekoulou and Trivellas 2015). Moreover, satisfaction decreases, since production operators lack effective integration (Dekoulou and Trivellas 2015; Hatane 2015).

6.3 The Company Sets Policies, Objectives, and the Structure of Kaizen Events

This item has a median value of 4.063, and it is closely linked with the first activity. Kaizen policies, objectives, and a Kaizen structure, require more specific actions to determine how activities will be carried out to achieve improvements, and which resources or channels will be used.

As regards Kaizen policies, companies must follow a series of procedures to achieve the goals that were initially established. However, it is also important to ensure a Kaizen structure by assigning specific tasks and responsibilities to each member of the continuous improvement groups (Audenino 2012). The executive department must support leaders selected among these groups, since it is important for both to maintain a close relationship that ensures effective communication.

Certain authors have argued that Kaizen organizational structures and communication channels within improvement groups help ensure a proper information flow. Furthermore, when someone needs assistance, everyone knows who the appropriate person to reach is, since responsibilities are clearly communicated and established (Rico and Cohen 2005).

6.4 Customers' Opinions are Taken into Consideration When Making Changes

This activity ranks fourth in the univariate descriptive analysis, and it has a median value of 4.040. Customers' opinions are important since clients must be the focus of every improvement project, otherwise Kaizen implementation is not justifiable (Kerrin 2002).

Many times Kaizen has improved and strengthened company–customer relationships in the service industry, and this becomes a quick indicator of the quality of the service provided (Striteska and Jelinkova 2015; Wouters and Kirchberger 2015). Ignoring customers' voice while implementing Kaizen or any other LM tool can be interpreted as a business suicide. Customer-oriented activities is a nonwritten policy that must always be followed as a means to improve economic profits (Fodness and Murray 2007). Therefore, companies must find the way of meeting customers' needs and knowing their expectations.

6.5 Members of Improvement Groups are Skilled and Experienced

This is another important characteristic to make meaningful improvements. It is the fifth item of the descriptive analysis and has a median value of 4.033, only seven decimal digits below the first item.

The importance of having skilled and experienced work teams mainly relies on their problem-solving capabilities. Without knowledge and expertise, problems may be incorrectly formulated and, thus, incorrectly identified. This means that, in the end, improvement teams would be trying to solve an issue that does not really exists as they think.

Skills and knowledge are strongly related to education and training. However, experience gained over time is also essential, and it is achieved with the participation of production operators and continuous improvement group members (Hashimoto et al. 2010). As a conclusion, being skilled is the characteristic of an improvement team leader, while experience refers to the events that production operators have lived (Ortiz 2009).

6.6 Suggestion Groups are Organized in Order to Improve Products and Process and to Solve Problems

This is the sixth item with a median value of 4.028, which indicates that surveyed companies very often organize groups to seek for improvement opportunities and solve problems.

Quality circles emerged in Japan and are the basis of Kaizen events. Initially, they were participatory groups organized by production operators who sought to address and solve a particular issue. However, quality circles have evolved so fast that now they are not exclusive to production systems. Administrative systems and service departments also rely on this technique in order to improve their current processes (Lillrank and Kanō 1989).

With slight variations, quality circles have been implemented in many companies from different countries (Jin and Doolen 2014). However, their organization must be the executive's initiative, until positive results are obtained and employees see improvements achieved, which become a habit and promote an improvement-focused culture. After this, it will no longer be necessary to organize operators, since they will be autonomous in addressing and solving problems (Kuşcu et al. 2015).

6.7 The Management Department Plans the Acquisition of All the Resources Needed for Improvement Programs (Financial Resources, Physical Space, Time)

This item has a median value of 3.983, and it is the first one lower than 4. Since it is only 17 thousandths below the first item, it can be concluded that managers of the surveyed companies always carry out this activity when planning Kaizen implementation.

Kaizen members tend to measure managerial commitment based on the resources that managers can provide, which is why the biggest investments are usually made at the initial stages of Kaizen implementation. However, managers must pay special attention to the provision and distribution of the financial support. Similarly, they are responsible for providing a comfortable and adequate physical space for the groups' performance and meetings. Also, these meetings must be organized, delimiting time and frequency at which they will be carried out, since they usually occur during working hours (Brunet and New 2003).

6.8 The Company Develops a Continuous Improvement Culture

This may be the most important activity when analyzing future plans and long-term goals. A company under a continuous improvement culture does not depend on its leader's directions, as it has the initiative and willingness of its operators to solve problems. This item ranks eighth with a median value of 3.983, although it has the same value that item 7. As in the previous case, even though the value is below 4, surveyed companies generally work under a continuous improvement culture.

At the initial stages of Kaizen implementation, managers are responsible for promoting and ensuring a Kaizen culture; nevertheless, over time, this activity should be delegated to continuous improvement group leaders and members (Hohan et al. 2015). For this reason, it is very important to keep employees motivated by sharing the results obtained and through some type of reward system (Cumbler et al. 2016). However, companies often encounter obstacles in the process of developing a new culture. The most notorious is resistance to change when production operators who wish to maintain the "status quo" (Lodgaard et al. 2016).

6.9 The Company has a Structure to Detect Failures

This item holds the ninth place in the descriptive analysis with a median value of 3.960. If companies are incapable of properly identifying errors and failures that deserve improvements, they may be trying to fix problems that do not really exist in the production system (Mandic et al. 2014).

There is not a specific organizational structure to solve problems in production systems. Sometimes Kaizen group members identify errors and failures by themselves, and they later communicate them to team leaders who, in turn, decide on their relevance and level of priority (Gou et al. 2016). Some companies implement this dynamic because managers usually know the strategic policies, and when they are informed of the problems, they are able to establish a priority system of projects to be solved, while meeting operator's needs and complying with the company's mission and vision.

However, in other organizations, middle managers serve as intermediaries between the production lines and the executive department. They must set the priorities and preference levels for each project to be carried out and problem to be solved (Mandic et al. 2014).

6.10 The Company Organizes Groups to Support Kaizen Execution

This is the tenth activity with 3.956 as median value. Support groups are important, because they provide assistance to Kaizen groups. They are composed of Kaizen experts that have access to the required information. Moreover, these professionals can help analyze such information with the help of specialized software, which may be unfamiliar to group members (El-Mekawy et al. 2015) but is a helpful tool for identifying trends in the process.

Other important kinds of support include ensuring a clean space for the meetings and providing all the required materials to work. Even though leaders of Kaizen groups are responsible for resources management, other support groups are usually in charge of these activities (Baril et al. 2016).

6.11 Production Operators and Administrative Staff are Trained

This item ranks eleventh in the descriptive analysis. Its median value being 3.910 implies that surveyed companies very frequently train their operators and administrative personnel when implementing a Kaizen project. Training is important since it is the basis of progress for any company and continuous improvement.

Executives and Kaizen or continuous improvement group leaders are responsible for this activity. Since they are familiar with the company's deficiencies and learning needs, they thus ensure and provide the appropriate training and education to every employee (Hussein et al. 2016).

Training and education are also a source of motivation to employees, who evaluate managerial commitment based on the resources that managers provide (Ortiz 2009). Similarly, some authors argue that the company must guarantee the best tools and resources to solve problems, and one of these tools includes training in different work skills (Cumbler et al. 2016). Moreover, if an organization fails to provide education and training, it will soon become obsolete and will have little participation from operators, thus losing sustainability in the projects initiated (Higuchi et al. 2015b).

Finally, the first things to be taught when planning continuous improvement projects must be Kaizen techniques, since employees usually lack knowledge on the philosophy regarding its scope as a lean manufacturing tool (Mano et al. 2014). Unfortunately, this is one of the major limitations for its successful implementation (Maarof and Mahmud 2016).

6.12 The Management Department Is Trained in Teamwork and Problem-Solving Skills

This is the twelfth item of the list with 3.862 as median value. It is thus concluded that manufacturing companies surveyed frequently provide training to executives and managers when planning a Kaizen project.

One may have expected a higher place in the classification, since top managers are those who share their knowledge and experiences with the rest of the organization (Taleghani 2012). Therefore, a management department with poor training in work techniques and problem-solving skills communicates little confidence to production operators. Furthermore, there is a strong relationship between manager's education and their creativity (Mobarakeha 2011), although their success also depends on their disposition to learn new things (Taleghani 2012).

Finally, it is important to mention that education and training for managers of Mexican manufacturing companies are usually offered in the facilities of the parent companies, where language is often a limitation. Therefore, in the Mexican context, proficiency in English must be a requirement for senior and middle managers. For this reason, companies must encourage hard work and creativity in the minds of administrators, since other studies have found a strong connection between time invested in training and firm performance (Esteban-Lloret et al. 2014).

6.13 Continuous Improvement Groups Are Heterogeneous

This item occupies the penultimate position in the list. It has a median of 3.774, indicating that in the surveyed manufacturing companies Kaizen groups are very frequently heterogeneous.

Improvement groups go against the high levels of specialization of some other groups, as the company is an organism in which each department and individual represents an essential part of an integrated system (Colenso 2000). If improvement groups were highly specialized, they would be very homogeneous. However, solutions to problems affect other departments (Sandoval-Arzaga and Suárez-Barraza 2010). Thus, multidisciplinary groups can guarantee holistic, system-focused solutions that benefit the whole company, not just a reduced number of people or a single department (Cooney and Sohal 2004).

Also, integration of these groups promotes interaction among members from different areas who approach problems differently. This stimulates the generation of new ideas and solution alternatives that enable to select the most appropriate and holistic one (Liu et al. 2015a). Finally, note that recent studies have shown that improvement groups are more efficient, thanks to their multidisciplinary focus, although they need a competent leader that is able to successfully integrate and focus them (Cumbler et al. 2016).

6.14 Work Teams Are Committed and Motivated

This is the last activity listed in the analysis. The item has a median value of 3.726, which suggests that continuous improvement groups of manufacturing companies in Ciudad Juárez are generally motivated when starting a Kaizen project.

On one hand, top managers and group leaders are responsible for a motivating environment. One way of promoting such a work climate is by sharing the results obtained from improvement projects with all employees (Recht and Wilderom 1998; Dwivedula and Bredillet 2010). Similarly, some companies have implemented diverse reward systems or incentive programs. Some of them include profit-sharing schemes, depending on the organization's savings and profits earned as a result of improvements achieved and their impact on problems solved (Farris et al. 2009a; Topuz and Arasan 2013).

On the other hand, to promote commitment among a continuous improvement group, it is important to create a work plan, scheduling every task, and clearly assigning them to group members. This helps have a clear view of who is responsible for what. However, this means that roles within the group have been previously and clearly established. This way, all group members are committed to their roles within the hierarchical structure of the group (Topuz and Arasan 2013).

6.15 Conclusions

As any other LM tool, Kaizen must be properly planned. This book identifies 14 activities that are important to successfully achieve this task. Some of the most important are:

- Companies must properly identify problems in the production process to be improved. This must be based on the statistical analysis of information.
- Every objective and goal in every improvement project must be clearly stated and fully understood by all hierarchical levels, especially improvement groups. Top managers must be the first to be convinced of Kaizen functionality, and they must communicate this by providing all the necessary resources for continuous improvement groups.
- Companies must implement education and training programs for production operators, since one of the main obstacles for Kaizen implementation is a lack of knowledge of work tools and techniques.
- Information flow along the organizational structures is important. Feedback must always be provided in order to improve production processes.

Chapter 7
Descriptive Analysis of Items: Kaizen Execution Phase

This phase comprises 24 activities. As in the previous stage, they are analyzed to know their corresponding measurements of central tendency and dispersion (the median and the interquartile range, respectively). Table 7.1 below lists the 24 items corresponding to the Kaizen execution stage. They are ranked in descending order according to their median values (second quartile). Also, the last column includes the IQR values.

7.1 Internal Processes are Efficient in Checking the Effectiveness of Proposed Solutions

This activity occupies the first place. Its median value equals 4.286 and indicates that this Kaizen activity is almost always performed in the manufacturing companies from Ciudad Juárez. As regards the interquartile range (measure of data dispersion) its value equals 1.624. This denotes moderate consensus among respondents regarding the median value of the item.

Without monitoring systems or processes, it would be impossible to know whether improvements have actually been achieved (Carvalho et al. 2015). Therefore, from the moment problems are identified and defined, it is important to set the metrics or measurements that would help assess the problem's variables. Then, such variables must be monitored and assessed after the intervention process by comparing their values before and after the solution (Joslin and Müller 2015).

When companies do not have mechanisms to assess the effectiveness of the solutions they implement in their production processes, they will not be able to identify whether improvements have actually been made. Clear improvement metrics, measurements or standards must be established from the Kaizen planning

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Table 7.1 Descriptive analysis of items—Kaizen execution phase

Activity	Quartile			
	Q1	Q2	Q3	IQR
Internal processes are efficient in checking the effectiveness of proposed solutions	3.327	4.286	4.951	1.624
Improvement groups include representatives of different disciplines	3.186	4.129	4.827	1.640
The company is customer-focused	3.229	4.125	4.818	1.589
The company follows a standard operating procedure (SOP)	3.159	4.116	4.838	1.679
The company has a well-defined organizational structure	3.189	4.071	4.785	1.596
The company follows specific methodologies to understand customers	3.118	4.049	4.788	1.670
The company relies on a quality management system to achieve customer satisfaction	3.096	4.028	4.776	1.680
The PDCA cycle (plan-do-check-act) is used as a Kaizen strategy	3.099	4.021	4.771	1.673
Managerial and departmental leadership	3.031	4.018	4.790	1.760
Job rotation is promoted	3.095	3.992	4.735	1.640
The intelligence and creativity of workers are used in a productive way	3.066	3.966	4.717	1.651
5S is implemented as a Kaizen strategy	3.020	3.960	4.734	1.714
The improvement approach is consistent with the organizational culture	3.044	3.925	4.694	1.650
The company focuses on critical processes that definitely influence Kaizen sustainability	2.777	3.886	4.751	1.974
An internal or external facilitator helps effectively coordinate the improvement program	2.917	3.878	4.692	1.776
Collaborators eagerly contribute to continuous improvement changes	2.966	3.841	4.651	1.685
Administrative staff and operators are self-disciplined	3.021	3.828	4.612	1.591
Employees are skilled and experienced	3.077	3.801	4.560	1.483
Human resources are integrated	2.788	3.739	4.604	1.816
Kaizen group members are acknowledged for their achievements and efforts in Kaizen events	2.693	3.697	4.569	1.877
Kanban is implemented as a Kaizen strategy	2.570	3.677	4.595	2.025
Employees are committed and motivated	2.589	3.668	4.582	1.993
Customer satisfaction is measured when implementing improvement proposals	2.535	3.619	4.552	2.018
Restrictions to implement the proposed improvement changes	2.734	3.600	4.443	1.709

phase, integrating the minimum and maximum accepted values, although sometimes a nominal value may be more appropriate (Petro and Gardiner 2015; Aga et al. 2016).

7.2 Improvement Groups Include Representatives of Different Disciplines

We have already discussed this element in the preceding chapter, where we deal with Kaizen planning phase activities. In this chapter, the median and IQR values of this item (4.129 and 1.640, respectively) indicate that this activity is very frequently carried out and survey respondents agree with its median value.

Multidisciplinary work groups are a guarantee that the analyzed problem would be seen from different points of view and criteria. Thus, ideas for its solution would be many and diverse, with several alternatives and proposals for integral and holistic solutions (Deering et al. 2011). However, note that, at this point, one important task of improvement group leaders is to homogenize ideas and avoid division, since this may lead to arguments, and there would be little consensus inside the work team. Remember that it is important to seek integral solutions for the company and not for a particular person or department (Ringquist 2015; van Veen-Berkx et al. 2015).

7.3 The Company is Customer-Focused

This item holds the third place in the list. As in previous cases, the median and IQR values of this item (4.125 and 1.589, respectively) indicate that this activity is very frequently carried out and survey respondents agree with its median value.

If improvement groups do not focus on providing solutions that are beneficial to customers, improvements implemented have no justification whatsoever. Instead, they are a waste of money and time for everyone. They imply costs that add no value, yet they will be added to the final product price (Abrell et al. 2016). This is why, although improvement projects are proposed by Kaizen groups, they should be approved by the senior management, who is more familiar with the corporate strategies and the business mission (Wang et al. 2016).

Companies without a customer focus are likely to fail. Even if they manage to improve their manufacturing processes, products would fail to meet the characteristics demanded by clients (Bole et al. 2016). Every improvement project must be customer-focused, since customers pay for the products. Customers are the reason why companies exist.

7.4 The Company Follows a Standard Operating Procedure (SOP)

This is the fourth activity from Table 7.1. It shows a median value above 4 (4.116), which indicates that standard operating procedures are a common trend in the manufacturing companies of Ciudad Juárez, who very frequently follow them. Also, the IQR value shows consensus among respondents regarding the median value of the item (IQR = 1.679).

Process and procedure standardization is important to the production process. Standardization supports task performance, monitoring, and control. In that sense, Kaizen is usually combined with 5S programs, in which the fourth activity aims at using standard procedures to confirm the condition of the improved process (Howell 2009).

Undoubtedly, standardization implies communicating to and showing the whole company how certain activities must be carried out. Examples of standardized procedures include preestablished forms for process reports, which must be handed into the right person through the appropriate channels (Weber 2015a). Standardizing procedures makes all improvement group members understand or have the same concept about what to do, which reduces mistakes and misunderstandings within the group (Zelinski 2005).

7.5 The Company Has a Well-Defined Organizational Culture

This is the fifth activity from Table 7.1. Again, we can observe a median value above 4 (4.071), which indicates that many manufacturing companies of Ciudad Juárez work under a well-defined organizational culture. Also, the IQR value of this item shows consensus among respondents regarding the median value, since IQR = 1.596.

Businesses must clearly define their organizational structure vis-à-vis suppliers, employees, and customers, since this facilitates the information flow. For instance, when employees know how the company is organized, each person knows what he/she does and what others do. Moreover, continuous improvement group members are familiar with the responsibilities of the senior management and the other departments (Iljins et al. 2015).

When we talk about organizational structure, we also refer to the structure of Kaizen groups. When continuous improvement group leaders—both formal and informal—are clearly identified, the group will work in a more integrated way and will more efficiently focus on production improvements (Putthiwanit 2015; Somprach et al. 2015).

Finally, a well-defined work structure allows for successful delegation of authority and responsibilities, since everyone knows what he/she is responsible for and when he/she must do it. Similarly, it is easier to identify what tasks are not our job. In the end, we avoid double efforts and prevent unaccomplished work. Both are crucial to a successful improvement project (Klimas 2016).

7.6 The Company Follows Specific Methodologies to Understand Customers

This item holds the sixth place in Table 7.1. The median and IQR values (4.049 and 1.670, respectively) indicate that manufacturing companies in Ciudad Juárez generally rely on specific tools or methodologies to identify and understand customer needs, and participants agree with the median value of the item.

Listening to the voice of the customer as a quality philosophy always implies using mechanisms and methodologies that actually help do so (Reed et al.). Some companies directly survey customers as a means to gain insight into their concerns and needs. Likewise, other organizations prefer virtual surveys or comment mailboxes on their webpages (Bove and Robertson 2005).

However, these mechanisms should not be apparent instruments. Information must be truly analyzed and taken into account in the decision-making process, as such data allow the senior management to closely attend the needs of their customers. If a company does not thoroughly examine, or if it ignores customers' comments and complaints, it merely wastes money on resources it does not exploit (the survey mechanisms). Furthermore, sooner or later, customers will realize that their requests are ignored, and they will lose interest (Ishar and Roslin 2016). Therefore, every business should provide follow-up to customers' comments, letting them know how their suggestions or complaints are addressed. This is particularly important in the service industry (Assaf et al. 2015).

7.7 The Company Relies on a Quality Management System to Achieve Customer Satisfaction

This item holds the seventh place in Table 7.1. It also shows a median value above 4 (4.028), which indicates that manufacturing companies in Ciudad Juárez very frequently incorporate quality management systems into their approach to reach customer satisfaction. Also, note that the IQR value of this item (IQR = 1.680) shows a moderate standard deviation.

A quality management system must be the response to the voice of the customer. It is the business practice of what the client demands and needs (Agus and Hassan 2011). It is important for companies to identify every variable and attribute demanded in the product, since quality systems must be grounded in the product specifications and requirements (Striteska and Jelinkova 2015).

Two other factors that influence product quality are employee training and a continuous improvement culture. Both elements can guarantee compliance with and sustainment of the corporate objectives (Williams et al. 2015). If there is no quality training and education, nothing can guarantee that the implemented systems will endure, since there is no support for them.

7.8 The PDCA Cycle (Plan-Do-Check-Act) is Used as a Kaizen Strategy

This is the eight item listed in Table 7.1. Again, we can observe a median value above 4 (4.021), which indicates that many manufacturing companies of Ciudad Juárez implement the PDCA cycle for Kaizen support. Also, the IQR value of this item shows consensus among respondents regarding its median value (IQR = 1.673).

The PDCA cycle is the basis for many quality philosophies in the industrial sector. Similarly, it is widely employed to identify problems and root causes (Jin et al. 2012). The PDCA cycle is grounded in the precepts of many quality pioneers, such as William Edwards Deming and Joseph M. Juran, who transformed quality into a philosophy.

Kaizen events depend on recognizing and defining the root problems. At this stage, improvement groups identify the variables or metrics to improve, as well as the strategies to be followed in order to solve the problem (Böhner et al. 2015). Then, results are verified, and action is taken based on deviations that may exist. It is worth mentioning that the PDCA cycle methodology is vital in other lean manufacturing tools, such as Six Sigma. Six Sigma is a philosophy sought to be implemented in the entire company, and which is lately referred as Lean-sigma (Jain and Samrat 2015).

7.9 Managerial and Departmental Leadership

This item ranks ninth in Table 7.1. The median value above 4 (4.018) indicates that many manufacturing companies of Ciudad Juárez frequently benefit from managerial and departmental leadership. Also, the IQR value of this item shows consensus among respondents regarding its median value, since IQR = 1.760.

Managerial and departmental leadership are keys to the organization and survival of organizational structures and improvement groups. Senior managers must set the example, as their commitment directly influences the success or failure of improvement projects (Rajiah and Bhargava 2016). Some authors posit that the skills and commitment that human resources have are a reflection of the kind of leadership and commitment that managers show in improvement projects

(Aga et al. 2016). Also, it is argued that any leadership must follow a set of rules, which can be easily measured for corrective actions to take place (Dombrowski and Mielke 2014).

We thus conclude that leadership within improvement groups is essential and should always be a main concern for managers, since the commitment of employees with improvement projects is proportional to the commitment and kind of leadership provided by supervisors (Tabassi et al. 2016). Leadership even impacts on participation. If a leader is not accepted, participation within the group is low (Yang et al. 2016), which reduces creativity and contribution to the project.

7.10 Job Rotation is Promoted

This is item holds the tenth place in Table 7.1. This is the first item with a median value below 4 (3.992), which indicates that manufacturing companies in Ciudad Juárez less frequently carry out this activity when implementing Kaizen. Likewise, note that the IQR (IQR = 1.640) value denotes consensus among respondents regarding the median value of the item.

Job rotation is a response to a need for multifunctional workers, who can perform diverse activities. This technique has the following advantages (McCrie 2016b):

- Operators can hold any position within the production plant in case another operator is absent or leaves the company.
- Operators develop different skills. Thus, they can adopt different perspectives when analyzing a problem within the improvement group (Kane et al. 2005).
- Job monotony is avoided and operators remain motivated. Companies make sure production operators know the needs and requirements of other positions, and these operators can be promoted.

The most important aspect here is the different job skills that operators can develop. However, it is also important that improvement groups tackle a problem from various perspectives. This allows for a holistic and systemic vision, where opinions influencing solutions take into account the needs and perspectives of not only one job, but the whole organization.

7.11 The Intelligence and Creativity of Workers are Used in a Productive Way

This is item holds the eleventh place. The median value is below 4 (3.992), which indicates that manufacturing companies in Ciudad Juárez less frequently exploit employee intelligence and creativity when implementing Kaizen. Likewise, the IQR value (IQR = 1.651) denotes moderate consensus among respondents regarding the median value of the item.

This activity implies that all the problems in the production lines must be analyzed before taking any corrective action or making any improvement. That is, the problem must be addressed with the mind and intelligence before it is manually handled. However, for the intelligence and creativity of the employees to be exploited, improvement groups must be fully motivated, since a lack of motivation is one of the main obstacles to Kaizen success (Lodgaard et al. 2016).

This activity is closely related to others previously discussed, such as leadership, motivation, and the organizational culture (Katzman and Paushter 2016). Some authors recommend that improvement groups be fully interdisciplinary, since a diversity of approaches allows for different perceptions on the same problem. However, it is equally important that improvement groups encompass all disciplines and departments (Cumbler et al. 2016). Trying to solve problems from the viewpoint of a single department might denote a tendency to look for quick and short-term solutions, making use of hands and not the minds and creativity of many other employees.

7.12 5S is Implemented as a Kaizen Strategy

This activity occupies the twelfth place. Its median value equals 3.960 and indicates that manufacturing companies in Ciudad Juárez often implement 5S as part of Kaizen implementation. As regards the interquartile range (measure of data dispersion) its value equals 1.714. This denotes moderate consensus among respondents regarding the median value of the item.

The 5S methodology is the basis of every Kaizen program. As previously discussed, improvements can be made only under clean and safe places and by performing standardized operations. One of the first improvement areas is the work place, which implies a series of new procedures to be followed (Azizi and Manoharan 2015). Many continuous improvement projects carried out at the early stages of Kaizen implementation could be considered 5S projects (Taghizadegan 2006).

As mentioned in Chap. 1, the 5S philosophy is part of the lean manufacturing (LM) family. Because Kaizen never acts in isolation but provides the basis for a more integral improvement philosophy, it is important to work jointly with other LM techniques, such as standardized work, total preventive maintenance (TPM), value stream maps (VSM), and visual factory, to mention but a few. Such an integral approach decreases production costs, increases quality, and reduces delivery times. Likewise, it is a source of motivation for operators, who work in a more friendly and efficient environment (Jiménez et al. 2015; Azizi and Manoharan 2015).

7.13 The Improvement Approach is Consistent with the Organizational Culture

This activity occupies the thirteenth place in Table 7.1. Since its median value equals 3.925, we can conclude that manufacturing companies in Ciudad Juárez often carry out this activity when implementing Kaizen. Also, note that the IQR value equals 1.714, which shows moderate consensus among respondents regarding the median value of the item.

If employees or improvement groups notice inconsistencies, senior managers and group leaders might doubt about which direction solutions should follow (Zain and Kassim 2012). Therefore, the objectives to be achieved with Kaizen must always be aligned with the corporate mission and business model. Moreover, commitment and integration inside improvement groups largely depend on their opinion regarding what the company does and says (Allen and Cervo 2015). Hence, all projects and problems should be endorsed by the senior management, once they have been proposed by the improvement group leader and the group. This ensures successful strategic alignment grounded in the company's mission and strategic objectives (Cumbler et al. 2016).

7.14 The Company Focuses on Critical Processes that Definitely Influence Kaizen Sustainability

This item holds the fourteenth place in Table 7.1. The median and IQR values (3.886 and 1.974, respectively) indicate that manufacturing companies in Ciudad Juárez are often able to prioritize issues related to Kaizen sustainment, and participants moderately agree with the median value of the item.

Identifying critical processes helps successfully allocate the available resources, whether economic or in terms of materials, in those activities that are key to Kaizen sustainability (Manzini and Urgo 2015). One way of identifying critical process is using Pareto charts. These charts are one of the seven traditional quality control tools used in quality management. Pareto charts are effective in identifying the truly critical problems by separating them from those that may be trivial (Esmaeilian et al. 2016).

Brainstorming and nominal groups are two other well-known techniques for identifying critical processes. In brainstorming sessions, improvement group members openly issue their opinions or ideas, being heard by all other participants in the meeting. Meanwhile, in nominal groups employees anonymously express these ideas by writing them down on a paper, so no one knows who is proposing a solution (Li and Duan 2015). Nominal groups are particularly useful when there are conflicts of interest between group members.

Finally, time is an important element. Failure to timely identify critical processes means a loss of time and resources. In fact, companies may be trying to solve a problem that is irrelevant and whose root cause is unknown (Lester 2014), while the real problem is exponentially increasing.

7.15 An Internal or External Facilitator Helps Efficiently Coordinate the Improvement Program

This is item holds the fifteenth place. It shows a median value below 4 (3.878), which indicates that manufacturing companies in Ciudad Juárez often carry out this activity when implementing Kaizen. Likewise, note that the IQR value (IQR = 1.776) reveals moderate consensus among respondents regarding the median value of the item.

Facilitators are of vital importance, especially at the early stages of Kaizen implementation, where there are no proven demonstrations of the company's experience in implementing this technique. External consultants are often hired at these early stages. They are frequently assisted by employees who will later become improvement group leaders. When Kaizen implementation reaches its maturity, these leaders guide the implementation process (Latham 2013; Jönsson and Schölin 2014).

Improvement group leaders must have the senior management's endorsement, as they must be hardworking employees, demonstrating loyalty to the company and knowledge of and expertise—to some degree—in Kaizen implementation. Loyalty is important, since companies do not take the risk of training a person who would soon leave the company to be hired in another one, as this might leak information and knowledge (Grille et al. 2015).

Finally, facilitators should be charismatic, so they can be accepted by the other improvement group members. Also, they must be well-accepted in the group and considered as another group member who can be trusted with the group's ideas, feelings, and concerns (Firmin 2016).

7.16 Collaborators Eagerly Contribute to Continuous Improvement Changes

This is item holds the sixteenth place. It shows a median value above 3 (3.841), which indicates that manufacturing companies in Ciudad Juárez often benefit from voluntary participation of employees in Kaizen implementation. Likewise, note that the IQR value (IQR = 1.685) reveals moderate consensus among respondents regarding the median value of the item.

Participation has been previously addressed from a general point of view, when we discussed the importance of a continuous improvement culture. An organizational culture is generally associated with leadership and the example leaders set, since senior managers are responsible for disseminating and promoting attitudes (Giauque 2015). However, this item refers to the attitude of production operators and continuous improvement group members toward the changes that have proposed on their own.

Participation during the Kaizen implementation process heavily depends on the efforts made by companies and their leaders to generate an appropriate organizational culture. In fact, the culture of workers and improvement group members is only a part of what makes the whole culture of the company, regarding change and continuous improvement (van den Heuvel et al. 2015). Thus, senior managers and improvement group leaders are in charge of disseminating policies that promote a culture of change and continuous improvement (Choi 2011).

7.17 Administrative Staff and Operators are Self-Disciplined

This item is ranked seventeenth in Table 7.1. Once more we observe a median value above 3 but below 4 (3.828), which reveals that this element is often present in manufacturing companies in Ciudad Juárez. In addition, the IQR value reveals consensus among respondents regarding the median value of the item, since IQR = 1.591.

Self-discipline is perhaps the most important value for promoting a continuous improvement culture. Every improvement group member should be able to *stay on track* and decide on the best solutions or alternatives to be implemented (Dick and Collings 2014). Self-discipline is intimately related to employee empowerment, although the latter obligatorily proceeds experience and training (Jones and Saundry 2012). In other words, self-discipline is the result of a personal decision, but employees cannot be trusted to make decisions if they have not received sufficient and adequate training, especially in Kaizen and problem-solving techniques (Tong et al. 2015). Thus, self-discipline is the consequence of education in continuous improvement (Ling et al. 2015).

Finally, norms are a central aspect in self-discipline. Through managers and continuous improvement leaders, companies must establish and define clear rules to be followed by production operators and administrative staff. People cannot be considered as undisciplined in compliance with a rule or norm, if such regulations have not been adequately spread and stated (Åkerman et al. 2016). In other words, work rules and norms must be clearly explained from the beginning, and companies must make sure everyone understands them in a similar way. This will avoid a great number of problems.

7.18 Employees are Skilled and Experienced

This item is ranked eighteenth in Table 7.1. The median value of this item equals 3.801, which means that skilled and experience employees are a recurrent benefit of manufacturing companies in Ciudad Juárez. Considering the IQR value (IQR = 1.483), there seems to be moderate consensus among respondents regarding the median value of the item.

The skills that production operators develop, as well as the amount of experience that they gain, largely depend on the professional development opportunities and training programs offered (D'Alleo 2011). Thus, skills and knowledge are linked to several factors. For instance, they depend on the amount of hours dedicated to previous improvement projects. Second, both skills and experience are the result of the quality of training (Russell et al. 2016).

In some companies, employees must comply with a minimum of training hours in a year, In Mexico, the Ministry of Labor and Social Security demands that companies offer a minimum of training hours in a year, focusing on improvement processes and organizational safety. This ensures that if for some reason employees are dismissed or discharged, they have enough abilities and skills to be hired in another company (Dusi et al. 2014).

7.19 Human Resources are Integrated

This item occupies the nineteenth place in Table 7.1. Its median value (3.739) reveals that in the context of manufacturing companies in Ciudad Juárez, human resources are often integrated. Moreover, the IQR value of this item equals 1.816, which shows that participants moderately agree with the median value.

Human resources are the basis of all progress. Thus, their integration should always be a priority, since it is the only way of joining forces and concentrating all resources on achieving the business goals (Lee 1993). Therefore, each department should have its own integration, which means that department managers are as responsible as senior managers for promoting collaboration and communication (ĉernetiĉ 2006; Belizón et al. 2016).

When departments work in isolation they might drift from the company's objectives and mission. Hence, far from benefiting or aiding the company, such a work approach becomes an obstacle the company's growth and development.

Human resources integration should have a number of structures. First, there must be appropriate communication and collaboration between middle and senior managers, who would then seek to ensure the same integration along their departments (Ford et al. 2012).

7.20 Kaizen Members are Acknowledged for Their Achievements and Efforts in Kaizen Events

This item holds the twentieth place in Table 7.1. The median and IQR values (3.697 and 1.877, respectively) indicate that manufacturing companies in Ciudad Juárez often recognize Kaizen members for their performance, and survey participants agree with the median value of the item.

Joining improvement groups is a completely voluntary activity, since studies have shown that performance and participation are affected when forcing employees to participate in Kaizen events. Therefore, as a reward for the outstanding effort of improvement group members, many companies establish bonus schemes and other rewarding programs for employees based on the results of their completed projects (Glover et al. 2011a). Such an approach engages operators who have not yet been integrated to improvement groups, but also serves as an incentive or motivation for those who already are involved in Kaizen events.

While some studies propose bonuses as economic rewards, some others suggest rewards in the forms of home supplies. Either way, social recognition should not be forgotten, and it usually consists of a diploma openly granted (García et al. 2014a; Suárez-Barraza and Ramis-Pujol 2010). Also, many companies in the United States organize 1 day a year when all improvement groups collectively report and share the results obtained in their projects. Then, a jury evaluates such performance, thus rewarding the best scored group. However, note that organizations ought to establish rules and regulations for such rewards, and they must communicate them to every group member from the moment he/she joins the group (Stone and Kerno 2010).

7.21 Kanban is Implemented as a Kaizen Strategy

This is the twenty-first item listed in Table 7.1. Considering its median value (3.677 units), we can conclude that manufacturing companies in Ciudad Juárez often implement Kanban to support Kaizen projects. Similarly, the IQR value (IQR = 2.025) reveals moderate consensus among respondents regarding the median value of the item.

Both Kanban and Kaizen are LM tools. The former aims at improving the material flow and supporting inventory management, while the latter seeks to enhance the whole production process. Kanban can be thus considered as a part of Kaizen, since the materials flow is only one area of the manufacturing process. The flow of materials always provides opportunities for improvement, since long distances and a slow material flow add no value to the product, yet they represent costs (Rahman et al. 2013). Studies have estimated that costs derived from material handling and logistic services represent up to 70 % of the product price. Not surprisingly, organizations pay careful attention to the flow of materials, which can always be improved (Maarof and Mahmud 2016).

If LM is seen as a house, Kanban and Just In Time (JIT) are the pillars associated with of the material flow. Over such pillars, several other LM tools rely (Maarof and Mahmud 2016; Nelson 2016). However, Kanban should be implemented only after foundations of Kaizen and the 5S methodology are appropriately established.

7.22 Employees are Committed and Motivated

This is the twenty-second item listed in Table 7.1. Its median value equals 3.668, meaning that employee commitment and motivation is often achieved in manufacturing companies of Ciudad Juárez. Similarly, the IQR value (IQR = 2.025) reveals moderate consensus among respondents regarding the median value of the item.

As previously discussed, incentive programs must aim at motivating improvement groups, since this supports the improvement process (ÖZlen and Hadžiahmetović 2014). Also, we have mentioned that improvement groups are voluntary, but always rewarded if results are satisfactory. Such rewards also keep group members motivated and encourage other employees to participate (Rodriguez and Lopez 2012).

As for commitment, it is important to clearly assign responsibilities in every improvement plan or project to be implemented. To achieve this, groups can list all those activities that must be carried out and assign them to the most suitable person. Then, every improvement group should sign the list (Dan et al. 2011). Signing is a double strategy. On the one hand, it encourages commitment. On the other hand, it demonstrates that everything is properly planned and organized, and that plans are not randomly carried out.

7.23 Customer Satisfaction is Measured When Implementing Improvement Proposals

This item holds the penultimate place in the list. It has a median value equal to 3.619, indicating that this activity is often carried out during Kaizen execution. Likewise, the IQR value indicates little consensus among respondents regarding the median value of the item.

As mentioned above, customer satisfaction and the final product must be the main reason why improvement groups are created through Kaizen philosophy, otherwise they will only represent costs and will not justify Kaizen implementation (Valmohammadi and Roshanzamir 2015). Therefore, as part of a continuous improvement culture, all production activities and phases must be customer-focused.

Several techniques are helpful when measuring customer satisfaction. Two of them are surveys—either personal or virtual—and suggestion boxes (Topalović 2015). However, note that such techniques should be monitored, and customers must be informed of the actions taken. Some business seeks to personally contact consumers to better understand their suggestions or complaints (Ugboro and Obeng 2000). Such an approach makes customers feel that they are an integral part of the company's improvement process.

7.24 Constraints to Implement the Proposed Improvement Changes

This item ranks last among the 24 analyzed Kaizen execution activities. The median value equals 3.6, which reveals that this activity is occasionally carried out in manufacturing companies of Ciudad Juárez. Similarly, the IQR value indicates moderate consensus among respondents regarding the median value of the item.

This item refers to the obstacles to implementing changes which hinder progress. Fortunately, this activity is ranked last (Lodgaard et al. 2016). However, taking into account the median value, it is inferred that Kaizen execution often represents a challenge to managers and Kaizen implementation administrators.

As previously discussed, barriers to improvement are usually associated with human resources organization and integration. Sometimes, improvement groups are not as heterogeneous, since many members represent a same department or area, and they thus tend to adopt solutions that may not meet the needs of other areas in the same way (Mitki et al. 1997). Experts thus emphasize on the importance of heterogeneous and multidisciplinary improvement groups. Diversity supports the decision-making process through a wide and diverse range of perspectives, skills, and knowledge. Similarly, it ensures communication in the entire organization, as every department is directly involved in the processes. This guarantees accurate decisions regarding the changes to be implemented.

7.25 Conclusions

This chapter discusses 24 Kaizen execution activities. The analysis of such elements allows us to conclude the following regarding this Kaizen implementation phase in the environment of manufacturing companies located in Ciudad Juárez:

- Senior managers must strive to promote and maintain a culture that helps manage changes and embrace improvement projects.
- Improvement groups must be multidisciplinary in nature in order to ensure holistic and comprehensive problem-solving approaches.
- Every improvement project to be implemented must be customer-focused. Since customers pay for the final product, their needs must be met, and their satisfaction ought to be constantly measured.

- Improvement groups should choose a leader that acts as an effective communication channel between the senior management and employees. Organizational structures ought to be clear and well-defined. This ensures employees approach the right person in case of help.
- Incentive programs vis-á-vis results must be considered as an effective means to increase and maintain employee motivation.
- Managers must be committed to removing or reducing as much as possible all situations that may compromise changes to be implemented, and thus, continuous improvement.

Chapter 8
Descriptive Analysis of Items: Kaizen Control Phase

In this chapter, we discuss 12 activities for successful Kaizen control. Table 8.1 lists such activities based on data gathered from survey participants. As in the two preceding chapters, the second, third, and fourth columns include values of the second, third, and fourth quartiles, respectively. Also, the interquartile range (IQR) is considered as a measure of data dispersion, and its values can be seen in the fifth column of the table. Finally, note that items are sorted in descending order based on their median values.

Note that seven items have a median value higher than four, while the remaining five show values below four. As regards the former set, we can conclude that manufacturing companies in Ciudad Juárez very frequently carry out such activities as a way of controlling Kaizen events. However, median values in the latter group reveal that such activities are less frequently carried out.

The interquartile range (IQR) is a measure of data dispersion. On one hand, ten items show IQR values higher than 1 but lower than 2. This suggests moderate consensus among survey respondents regarding the median value of the items, or the frequency at which the ten Kaizen control activities are carried out in manufacturing companies. On the other hand, two items have values higher than 2, which reveals low consensus among respondents.

8.1 The Company has Security Programs

This item ranks first in Table 8.1 and has a median value equal to 4.275, which implies that manufacturing companies in Ciudad Juárez very frequently establish security programs. Likewise, the IQR value (IQR = 1.611) indicates moderate consensus among survey participants regarding the median value of the item.

It is not surprising that this activity holds the top position. Safety and integrity are priorities in the industry. Thus, problems associated to them are the first to be improved—and monitored once they have been improved. Companies must be fully

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Table 8.1 Descriptive analysis of items—Kaizen control phase

Benefit	Percentiles			IQR
	25th	50th	75th	
The company has security programs	3.340	4.275	4.950	1.611
Processes are standardized and measured	3.393	4.267	4.916	1.523
Managers are committed until the end	3.278	4.171	4.843	1.565
Forms and/or control records are used to assess activities performance	3.236	4.157	4.848	1.612
Pending issues are documented and monitored	3.222	4.125	4.823	1.601
Interdepartmental communication	3.219	4.101	4.835	1.523
Progress toward the objectives is continuously measured	3.213	4.097	4.807	1.594
The company has an organizational structure to detect failures	3.092	4.035	4.777	1.685
The company applies appropriate control and monitoring techniques	3.031	3.909	4.699	1.668
Managers inform operators of their work performance	3.018	3.878	4.672	1.654
Enhancers take Kaizen philosophy to the level sought	2.796	3.780	4.618	1.822
Value chains are mapped	2.568	3.680	4.576	2.008
Employees are interviewed to identify their needs	2.550	3.640	4.560	2.010

committed to providing a safe work environment and complying with government regulations that ensure work safety. In Mexico, both the Secretariat of Labor and Social Welfare (STPS) and the Mexican Social Security Institute (IMSS) periodically conduct supervisions to companies in order to identify improvement areas regarding occupational risks. Thus, safety issues must be quickly addressed to avoid being sanctioned either administratively or economically.

Fortunately, Ergonomics has nowadays made important contributions to the field of work safety. In fact, Ergonomics seeks to improve integration of employees into their work environment. Current trends in ergonomics emphasize on and propose risk prevention programs as a means to avoid occupational hazards and accidents. Many authors view Ergonomics as another LM tool (Cirjaliu and Draghici 2016), since work safety is intimately related to improvement programs, especially due to the high costs incurred from accidents, injuries, and illnesses (Vieira et al. 2012b). Thus, in order to achieve outstanding results in occupational health, many support Ergonomics as a LM tool (Kumashiro 2011).

8.2 Processes are Standardized and Measured

This item ranks second in the table. Its median value equals 4.267, which implies that manufacturing companies in Ciudad Juárez very frequently standardize and measure processes during Kaizen control. Similarly, the IQR value (IQR = 1.523) indicates moderate consensus among survey participants regarding the median value of the item.

Kaizen requires measuring all processes in order to know their current status. Based on such information, improvement solutions are proposed, and interventions are planned (Maasouman and Demirli 2015). Eventually, once such processes have been intervened, companies need to measure them once more to determine whether they were improved, in which case new standards must be established (Diego Fernando and Rivera Cadavid 2007).

Standards reached in the production process are temporary. As the company evolves, old standards must be replaced or modified based on the improvements achieved (Wahab et al. 2013). Making improvements often means adopting new work methods or approaches. In these cases, once a new standard has been set, employees must be fully trained in the new work methodologies, as this will ensure standards are always met.

8.3 Managers are Committed Until the End

This item ranks third in Table 8.1 and has a median value equal to 4.171, which implies that managers from manufacturing companies in Ciudad Juárez are very frequently committed to Kaizen implementation until its completion. Likewise, the IQR value (IQR = 1.565) shows moderate consensus among survey participants regarding the median value of the item.

Managerial commitment is perhaps one of the most important elements to ensure Kaizen success in the industrial sector. Commitment from managers is a constant, from the Kaizen planning phase until the control phase, when companies seek to maintain and improve the standards already established thanks to improvements attained (Alukal and Manos 2006). Without managerial commitment at the control stage, production operators may neglect the new standards; thus, the effort put on achieving improvements would be a failure. Companies would have used their economic recourses, materials, and effort in exchange for nothing (Suárez-Barraza and Miguel-Dávila 2014).

Some companies have departments that specialize in continuous improvement. Such departments demand periodical reports on the changes implemented, which are being monitored and controlled. Similarly, they interact with the senior management and improvement groups to discuss the implemented changes, thus receiving feedback from those who are directly involved in the new modifications. Finally, senior managers make suggestions based on the progress achieved, letting people know they are not alone in the process of monitoring and surveillance.

8.4 Forms and/or Control Records are Used to Assess Activities Performance

This item ranks fourth in Table 8.1. Its median and IQR values (4.157 and 1.612, respectively) show that manufacturing companies in Ciudad Juárez very frequently carry out this Kaizen control activity, and survey participants moderately agree with the median value of the item.

We have previously discussed the importance of process standardization. However, administrative processes should also be standardized in order for everyone to interpret information in the same way (Glover et al. 2013a). The most traditional way of standardizing an administrative process is using general or specific forms that allow everyone to similarly organize information. Nevertheless, standardization encompasses more than using such forms. Information must be stored in a database for its eventual analysis and use in reports (Stone 2010). Paper-based forms are fieldwork instruments, but information must always be electronically stored.

Standardized administrative processes also make it easy for everyone to track the achieved improvements. Moreover, if anyone fails to report information regarding his/her responsibilities, somebody else may do it, as it is a standardized procedure (Montabon 2005). In fact, when an improvement group member leaves the group, standardized forms help other group members easily take the place of the person who left.

Finally, each improvement group must show evidence of the achieved progress and rely on preestablished forms to formally report such progress. This information is usually stored by the continuous improvement department, which concentrates inside some hard or electronic folder all the reports and records from every improvement group, and, as far as possible, they must unify the reports and create a general one.

8.5 Pending Issues are Documented and Monitored

This item ranks fifth in Table 8.1. Its median and IQR values (4.125 and 1.601, respectively) show that manufacturing companies in Ciudad Juárez very frequently carry out this Kaizen control activity, and survey participants moderately agree with the median value of the item.

Sometimes objectives in Kaizen projects are not achieved, and thus, there are always improvement areas to address. This is where the concept of continuous improvement comes from, as Kaizen never stops improving the process. Therefore, it is important to properly document any pending issue that does not show the expected results or has not been completed. This allows group leaders to provide timely follow-up, so the issue is not overlooked or neglected (Martin and Osterling 2007).

All missed objectives must be reported to the senior management, and they usually occur when solutions are outside the scope of action of continuous improvement groups, and only the senior management can provide the resources or allow access to information needed (Kosandal and Farris 2004). However, sometimes improvement groups may be dealing with legal issues, and once again, only managers or knowledgeable people can help solve these problems (Duffy 2013). Finally, note that pending objectives and actions help generate a new continuous improvement project.

8.6 Progress Towards the Objectives Is Continuously Measured

This item ranks sixth in Table 8.1. Its median and IQR values—4.097 and 1.594, respectively—indicate that manufacturing companies in Ciudad Juárez very frequently carry out this Kaizen control activity, and survey participants moderately agree with the median value of the item.

Continuous improvement groups respond to the need for improving one area or production process, which is generally identified thanks to information obtained through measurements, whose results determine whether the issue can be improved (Doolen et al. 2008). Without improvement areas, continuous improvement groups are not justifiable, since they imply investing time, money, and efforts.

Once an improvement group is established, the group leader must schedule meetings to assess the status of the process to be improved by monitoring and measuring it (Burch 2008). Improvement groups themselves determine how often work meetings will take place. However, two objectives must be met. On one hand, meetings should be as frequent as possible, since this allows groups to take corrective actions in a timely manner. On the other hand, it is also expected that such meetings do not interrupt the job of employees, as this represents costs incurred (Tucker 2014).

Thus, group leaders ought to determine how serious a problem is, and based on this, they must schedule the meetings. Some groups gather on a weekly basis due to the complexity of a problem, while others meet every two weeks or every month, as the process metrics do not require immediate action.

8.7 The Company Has an Organizational Structure to Detect Failures

This item ranks seventh in Table 8.1. Its median and IQR values—4.035 and 1.685, respectively—indicate that manufacturing companies in Ciudad Juárez very frequently carry out this Kaizen control activity, and survey participants moderately agree with the median value of the item.

Once companies see how Kaizen brings benefits to their production processes, they are in constant search of other opportunity areas to be improved. As a result, with time and experience, their organizational structures easily identify those aspects that need to be improved. In this sense, experience is crucial, as it helps human resources and continuous improvement groups easily and naturally detect opportunity areas (Glover et al. 2014). However note that reaching such a level of autonomy demands empowerment, which is only possible once groups demonstrate outstanding problem-solving abilities (Stone 2010).

Companies empowering their employees are widely benefitted from such an approach. Empowerment guarantees that opportunity areas are identified on time, thus avoiding major problems. Moreover, employees are able to solve problems on their own (Liu et al. 2015c). However, when Kaizen implementation has not reached enough maturity, and, still, employees are empowered, opportunity areas may be incorrectly identified, or solutions proposed may meet the needs of a particular group of people, and not those of the company as a whole. Therefore, empowerment is a useful technique, but it should be extremely careful when implementing it.

8.8 The Company Applies Appropriate Control and Monitoring Techniques

This item ranks eighth in Table 8.1. Its median and IQR values—3.909 and 1.668, respectively—indicate that manufacturing companies in Ciudad Juárez often carry out this Kaizen control activity, and survey participants moderately agree with the median value of the item. Note that this is the first item showing a median value lower than 4.

Continuous improvement groups must be able to identify control and monitoring techniques to be employed to track the effectiveness of proposals implemented (Worley and Mitchell 2008). Several control techniques rely on indices, such as percentages or units, and they can be used to monitor improvements in the areas of waste, processing times, and defective parts, among others (Miller et al. 2014). Note that such indices must be clearly stated from the beginning, to prevent group members from reporting different indices of the same measurement or attribute.

If a different index must be used, group leaders ought to quickly adjust it. This usually occurs when the senior management demands statistical information and wants to perform a comparative analysis of a given situation (Glover et al. 2011b). If these changes frequently occur, leaders should propose a change of measurements to avoid double work. However, the senior management or continuous improvement department must standardize indices to be included in the reports.

8.9 Managers Inform Operators of Their Work Performance

This item ranks ninth in Table 8.1. Its median and IQR values—3.878 and 1.654, respectively—indicate that manufacturing companies in Ciudad Juárez often carry out this Kaizen control activity, and survey participants moderately agree with the median value of the item.

We have already highlighted the importance of communication, especially among the different organizational levels. Communication must be constantly promoted in all senses. That is to say, continuous improvement groups must inform the group leader the progress achieved or obstacles encountered in the improvements implementation process. Then, leaders vertically spread such information (García et al. 2013a). Nevertheless, it is important to specify how often reports must be issued, depending on the amount of time needed by the improvement project and the complexity of the problem (García et al. 2014a).

In some companies, leaders of continuous improvement groups issue weekly reports to senior managers, who in turn provide feedback in the following 5 or 7 days. Studies have found that Mexican manufacturing companies hold work meetings every 2 weeks, where each group leader briefly presents the progress achieved in his/her projects, thus benefiting from on-the-spot feedback from the senior management. However, it was also found that every 2 months, these businesses schedule work meetings where all improvement group members participate. In these reunions, employees are informed of their overall performance, providing suggestions for improvements, identifying weaknesses and strengths, and determining changes to be performed. These meetings are well-regarded by improvement group members, as they reflect commitment made from every employee.

8.10 Enhancers Take Kaizen Philosophy to the Level Sought

This item ranks tenth in Table 8.1. Its median and IQR values—3.780 and 1.822, respectively—suggest that manufacturing companies in Ciudad Juárez often carry out this Kaizen control activity, and survey participants moderately agree with the median value of the item.

As previously mentioned, there are many ways of implementing Kaizen philosophy in the production lines. Some of these alternatives are listed below

- The presence of managers in continuous improvement groups is the first enhancer. It increases the group's commitment to Kaizen events and reflects the level of managerial commitment (Maarof and Mahmud 2016).

- Some companies have lean manufacturing departments, while some others rely on coordination departments for continuous improvement groups. In these departments, employees monitor and support activities carried out (Audenino 2012).
- Leaders of continuous improvement groups must be chosen considering the opinion of the senior management and group members. Similarly, leaders must be vertically and horizontally accepted, and they should possess teamwork management skills, experience in Kaizen events, self-discipline, while they must also be charismatic to guarantee their acceptance (Yokozawa and Steenhuis 2013b).
- Incentive programs for continuous improvement groups are another effective Kaizen enhancer. Group members must be openly acknowledged for their work performance and skills. Examples of incentive programs include economic rewards based on the results obtained and the savings made in the involved production line.

8.11 Value Chains are Mapped

This item ranks eleventh in Table 8.1. Its median and IQR values—3.680 and 2.008, respectively—suggest that manufacturing companies in Ciudad Juárez often carry out this Kaizen control activity, and survey participants slightly agree with the median value of the item. Note that this is the first activity at this stage with an IQR value higher than 2.

Kaizen seeks improvement in all aspects of the production process. Hence, it is important to detect all opportunity areas that add no value to the final product, so they can be removed. This is what value stream mapping (VSM) is about (Miller et al. 2014). The word *stream* has an interesting meaning in this context, as it refers to every production process, from raw material procurement to final product delivery.

Successful VSM is supported by many other LM tools, such as SMED and standardized work. The former is machine-focused, while the latter is employee-focused. SMED seeks to identify dead times in machinery and equipment during changeovers, while standardized work seeks to identify and reduce operator's motion (Prabhuswamy et al. 2013; Farris et al. 2009b).

8.12 Employees are Interviewed to Identify Their Needs

This item ranks twelfth in Table 8.1. Its median and IQR values—3.640 and 2.010, respectively—suggest that employees from manufacturing companies in Ciudad Juárez are often surveyed, and participants slightly agree with the median value of the item.

The needs, feelings, and concerns of human resources play a crucial role in the success of continuous improvement. The best way of knowing how a person feels and what he/she thinks is by asking. Thus, senior managers and improvement group leaders are responsible for identifying how employees feel and what they need. However, the term needs in this context refers to both what employees consider as necessary to appropriately do their jobs, but also, the skills that they lack or need to further develop.

Surveys are the most common technique to identify employees' needs; however, managers and improvement group leaders must also directly interview their subordinates. In addition, in work meetings, leaders should periodically designate a certain amount of time to address such issues. During those meetings, employees must be able to openly express themselves (Farris et al. 2009b; Glover et al. 2011b).

The senior management must decide on the best way human resources are interviewed. They may be orally approached, or through of paper-based or computer-based surveys (Vieira et al. 2012a). Finally, not only is it important to identify employees' needs but to actually meet them. One way of addressing professional development needs or training needs is by establishing training programs and courses. Such actions make employees feel they are taken into account. Consequently, motivation and productivity increase. These are two Kaizen benefits discussed in the following chapter.

8.13 Conclusions

In this chapter, we discussed and analyzed 12 activities that are critical to successful Kaizen control within companies. Therefore, based on the descriptive analysis of items, we conclude the following:

- A safe work environment is the priority of any continuous improvement project. Changes implemented in terms of work safety must be the first to be controlled and monitored.
- Companies must prioritize safety plans and programs at the Kaizen control phase in order to protect human resources.
- Successful improvement changes rely on standardized and measured production processes.
- The senior management must be present at any phase of Kaizen implementation, including the control phase.
- Since sometimes objectives cannot be achieved, it is important to keep record of all pending issues.
- Companies must provide sufficient and adequate training to human resources, since they will help employees develop important work skills.
- Periodical value stream mapping is important to identify opportunity areas.
- Interest shown in identifying and meeting employees' needs is relevant to Kaizen control.

Chapter 9
Descriptive Analysis of Kaizen Benefits

Previous chapters have addressed the activities or critical success factors that must be carried out for successful Kaizen implementation. As a consequence of such activities, companies obtain numerous benefits in terms of profits, competitiveness, and for their human resources. All these advantages are described in this chapter.

9.1 Kaizen Economic Benefits

The analysis identifies 14 economic benefits as the result of successful Kaizen implementation. Table 9.1 lists these benefits in descending order according to the median value or 50th percentile, which is found in the third column.

As can be observed, only two of the listed benefits have median values higher than four, and all values are very close to one another. The maximum median value is 4.0980, while the minimum is 3.7417, which makes a difference of only 0.3563 units. All this implies that, in general, manufacturing companies in Ciudad Juárez often obtain all these benefits as a result of Kaizen implementation. As regards the IQR values, all of them are lower than two but higher than one, which demonstrates consensus among respondents regarding the median value of every Kaizen benefit.

9.1.1 Compliance with Product Delivery Times and Quantities

This is the first benefit listed, and thus the most frequently obtained in the manufacturing sector of Ciudad Juárez. The median value of this item is 4.098 and the IQR value is 1.657.

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Table 9.1 Kaizen economic benefits

Benefit	Percentiles			IQR
	25th	50th	75th	
1. Compliance with product delivery times and quantities	3.155	4.098	4.812	1.657
2. Maximized profits	3.220	4.073	4.778	1.558
3. Increased work productivity	3.109	3.952	4.702	1.592
4. Increased and improved economic balance	3.143	3.932	4.678	1.535
5. Fewer production process stages	3.066	3.908	4.697	1.631
6. Increased overall productivity	3.083	3.869	4.632	1.549
7. Short design and operating cycles	3.062	3.857	4.635	1.573
8. Improved cash flow	3.071	3.846	4.625	1.554
9. Machine failures reduction	3.093	3.841	4.598	1.505
10. Waste reduction (inventories, waiting times, transport, movements from workers)	2.916	3.832	4.652	1.736
11. Materials handling	2.925	3.809	4.630	1.704
12. Unit manufacturing cost reduction	3.007	3.803	4.605	1.597
13. Defective products reduction	3.027	3.793	4.568	1.540
14. Order lead times reduced as close as possible to zero	2.781	3.741	4.607	1.826

Compliance with product delivery times and quantities is the result of coordination between Kaizen philosophy and a company's quality programs, in which delivery times are a top priority (Milgram et al. 1999). Also, both Kaizen as a LM tool and the Six Sigma philosophy look for quality not only in the production process, but from the product design (Taghizadegan 2006). Today, benefits of improved delivery times as a consequence of continuous improvement are not only applicable to the automotive industry, as there initially were. Compliance with delivery times is also a priority in the service industry (Iberahim et al. 2016), or in hospital environments, where medications must be delivered to patients in a timely manner and the exact amount required (Tetteh 2012).

9.1.2 Maximized Profits

This is the second most obtained benefit among manufacturing companies of Ciudad Juárez. The median value of this item equals 4.073, which shows that the manufacturing sector in this region frequently maximizes profits thanks to Kaizen implementation. Moreover, according to the IQR value, which equals 1.558, there seems to be consensus among respondents regarding the median value of the item.

The first benefit can be the reason why companies maximize their profits. A company that manages to deliver a product on time and in the right quantities surely has a better commercial image than most of its competitors, and therefore, customers have more confidence in its performance, which as a consequence, increases profits from sales (Macpherson et al. 2015b). However, it must be kept in mind that since Kaizen aims at continuous improvement, it is applicable to the whole supply chain, especially the production lines. In this sense, Kaizen seeks to eliminate waste and errors, which, in the end can also be translated into more profits. Some examples of production lines improved with Kaizen are found in India (Arya and Jain 2014).

Similarly, the benefits of a continuous improvement philosophy are not exclusive to the manufacturing sector. Research has shown that in the construction industries of countries such as China, one of the most obtained benefits as a result of Kaizen implementation is cost reduction, which translates into prosperity as a result of increased profits (Shang and Pheng 2013). Likewise, Kaizen has played an important role in the food industry, where quality control and process improvement are meticulously supervised (Suárez-Barraza et al. 2012). In conclusion, continuous improvements bring greater customer satisfaction, but also increased financial performance for companies.

9.1.3 Increased General Productivity

This is the first benefit of the list with a median value below 4 (3.952), which demonstrates that productivity occasionally increases in the surveyed manufacturing sector as a result of Kaizen implementation. Similarly, the IQR equals 1.592, and this shows moderate consensus among respondents regarding the value of this item.

Productivity refers to the rational measurement of a company's inputs and outputs, indicating the amount of raw materials required for a product. It shows how companies use available resources during continuous improvement programs (Radharamanan et al. 1996). Better use of resources also involves waste reduction in terms of downtimes, improved plant layout, and reduced material flow, among others. Some examples of productivity benefits can be found in the furniture industry (Radharamanan et al. 1996), the metal-mechanic industry (Choomlucksana et al. 2015), and automation processes, where Kaizen as a LM tool is fully associated with quality principles (Azizi 2015).

9.1.4 Increased and Improved Economic Balance

This benefit is ranked fourth in the descriptive analysis. Its median value equals 3.932, which implies that manufacturing companies in Ciudad Juárez occasionally obtain this benefit. As regards the IQR value, it equals 1.535, which denotes moderate consensus among respondents concerning the value of the item in the survey.

Economic balance is the result of an equilibrium between a company's income and its costs incurred in generating a product or service. Companies have both fixed and variable costs. The first is not associated with production levels, while the second is indeed related to this variable. Therefore, a company without production has fixed costs, and when it starts producing, variable costs will appear and will be associated with the amount of a product/service generated. Such a product or service will be sold, and, thus, profits will appear.

Companies that improve their economic balance do not require great amounts of product to start generating profits. This is a part of the premise that when production decreases, companies have many fixed costs, while variable costs are prorated among a reduced number of products. Similarly, revenues are low, since little product or service is sold.

The importance of Kaizen relies precisely on its ability to identify waste in the production process, which decreases related costs and improves the economic balance, assuming that revenues from sale concepts remain stable and the price does not increase (Perner et al. 2016).

A company's balance point has a direct impact on the economy of a country, which is why it must be thoroughly analyzed (Szirmai and Verspagen 2015). However, efforts to improve economic performance do not mean neglecting environmental issues, which are variables widely related to such performance (Gao et al. 2016). That said, there are many ways of improving an organization's economic balance, and Kaizen has an important impact on all of these techniques. Some of them are described as follows:

- Reduce fixed costs associated with the required production. It is frequently a challenging task to accomplish, since administrative aspects are involved.
- Increase the price of the generated product. This may put companies in a disadvantageous position and may lose clients, which reduces revenues.
- Diminish variable production costs. Kaizen has a strong impact on this.

9.1.5 Fewer Production Process Steps

This is one of the benefits of continuous improvement systems applied to production lines. The median value of this item equals 3.908, while the IQR value is 1.631. Thus, it can be said that the manufacturing sector of Ciudad Juárez occasionally manages to reduce steps in the production process with Kaizen. Moreover, there is moderate consensus among respondents regarding the median value of the item.

This benefit is the product of Kaizen basic principles, which seek to improve all production processes in the production lines, mainly through waste reduction. It is usually argued that not a single day must pass without identifying at least one opportunity or improvement area within the production system. Commonly, such improvements lead to the elimination of unnecessary production activities that add no value to products or services but increase their price. In this sense, Kaizen provides great support to techniques, such as value stream maps, that seek to remove such unnecessary tasks (Visuwan et al. 2010).

Steps reduction leads to a simpler and more straightforward production process. However, companies must keep in mind that every time steps are removed, production operators must be trained in the new activities, emphasizing on those that have been eliminated, so they are not repeated (Lyu Jr 1996).

Companies that successfully remove unnecessary production steps are more productive. This shows their ability to generate a higher amount of a product with less consumption. Fortunately, results obtained in this process have taken Kaizen to administrative environments. This is why Kaizen is said to be applicable not only to the manufacturing sector, but also to sectors where administrative processes are too tedious (Suárez-Barraza1 and Lingham 2008).

9.1.6 Increased Work Productivity

The third benefit listed in Table 9.1 specifically refers to an increase in work productivity. However, productivity is a multidimensional factor, especially to the industry. It holds the sixth place in the list with a median value of 3.869 and an IQR that equals 1.549. These values show that manufacturing companies in Ciudad Juárez occasionally benefit from increased work productivity as a result of Kaizen implementation, and there is moderate consensus among respondents regarding the median value of this item.

Economic benefits are the most sought when productivity is improved. Even though companies that implement Kaizen mainly seek to increase their profits, some authors suggest being more open-minded regarding the paybacks of increased work efficiency. Among the most significant productivity, dimensions include logistics systems and human resources productivity.

On the one hand, efficient logistics systems are important, because moving a product constantly and unnecessarily does not add any value to it. Thus, companies should seek to make the minimum investments possible in this sense (Krajewski et al. 2013; Farris et al. 2009b; García et al. 2013a). On the other hand, human resources must be properly employed, otherwise companies may be wasting resources. Often, the most qualified employees are engaged in activities that do not require much training and can be performed by novice operators (Glover et al. 2011a; García et al. 2014a).

9.1.7 Short Design and Operating Cycles

All the benefits listed in Table 9.1 are actually related to one another. They are either the cause or the consequence of a similar activity. In this case, shorter design and operating cycles can be the consequence of reduced steps in the production process (benefit no. 5). Similarly, it is the cause of many other Kaizen advantages, including faster delivery times to customers, because long operating cycles mean long delivery time.

This benefit ranks seventh in Table 9.1. Its median value is 3.857, which suggests that the surveyed manufacturing sector occasionally obtains this benefit from Kaizen implementation. Similarly, the IQR of this item equals 1.573, which shows moderate consensus among respondents in terms of the real median value of the item.

In addition to having simpler and faster production processes, companies that have shorter design and operating cycles rely on the proper technology (Knechtges and Decker 2014b). For instance, as regards product design, computer-assisted design (CAD) software can successfully replace drawing boards to make a product prototype. That is, specialized pieces of software are now able to generate, in a minimum amount of time, impressive drawings with even higher quality than conventional sketches.

Furthermore, 3D printers make it possible to create three-dimensional prototypes, while considerably reducing the amount of time required to make the design (Chugh et al. 2016). Also, as regards operating cycles, many production processes are supported by technology integrated into the machines and equipment. This helps quickly identify deviations in the quality metrics and to make fast decision as response (Hofman et al. 2016; Mitra et al. 2016; Paul and Suresh 1992; Visuwan 2010).

9.1.8 Improved Cash Flow

This is the eighth benefit of the list. The median value of this item equals 3.846, while the IQR value equals 1.554. Such values indicate that manufacturing companies Ciudad Juárez sometimes obtain this benefit from Kaizen projects, and there is moderate consensus among respondents regarding the median value for the item.

Improved cash flow is related to a company's financial performance. It is the result of savings achieved by increasing productivity, removing waste in the production process, and improving new products and processes design. Similarly, it is related to the first goal of any LM tool, which is generating higher dividends for shareholders (Visuwan 2010). However, note that this benefit does not refer to increased availability of assets. In fact, companies can have warehouses full of finished goods and raw materials that they have been unable to sell. Thus, the most important is to sell such products to be able to generate cash flows (Stefea and Abbas 2015).

This benefit is also the result of waste reduction in all areas of the company, and thus reduced unit costs of production in all the products of the different lines (Ghicajanu 2011). In addition, the amount of cash flow depends on the speed at which a company manages to reach a market with new and innovative products.

However, note that such products include all the characteristics demanded by the customer and represent a true strategic advantage. It is pointless being the first to reach a market if the product is not fully accepted.

9.1.9 Machines Failures Reduction

This is the ninth benefit listed in Table 9.1. The median value of this item is 3.841, whereas the IQR value equals 1.505. As can be assumed, the manufacturing sector surveyed often obtains this benefit, and there is moderate consensus among respondents regarding the median value of this item.

This benefit is strongly related to total productive maintenance (TPM) processes established in the production area. TPM emphasizes on preventive maintenance, which involves searching for and identifying all possible errors or causes of failure in machinery and equipment that could compromise the production flow.

As previously mentioned, continuous improvement programs are not isolated, as they need the support of other tools and resources. In this case, TPM plans and programs are associated with Kaizen to ensure the ideal state and permanent availability of production machinery and equipment (Prabhuswamy et al. 2013). However, note that SMED can also be successfully linked to continuous improvement programs, since it is a tool used to reduce changeover times (Sachit and Pardeep 2014).

Finally, it is important to mention that machine failures reduction has a direct impact on other benefits later discussed in detail. Some of them include product quality, as a result of better-calibrated machinery, and compliance with delivery times thanks to an uninterrupted production flow (Knechtges and Decker 2014b).

9.1.10 Waste Reduction (Inventories, Waiting Times, Transport, Operator's Movements)

This is the tenth benefit of the list. On the one hand, the median value of this item (3.832) shows that the manufacturing sector of Ciudad Juárez often manages to remove waste thanks to Kaizen implementation. On the other hand, the IQR value, which equals 1.736, shows moderate consensus among respondents regarding the median value of the item. Note that this value is one of the highest IQR values found in the list.

Waste reduction is often the focus of attention of senior managers and production line managers. On one hand, inventory reduction is particularly important, as there is no point in having large quantities of raw material or product in the production process if they cannot be turned into a final product to be sold and invoiced. Selling is the only way of gaining economic fluidity (Askarany et al.

2010). Thus, inventories reduction is one of the biggest goals to be achieved by companies, and also one of the most studied in inventory management and supply chain environments.

As for production waiting times, they are mostly due to machinery failures, a lack of planning from human resources, and a poor production plan (Higuchi et al. 2015b). Therefore, companies must strive to ensure a continuous production flow by preventing errors in the equipment and properly planning production processes (Prabhuswamy et al. 2013).

As regards motion actions, it is important to remove all unnecessary movements from people and machinery, which add no value to the final product, but do increase its final cost and price. In this sense, Kaizen has been a useful tool for improving distribution of production machinery and equipment to avoid unnecessary motion actions. Cellular manufacturing and technology groups are some examples of improved organization with Kaizen (Radharamanan et al. 1996).

9.1.11 Material Handling

This benefit ranks eleventh in the list of Table 9.1. The median value of this item equals 3.809, while the IQR value equals 1.704. It can be hence concluded that the manufacturing sector of Ciudad Juárez often obtains this benefit in its production lines thanks to Kaizen implementation, and there is moderate consensus among respondents regarding the median value of the item.

Material handling is similar to waste reduction, as it involves short-distance movements within a company's facilities. One of the main problems of unnecessary movements is that they increase the likelihood of having an accident (James et al. 2014a), which is why companies are often advised to rely on automated systems.

Another way of reducing material movement distances is by improving the organization and distribution of the manufacturing equipment. Nowadays, cellular manufacturing and technology groups are common and successful forms of grouping machines depending on the activities that they perform (Mizuno et al. 2012a; Ikuma et al. 2011). Similarly, new technologies and improvements made to production processes make it possible for the same equipment to perform tasks that initially had to be performed by two or more machines physically spaced or separated (Rieckhof et al. 2015; Guenther et al. 2015).

9.1.12 Unit Manufacturing Cost Reduction

This is the twelfth benefit listed in Table 9.1. The median value of this item equals 3.803, which denotes that Mexican manufacturing companies in Ciudad Juárez often obtain this benefit from Kaizen implementation. In addition, the IQR value

(1.597) shows moderate consensus among respondents concerning the median value of the item.

This benefit can be the result of many others previously addressed in the chapter, including reduced production process steps and waste elimination. As previously mentioned, when unnecessary activities are removed, instead of representing additional costs, they bring savings later translated into reduced manufacturing costs (Stefea and Abbas 2015).

Also, when companies improve their methods for product design through the use of specialized software, they save time that can later be used in simulations to analyze the efficiency of the generated prototypes. And this reduces the incidence of errors in the manufacturing process (Rof 2011).

Furthermore, continuous improvement processes have enabled better organization and distribution of the manufacturing equipment. As a result, movement distances are reduced, as unnecessary motion actions are removed, and this brings savings that are later translated into reduced manufacturing costs (Ghicajanu 2011). Likewise, when companies achieve a continuous production flow as a result of permanently available machinery, inventory in process is reduced, which also represents savings for the company, and thus, for the product.

9.1.13 Defective Products Reduction

This is the penultimate benefit listed in Table 9.1. The median value of this item equals 3.793; therefore, it is assumed that the manufacturing sector of Ciudad Juárez often manages to reduce the amount of defective products in their production lines as a result of Kaizen implementation. Similarly, note that the IQR value equals 1.540, and this denotes moderate consensus among respondents regarding the median value of the item.

This benefit is the result of many other Kaizen benefits. As previously mentioned, Kaizen does not work in isolation. It is supported by diverse tools, such as total quality control (TQC), and TPM. On one hand, TQC seeks to reduce production waste and rework, and this significantly reduces the number of faulty products (Knechtges and Decker 2014c). On the other hand, TPM ensures machinery is always properly calibrated. In this way, products are delivered with the demanded quality standards and requirements (Newitt 1996; Gondhalekar et al. 1995).

Finally, note that product quality does not result only from the correct functioning of production machinery. Companies should never underestimate the power of training production operators. That is, human resources also play an essential role in the amount of defective products appearing in the production line (García et al. 2013a; Mano et al. 2014).

9.1.14 Order Lead Times Reduced as Close as Possible to Zero

This is the last benefit listed in Table 9.1. The median value of this item equals 3.741, while the IQR value equals 1.826, and it is the highest in the list. It is thus assumed that manufacturing companies in Ciudad Juárez often obtain this benefit from Kaizen implementation, and there is moderate consensus among survey respondents regarding the median value of the item.

This benefit is usually obtained from the use of advanced manufacturing technologies in every stage of the production process. For instance, as far as product design is concerned, we have previously discussed the advantages of using specialized CAD software, such as AutoCAD®, and 3D printers (Salleh et al. 2012).

As regards production technologies, manufacturing resource planning (MRP) and enterprise resource planning (ERP) software have transformed modern manufacturing in terms of production planning and material management (Mizuno et al. 2012a; Imai 2006). However, there are many other pieces of software available to support distribution systems in the different channels. In the end, all of them together help reduce manufacturing times, from the product design to its final delivery.

9.2 Competitive Kaizen Benefits

Table 9.2 lists 14 competitive benefits that manufacturing companies can gain from Kaizen implementation.

Table 9.2 Kaizen competitive benefits

Benefit	Percentiles			IQR
	25th	50th	75th	
The company has the tools to meet customer needs	3.334	4.187	4.859	1.525
The company meets customer needs	3.340	4.167	4.834	1.495
Experience in and knowledge of production processes	3.302	4.136	4.791	1.489
Improved product quality	3.256	4.079	4.777	1.521
Improved employee skills	3.241	4.026	4.708	1.467
Strategic advantage toward competitors	3.175	4.020	4.725	1.550
Improved product designs	3.010	3.892	4.687	1.677
Reduction of changeover times	3.142	3.884	4.622	1.480
Global competition	3.002	3.876	4.682	1.680
Continuous adaptation to sudden market changes	3.054	3.816	4.599	1.545
New products are more often introduced into the market	3.012	3.754	4.547	1.534
Process-oriented thinking	2.936	3.751	4.556	1.620
Internal barriers are easily removed, and authentic and powerful work teams emerge	2.951	3.730	4.535	1.585
Systemic and holistic corporate vision	2.816	3.695	4.524	1.708

As in the previous section, the descriptive analysis of items includes values of the first, second, and third quartile, and the IQR. Note that items are sorted in descending order according to their median value (second quartile).

As can be observed, six benefits have median values higher than four, which implies that they are very frequently obtained in the manufacturing industry of Ciudad Juárez as a result of Kaizen implementation. However, eight benefits show median values lower four four but higher than three. This demonstrates that they are often present in the surveyed manufacturing sector.

As regards the IQR, the table shows that all items have values higher than one but lower than two. This denotes moderate consensus among respondents regarding the median values of items.

9.2.1 The Company Has the Tools to Meet Customer Needs

This is the first benefit of the list. Its median value equals 4.187, while the IQR value is 1.525. Thus, as can be assumed, manufacturing companies in Ciudad Juárez usually have what is needed to meet customer needs with Kaizen, and there is moderate consensus among survey respondents regarding the median value of the item.

The ranking of this item is not surprising, since the objective of any LM tool must be customer-focused. In this case, supported by a series of techniques and actions, Kaizen enables to quickly identify the needs of customers, so they can be later transformed into product or service characteristics and attributes (Ujimoto 1993).

To achieve this benefit, companies must employ some strategies, such as a marketing team that successfully gathers and interprets the voice and needs of customers (Ghicajanu 2011). Also, it is important to have product/service design and development groups (Reid and Brady 2012), a production system properly modernized and able to provide the desired design features (Reid et al. 2016), and an efficient distribution systems for quick deliveries to customers (Koichi et al. 2014).

9.2.2 The Company Meets Customer Needs

This benefit ranks second in the list with a median value that equals 4.167, which means that the manufacturing sector of Ciudad Juárez is usually able to meet customer needs with their products or services as a result of Kaizen implementation. Similarly, the IQR value of this item is equal to 1.495 (one of the lowest values), which shows moderate consensus among respondents regarding its median value.

Note that the first benefit in Table 9.2 concerns the ability of a company to address customer needs, while this benefit refers to the extent to which such customer needs are actually met. That is, companies may be completely capable of reaching customer satisfaction with the product, but they fail in the process as a result of an incorrect interpretation of those needs.

Therefore, according to information gathered, it seems that managers of manufacturing companies in Ciudad Juárez are not only capable of meeting customer needs, but they also actually manage to meet them. This implies that available resources properly used and allocated in order to achieve the desired objectives (Carrillo and Zárate 2009).

9.2.3 Experience in and Knowledge of Production Processes

This benefit ranks third in the list with 4.136 as its median value, and 1.489 as IQR value. Thus, it is concluded that Kaizen implementation in the surveyed manufacturing sector is a useful tool for frequently obtaining this benefit. Moreover, there seems to be moderate consensus among respondents regarding the median value of the item.

Experience and knowledge are the result of many activities and benefits previously discussed. Some of these include proper training and bonus and incentive schemes as a result of goals achieved. All these strategies increase motivation and ensure employee retention (Hadjimarcou et al. 2013).

However, manufacturing companies in Mexico have a peculiar organizational structure, which is rigorous and only adheres to the requirements of parent companies, which are located overseas (Sargent and Matthews 2009). Unfortunately, this prevents them from making major modifications to their production systems, as they depend on production orders and needs indicated by the parent companies (García et al. 2013a).

9.2.4 Improved Product Quality

This benefit has a median value that equals 4.079 and an IQR value equal to 1.521. Therefore, as a result of Kaizen implementation, manufacturing companies in Ciudad Juárez usually manage to improve the quality of their products. Likewise, there seems to be moderate consensus among participants regarding the median value of this item.

Improving product quality is also the result of several activities addressed in previous chapters. We know that Kaizen is not an isolated tool in the production lines, as it is related to many others (Weber 2015a), such as 5S and Kanban. On one hand, the 5S methodology ensures clean and safe work spaces, which help quickly identify and have at hand all materials required for work (Gupta and Jain 2014). On the other hand, Kanban is a scheduling system that supports materials management and flow along the production lines, which improves product delivery times.

However, in addition to these tools, companies should not underestimate the value of modern production technologies implemented in the processes, since they play an important role in ensuring the required characteristics and quality in a product (Singh and Kumar 2013).

Likewise, education and training are essential for quality improvement, not to mention the characteristics of the materials entering the process (Liu et al. 2015b). That said, technically sophisticated processes are useless if operators do not know how to relate with them or poor-quality materials are supplied. Thus, in conclusion, product quality is the result of many activities together, not only one.

9.2.5 Improved Employee Skills

This is the fifth benefit listed in Table 9.2. The median value of this item is equal to 4.026, which shows that employees of manufacturing companies in Ciudad Juárez usually succeed in improving their work skills through Kaizen projects. Moreover, note that the value of the IQR is the lowest value reported in Table 9.2 (1.467), although it still denotes moderate consensus among survey participants regarding the median value of the item.

This benefit is mainly the result of training and education provided to human resources, since Kaizen does not focus only on the production process. It feels concerned with the well-being and development of people, which in turn, helps enhance production processes (Paraschivescu and Cotirlet 2015).

Also, the skills that employees manage to improve depend on their participation in continuous improvement programs or Kaizen events. Companies are thus welcome to implement motivation plans and programs, especially for production operators, to integrate them into improvement groups. Such integration would allow operators to make use and share their knowledge regarding the production process and its problems (Higuchi et al. 2015b; Mano et al. 2014; Machickita et al. 2016).

Finally, note that education and training programs offered to human resources should be implemented during working hours. Companies must commit to supplying all the necessary materials and resources needed for such programs, to watch over their success, and ensure successful learning experiences. Skills learned thus become value added to both employees and the companies (Sandoval-Arzaga and Suárez-Barraza 2010; Magnier-Watanabe 2011).

9.2.6 Strategic Advantage Toward Competitors

This benefit holds the sixth place in the analysis. According to its median and IQR values (4.020 and 1.550 units, respectively), it is assumed that manufacturing companies in Ciudad Juárez usually gain strategic advantage thanks to Kaizen implementation. Similarly, there is moderate consensus among survey respondents regarding the median value of the item.

Developing a strategic advantage to face competition is one of the major concerns and goals of company managers and executives. Competitiveness guarantees survival within today's globalized market (Maarof and Mahmud 2016; Kosandal and Farris 2004). However, it mainly depends on how well Kaizen planning has been developed. Managerial commitment, a properly developed continuous improvement culture, support provided to improvement groups, and the ability to rapidly identify and correct errors are some of the key elements that guarantee a company an outstanding place in the market (Popescu 2015).

All strategic factors must be reinforced with operator-oriented leadership. In this sense, managers are responsible for properly directing the skills and capabilities of production operators to help them successfully identify errors and promote improvement changes (Tsao et al. 2015). Otherwise, if production operators are unable to detect errors, managers are less likely to detect them by themselves, as their positions involve more administrative tasks than operating activities.

Let us not forget that Kaizen administrators are responsible for appropriately integrating Kaizen with all the LM tools implemented in the company. Likewise, operators must know that the goal is to reach a lean production, which is why none of such LM tools is in conflict with another. Thus, they all must be correctly applied and supervised (Rahman et al. 2013; Jasti and Kodali 2014).

9.2.7 Improved Product Design

This benefit is ranked seventh in the descriptive analysis of Table 9.2. The median value equals 3.892, while the IQR value is equal to 1.677. As can be assumed, the manufacturing sector of Ciudad Juárez often—not regularly—manages to improve product designs as a result of Kaizen implementation. Similarly, there is moderate consensus among survey respondents regarding the median value of the item.

Product design is an interactive process where sale agents first identify customer needs. Later on, such information is conveyed to company designers who translate such needs into a 2D or 3D product design. (Huenteler et al. 2016; Song and Sakao 2016). However, the ability to improve a product design is directly associated with the technologies used. Such technologies include modern and specialized software for fast and precise design and 3-D printers (Wang et al. 2016). In the end, these resources enable to timely provide the final prototype to the production planning department. Then, at that stage, MRP software can help quickly generate a list of materials to be ordered, so the production process starts as soon as possible.

Finally, another key element to improving product designs is the speed at which modifications can be made to a final prototype. Moreover, nowadays it is possible to simulate a whole production process before the product is generated, which helps identify problems in terms of the installed manufacturing equipment (Zhu et al. 2016; Harder et al. 2016).

9.2.8 Reduction of Changeover Times

This benefit ranks eight in Table 9.2. According to its median and IQR values (3.884 and 1.480, respectively), it is assumed that manufacturing companies in Ciudad Juárez often obtain this benefit from Kaizen implementation, and there seems to be moderate consensus among respondents regarding the median value of the item.

This benefit is the result of many Kaizen planning activities previously discussed. However, perhaps the most significant is TPM (Prabhuswamy et al. 2013). As previously mentioned, TPM forces companies to properly schedule machine setup and maintenance sessions (Sachit and Pardeep 2014). However, note that in TPM, it is important to appropriately record why and when every machine component has been replaced (Ahmad et al. 2012a; Singh et al. 2013). The importance of this benefit relies on the fact that machine stoppages are reduced, which increases availability of the manufacturing equipment for the different production processes.

9.2.9 Global Competition

This is the ninth benefit listed in Table 9.2. The median value of this item equals 3.876, which shows that the surveyed manufacturing companies often obtain this benefit from Kaizen implementation. Also, the IQR value equals 1.680, which denotes moderate consensus among respondents regarding the median value of the item.

Kaizen makes improvements in the whole production system, from planning materials procurement to the production process and the final product distribution phase. Therefore, if companies consider knowledge from each one of the employees regarding these different processes, it will be easier to identify opportunity areas to be improved. This eventually translates into a competitive advantage and ensures early entrance to the different globalized markets (Sandoval-Arzaga and Suárez-Barraza 2010; Magnier-Watanabe 2011).

However, to reach these markets, it is necessary to identify the needs of different customers around the world. Afterward, companies should be willing to generate similar products with small variations according to the needs, likes, and cultural values of each region (Mihail Aurel et al. 2010; Machickita et al. 2016). Nevertheless, such variations may be a challenge to some production systems, since they imply small lot production, and companies must be able to address changeovers and setups as fast as possible. Also, production operators must be properly and sufficiently trained in the different activities involved in changeovers.

9.2.10 Continuous Adaptation to Sudden Market Changes

This benefit ranks tenth in the descriptive analysis. The median value of this item equals 3.816, while the IQR value is equal to 1.535. As can be assumed, the manufacturing sector of Ciudad Juárez often obtains this benefit as a result of Kaizen implementation, and there seems to be moderate consensus among survey participants regarding the median value of this item.

There are some similarities between this benefit and the previous one; however, while global competition regards the ability of a company to compete in the market, continuous adaptation involves the capacity of successfully responding to abrupt changes in demand. Since this capacity of response is more related to supply chain agility, it is important to discuss the different agility sources for organizations.

Companies should not underestimate the quality of information and communication technologies (ICTs) installed in the supply chain, as well as the different alternatives to generate the same product (Narasimhan et al. 2006; Kisperska-Moron and de Haan 2011). These technologies allow the company to be timely informed of the changes occurring in customer needs, so they can make decisions and adjustments according to the external environment in which they are competing (Mensah et al. 2015; Jorgenson and Vu 2016).

A lack of adequate information means that organizations would be unable to make quick and appropriate decisions. Fortunately, current technology tools allow decisions to be made in real time, since it is possible to monitor the current state of the production process within the company, as well as the customer needs outside of it (Chan 2016; Fan et al. 2015).

9.2.11 New Products are More Often Introduced into the Market

This is the eleventh benefit of the list in Table 9.2. Its median value is equal to 3.754, which implies that manufacturing companies in Ciudad Juárez often manage to introduce new products into the market with the support of Kaizen philosophy. Similarly, the IQR if this item equals 1.534, which shows moderate consensus among respondents regarding its median value.

This benefit is to a great extent the result of technologies used, especially for product design and prototyping. As previously discussed, many companies rely on modern software for computer-aided designs, which accelerates the design process and enhances production process synchronization, thus improving product deliveries to final customers (Mitta and Flores 1995). However, other types of technologies are also applied to the production area, and advanced manufacturing machinery thus simplifies the material flow and consequently reduces product delivery times (Singh and Kumar 2013).

9.2.12 Process-Oriented Thinking

This benefit ranks twelfth in Table 9.2. The median and IQR values of this item (3.751 and 1.620, respectively) suggest that manufacturing companies in Ciudad Juárez often obtain this benefit as a result of Kaizen implementation, and there is moderate consensus among survey respondents regarding the median value of the item.

Process-oriented thinking is the result of many Kaizen activities. Improvement or opportunity areas are generally identified in the production process, and this is where managers generally focus on to solve problems (Gupta and Jain 2014; Miller et al. 2014). However, one must bear in mind that problem solving requires great skills to detect issues, which generally involve production operators, since they are the ones familiar with the production process (Stone and Kerno 2010; García et al. 2014a).

Process-focused thinking was successful for a long time, and it even gave birth to important LM tools such as statistical process control (SPC). However, current trends for strategic competition now emphasize on more holistic approaches that do not highlight only the production process but the entire supply chain (Dass and Fox 2011; Askarany et al. 2010; Martínez-Jurado and Moyano-Fuentes 2014).

9.2.13 Internal Barriers are Easily Removed, and Authentic and Powerful Work Teams Emerge

This is the penultimate item of the list. Its median value (3.730) proves that manufacturing companies in Ciudad Juárez often obtain this benefit with Kaizen support. Likewise, the IQR value (1.585) shows moderate consensus among respondents regarding the median value of the item.

This benefit largely depends on how Kaizen is truly implemented in the company. It is the result of successful collaborative work among responsible people seeking to solve a problem in the production lines. Team members represent different areas and departments, which allow problems to be addressed from different perspectives, and their solutions do not pose problems or cause resistance to change (Olsen et al. 2014; Glover et al. 2011b; Oropesa-Vento et al. 2015b; Liu et al. 2015c).

If problems were addressed by only one person, the so-called ideal solution would reflect the thinking and vision of only this person. The advantage of multidisciplinary groups, thus, is the holistic approach that is ensured, which is reflected on the quality of the solutions and the company's reaction to them (Flohr-Rincon and Tucker 2012a).

Finally, it is important to mention that improvement group members often relate beyond the work environment and problem-solving contexts. In this sense, social relationships among coworkers facilitate communication among departments and employees.

9.2.14 Systemic and Holistic Corporate Vision

This benefit holds the last place in the list of Table 9.2. The median value of this item (3.685) shows that manufacturing companies in Ciudad Juárez often obtain this benefit from Kaizen implementation. However, note that it is the least frequently competitive advantage gained. Likewise, the IQR value, which is equal to 1.708, shows moderate consensus among respondents regarding the median value of the item.

A systemic and holistic vision is the reflection of many Kaizen activities successfully implemented. Perhaps the most important are improvement groups. As previously discussed, their multidisciplinary nature allows problem solutions to be proposed from a holistic approach, thus considering different needs and interests (Stone 2010; Medinilla 2014c).

Another key element of improvement groups is their ability to include members of different hierarchical levels, as a means to convey the company strategic needs. If improvement groups were homogenous, the company would lose its holistic vision. Similarly, it would be meeting the needs of a single organizational level (Popescu 2015; Wennecke 2008; Armstrong-Viner 2010). Thus, multidisciplinary and heterogeneous improvement groups guarantee information flow along the entire hierarchical structure, thus allowing all to know the operational problems of workers, but also the strategic vision of managers.

9.3 Human Resources Benefits of Kaizen

As previously mentioned, Kaizen as a LM tool can also be applied to the production process through human resources. Therefore, it is logical to assume that this philosophy also benefits employees who implement it and follow it. If this were not to be possible, interest on continuous improvement and Kaizen would be lost, and employees would think that changes are only the responsibility of executives and top managers.

Table 9.3 lists 13 Kaizen benefits for human resources identified in the literature. As in the previous analyses, items are organized in descending order depending on their median value (50th percentile) located in the third column. Similarly, the IQR provides the dispersion measure of each item.

As can be observed, almost all items show a median value below four, which shows that the manufacturing sector of Ciudad Juárez often, but not always, obtains

Table 9.3 Kaizen benefits for human resources

Benefit	Percentiles			IQR
	25th	50th	75th	
Increased customer satisfaction	3.223	4.073	4.776	1.552
Increased employee responsibility and commitment	3.164	3.977	4.683	1.519
Fewer cumulative trauma disorders (CTDs) from ergonomic problems	3.142	3.965	4.706	1.563
Attention is paid to the most important issues	3.144	3.958	4.687	1.542
Improved attitude and skills of managers and executives to address continuous improvement changes	3.102	3.915	4.674	1.572
Improved communication among administrative levels	3.064	3.839	4.614	1.549
Improved attitude and work skills of operators	3.036	3.831	4.614	1.578
Increased participation	3.056	3.822	4.609	1.552
Positive influence on individuals	3.017	3.806	4.609	1.592
Increased employee motivation	3.013	3.790	4.594	1.581
Participation and collaboration to build a new system	2.929	3.781	4.605	1.677
Decreased customer attrition and employee turnover	2.864	3.751	4.592	1.728
Increased employee self-esteem	2.886	3.739	4.572	1.685

benefits for human resources with the support of Kaizen. As regards the only item with a median value above four, it is assumed that manufacturing companies in Ciudad Juárez usually manage to increase customer satisfaction. Finally, considering the IQR, all values are higher than one but lower than two. Thus, there seems to be moderate consensus among survey respondents regarding the median values of items for this category.

It is important to mention that the benefits analyzed in this section of the chapter are comprised in two major categories: benefits gained within the company and benefits gained outside of the company. The former involve operators and managers, whereas the latter are associated with customers.

9.3.1 Increased Customer Satisfaction

This is the first benefit, and thus shows the highest median value, which is also above 4. Therefore, as previously mentioned, it is assumed that the manufacturing sector of Ciudad Juárez very frequently manages to satisfy customers with its products. As for its IQR value, it equals 1.552.

The position of this item in the list is not surprising. Every continuous improvement group must be focused on solving problems that can be translated into customer benefits. However, note that managers must also make this effort (García et al. 2013a; García et al. 2014a).

Therefore, customer satisfaction increases when product quality is improved, products are rapidly delivered, and customer needs and requirements are met on time (Wouters and Kirchberger 2015; Striteska and Jelinkova 2015). In conclusion, the values of this item in the analysis support the argument that all lean manufacturing tools must be customer-focused. Only satisfied customers can guarantee the survival of a company, because they buy the final product (Rasmussen and Tanev 2016; Ugarte et al. 2016).

9.3.2 Increased Employee Responsibility and Commitment

This is the second benefit listed in Table 9.3. Its median and IQR values (3.977 and 1.519) demonstrate that manufacturing companies in Ciudad Juárez often obtain this benefit as a result of Kaizen implementation, and there is moderate consensus among respondents regarding the median value of the item.

As in the previous case, the position of this benefit is not unexpected, since companies plan their Kaizen events or continuous improvement groups in a multidisciplinary way. However, each improvement project also comes with a work plan, in which each participant is assigned different activities to be performed in a certain period of time, and results must be reported to the group leader (Maarof and Mahmud 2016; Higuchi et al. 2015b). This routine not only seeks to obtain results, but to integrate operators in problem-solving situations. As a result, responsibility and commitment are promoted not only toward the project, but also toward the company and coworkers (Mizuyama 2012).

Improvement groups that properly record projects under development can easily identify the problem to be solved. Eventually, they will monitor the problem again once solution measures have been taken in order to determine results obtained (Armstrong-Viner 2010; Medinilla 2014a). In this case, success must be visible through information obtained from process statistical data.

9.3.3 Fewer Cumulative Trauma Disorders (CTDs) from Ergonomic Problems

This benefit ranks third in Table 9.3. Its median value equals 3.965, which shows that manufacturing companies in Ciudad Juárez often obtain this benefit with the support of Kaizen. Similarly, the IQR of this item is equal to 1.563, and this demonstrates moderate consensus among survey respondents regarding the median value.

As in previous cases, the position of this item is not a surprise. In a continuous improvement culture, all employees, especially production operators, are concerned with their safety and their coworkers'. Moreover, problems or situations associated with occupational hazards that may result in an accident or a cumulative trauma disorders are the first to be addressed by continuous improvement groups (Vieira et al. 2012b). Nevertheless, the company must also be interested in reducing the number of accidents, as this implies paying lower fees related to medical insurance, absenteeism, incapacities as a result of injuries (Rodriguez and Lopez 2012).

A high-risk company should be able to provide employees adequate working conditions; otherwise, it may be sanctioned by local, state, and national regulations. In the specific context of Mexican manufacturing companies, the Secretariat of Labor and Social Welfare supervises enterprises on a daily basis to analyze and identify possible sources of risk. Similarly, three days after being hired, employees must register with the Mexican Social Security Institute to receive medical and pension insurance. If employees are not registered, companies may be fined, and even shut down if they do not comply with regulations.

Therefore, since no manager wants his/her company to be administratively and economically sanctioned, and because employees do not want to suffer any accident or be exposed to risks at work, this is one of the most important benefits of Kaizen, which always seeks to improve working conditions.

9.3.4 Attention is Focused on the Most Important Issues

This benefit holds the fourth place on the list. Its median and IQR values (3.958 and 1.542, respectively) show that Mexican manufacturing companies in Ciudad Juárez often gain this benefit from Kaizen implementation, and there is moderate consensus among survey respondents regarding the median value of the item.

This benefit reflects how improvement groups truly work. They successfully identify and prioritize opportunity areas, and such priorities mostly depend on the economic impact, the number of customer complaints, or health repercussions of the issue or problem (Glover et al. 2014). Fortunately, improvement groups are taught problem-solving techniques that allow them to identify priorities. Some of them include the seven basic quality tools and Pareto diagrams, which enable to graphically visualize problem sources (García et al. 2013a; Higuchi et al. 2015b).

Finally, this benefit can also lead to other Kaizen advantages, especially in terms of satisfaction for managers and employees, who can successfully tackle the most important opportunity areas. However, this is also the product of a continuous improvement culture.

9.3.5 Improved Attitude and Skills to Address Continuous Improvement Changes

This benefit holds the fifth place on the list. Its median and IQR values (3.925 and 1.572, respectively) show that managers of Mexican manufacturing companies in Ciudad Juárez often improve their attitude and skills with Kaizen support, and there is moderate consensus among survey respondents regarding the median value of the item.

As previously mentioned, Kaizen allows employees to prioritize issues that are of foremost importance for the company or themselves. Thus, solutions chosen must be beneficial for all (Tong et al. 2015), and this is where improvement groups may encounter other challenges to overcome. When solutions are implemented, there may be resistance to change (Genevičiūtė-Janonienė and Endriulaitienė 2014).

However, if companies are trained enough in Kaizen, both managers and production operators would be more willing to embrace changes on a daily basis, respecting the opinions of the rest of the people involved (Grace et al. 2012). This ability reflects the kind of leadership of continuous improvement groups. If operators are not part of these groups, it is very likely that proposals will be rejected (Lines et al. 2015). Thus, it is important to promote a positive attitude to accept changes and improvements through a more holistic and integral approach.

9.3.6 Improved Communication Among Administrative Levels

This is the sixth benefit listed in Table 9.3. The median value of this item equals 3.839, which shows that the manufacturing sector in Ciudad Juárez often improves communication through Kaizen support. Likewise, the IQR value (1.549) implies moderate consensus among survey respondents regarding the median value of the item.

Kaizen seeks for continuous improvement from a holistic and integral approach, which is why enhanced communication is merely a direct result of Kaizen implementation when all activities are properly performed. However, it is important to mention that all administrative and management departments must be integrated to ensure a communicative environment. Moreover, consensus is essential when making decisions regarding the future of the company (Magnier-Watanabe 2011).

Similarly, as previously mentioned, continuous improvement groups must be multidisciplinary, so that all areas of the company are involved in the decision making process, and solutions are proposed from a holistic perspective. Undoubtedly, a multidisciplinary approach helps companies find the most suitable solutions, which are also more likely to be accepted by operators (Barbara 2015; Higuchi et al. 2015a).

9.3.7 Improved Attitude and Work Skills

This is the seventh benefit listed in Table 9.3. Its median and IQR values (3.831 and 1.578, respectively) demonstrate that Mexican manufacturing companies in Ciudad Juárez often manage to enhance their attitude and work skills with Kaizen support. Similarly, there is moderate consensus among respondents regarding the median value of the item.

While the benefit addressed two subsections above (see Sect. 9.3.5) specifically concerns acquiring attitudes and skills for continuous improvement management, this benefit refers to the ability of Kaizen to enhance work skills and attitudes in general. Thus, this benefit is the result of successful teamwork. In this sense, the social relationships among improvement group members, and workers in general, play an important role. When employees constantly interact at work, their relationships may go beyond the work place, which strengthens integration and communication in all directions (Dhurup et al. 2016).

Another factor that influences employee attitudes are results obtained from improvement projects implemented. Such results must be visible within the company's facilities, so all employees know them. Similarly, companies must make an effort to acknowledge human resources when necessary. All this ensures a trustful and integrate environment when operators feel comfortable with both the mission and vision of the organization. Consequently, work satisfaction increases (Livi et al. 2015). Therefore, as a conclusion, the best way to change the attitude and skills of both managers and operators is to make results and benefits obtained from improvement projects visible and tangible.

9.3.8 Increased Participation

This is the eight benefit listed in Table 9.3. It has a median value that equals 3.822, which denotes that the manufacturing sector of Ciudad Juárez perceives higher levels of participation from all employees thanks to Kaizen implementation. As for the IQR value, it equals 1.552 and shows moderate consensus among survey participants in terms of the median value of the item.

When Kaizen is properly implemented, companies can quickly see the positive results. These results impact on the economic and social aspects of organizations, but also on the life of each employee (Doolen et al. 2008). Thus, if such results are appropriately disseminated, it is easier to convince other departments and company areas to be part of the new multidisciplinary and collaborative way of working.

For this reason, it is important that executive departments support Kaizen groups in their goal of reaching solutions to production-related problems. That said, particular attention must be paid to novice members, since even the smallest failure may deeply disappoint them, and perhaps they may not want to participate again (Midiala et al. 2015; García et al. 2014a).

Therefore, at the Kaizen planning phase, Kaizen groups must be equipped with all necessary tools to easily reach their objectives (Glover et al. 2011c). Hence, executives must guide Kaizen groups with the help experts or leaders, and they must provide such tools and materials through group leaders. Global participation is only possible if the whole company is convinced of the benefits of Kaizen, as an improvement philosophy, to both the company and one's personal life.

9.3.9 Positive Influence on Individuals

This benefit holds the ninth place in the list of Table 9.3. Its median value is equal to 3.806, and this shows that employees of manufacturing companies in Ciudad Juárez are often positively influenced by Kaizen philosophy. Similarly, the IQR value, which equals 1.592 implies moderate consensus among respondents regarding the median value of the item.

Once Kaizen is properly implemented, its positive effects on the personal lives of individuals are not surprising (Stone 2010). When employees work under a continuous improvement culture, they become more motivated, as they feel capable of effectively and efficiently solving problems (Mizuno et al. 2012b) (Mizuno et al. 2012b). Moreover, they are acknowledged for their capabilities and outstanding performance, and, in some cases, they can be economically rewarded. Therefore, positive results from improvement projects are not only the objective of improvement group leaders. Company managers must be equally committed to reach such objectives, as the survival of Kaizen groups depends on them (Suárez-Barraza and Ramis-Pujol 2010; Stone and Kerno 2010).

Finally, note that when improvement groups are unable to successfully solve problems and reach the planned objectives, it is usually the reflection of integration and communication issues. This may be due to little participation or poor leadership, which have a negative impact on the group. Company managers should feel deeply concerned in these cases, and they must emphasize on the fact that results must be reached at a specific moment after a congruent period of time (Farris et al. 2009b).

9.3.10 Increased Motivation

This benefit is ranked tenth in Table 9.3. Its median and IQR values (3.790 and 1.581, respectively) show that employees of manufacturing companies in Ciudad Juárez become more motivated in a Kaizen environment, and there is moderate consensus among respondents regarding the median value of the item.

Increased motivation is the result of many other Kaizen planning activities and benefits previously discussed. Perhaps the most important of these elements is managerial commitment. It is important that executives ensure all materials and tools required to work (Kumashiro 2011). Training is also part of these tools, and must be offered as a means to develop the necessary skills to successfully reach the planned objectives (Topuz and Arasan 2013). Moreover, improvement groups must be guided by appropriate leadership (Kumashiro 2011), and managers must make sure that this is actually happening.

If managerial commitment exists, training and education are provided, and leadership is appropriately offered to continuous improvement groups. Then, companies are very likely to attain all the goals and objectives that they have planned, and thus motivation increases. However, this should not be the only source of satisfaction. The senior management department must recognize and acknowledge the efforts that every group member has made to reach the results desired. In this sense, many companies have implemented different incentive programs.

9.3.11 Participation and Collaboration to Build a New System

This benefit ranks eleventh in Table 9.3. The median value of this item (3.781) shows that the surveyed manufacturing sector in Ciudad Juárez often gains participation and collaboration from the whole organization to build a new and improved system. Similarly, note that the IQR value, which equals 1.677, is one of the highest values, and it proves that there is moderate consensus among survey respondents regarding the median value of the item.

We personally consider this benefit as one of the most important, and perhaps it should have occupied one of the first places in Table 9.3. Participation in continuous improvement groups is always collective. Moreover, it should not focus only on the area where the solution is implemented, but should seek to improve all the production or administrative system (Koide et al. 2007). That is, with every contribution made, companies should be able to improve the system as a whole.

As previously argued, managerial commitment in Kaizen groups is key to their performance and their commitment to the company, which should be both measured when possible by group leaders (Alukal and Manos 2006). In other words, efforts must be focused on making employees "put the shirt on." This is the only way of guaranteeing their commitment and the success of projects that they carry out. This to a great extent determines the system's improvement. No system operates with independently working parts.

9.3.12 Decreased Customer Attrition and Employee Turnover

This is the penultimate benefit in Table 9.3. Its median value equals 3.751 and demonstrates that the manufacturing industry in Ciudad Juárez often gains this benefit from Kaizen implementation. From a different perspective, note that the IQR value of this item is the highest of the list. This shows less consensus among survey participants regarding its median value.

Customer attrition is difficult to measure, since this type of information is only available to the company's sales department. In comparison, improvement group members are able to perceive how often their coworkers are replaced. In this case, reduced employee turnover occurs when workers become highly skilled in their positions and familiar with any problems that may arise there (Brunet and New 2003). Hence, since they become a source of value translated into knowledge, workers are rarely removed from their jobs, as it would imply a new and novice operator would need to undergo the learning process one more time.

Thus, managers usually decide to keep skilled employees in their current positions, allowing them to become experts, but also asking them to integrate with other groups that include different positions and function under other work dynamics to know the problem and seek a solution under a systemic approach (Modarress et al. 2005a).

9.3.13 Increased Employee Self-esteem

This is the last benefit listed in Table 9.3. Its median value (3.739) implies that manufacturing companies in Ciudad Juárez often manage to increase employee self-esteem with Kaizen support. Similarly, the IQR value, which equals 1.685, denotes moderate consensus among survey respondents regarding the median value of the item.

Increased self-esteem is another positive Kaizen impact on employees. However, it develops with time and is encouraged by knowledge and experience acquired. Therefore, it is important that managers guarantee an appropriate learning environment at work, where employee performance and presence in the company are valued and appreciated (Dwivedula and Bredillet 2010).

Similarly, the training system should primarily focus on promoting confidence, as employees would be provided with all the necessary tools to solve problems. Nevertheless, it is also important to remind employees that the expected results may not always be achieved, but the key is to learn from mistakes and failures. In this sense, group leaders must always establish challenging but reachable goals (Topuz and Arasan 2013).

9.4 Conclusions

This chapter analyses three major types of benefits that manufacturing companies can gain from Kaizen implementation. From the entire discussion provided in this chapter, it can thus be concluded that thanks to Kaizen in the manufacturing industry of Ciudad Juárez:

- Companies comply with scheduled product delivery times and follow the production plan.
- Companies make better use of the available resources, waste is eliminated, income is increased, and the cash flow is improved.
- Design and operating cycles are successfully reduced, allowing for fast product deliveries.
- Cellular manufacturing is employed to group production activities and reduce material movements and occupational accidents and risks.
- Production errors and rework are reduced, thus reducing unit costs.
- Motivation and self-esteem is increased. Thus, employees improve their attitudes towards changes.
- Communication is improved in both directions—vertical and horizontal—which enables to quickly solve problems.
- Employee participation is enhanced in order to solve problems in the production system.

Chapter 10
Validation of Variables

Before constructing the structural equation model, latent variables and their items (Kaizen activities and benefits) must undergo a validation process. As discussed in Chap. 3, Kaizen implementation has been divided into three phases, each one of them containing specific and critical activities. These activities—also named items or variables—are in turn included into categories known as latent variables. Such integration method has been employed according to previous research that we have carried out (García et al. 2014a; García et al. 2013a).

The questions underlying this chapter is whether the items or variables included in a given latent variable truly correspond to it, and whether Kaizen benefits identified should remain in the analysis. Therefore, the goal in this part of the book is to simplify latent variables to a minimum, which is why certain items discussed in the previous chapters may be removed to improve reliability of the study. To determine the inclusion or exclusion of variables, we use the Cronbach's alpha index (CAI). Therefore, the cutoff value is set to 0.8; thus, modifications to latent variables must be made if that value is not reached.

10.1 Variables at the Kaizen Planning Phase

This phase comprises 14 activities, items, or variables integrated into three latent variables:

- Managerial commitment
- Work team organization
- Human resources development.

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10.1.1 Managerial Commitment

This latent variable includes five observed variables or items previously discussed (see Chap. 3). Table 10.1 shows results from the validation process. The first column includes each activity, while the second column contains its CAI value. If a given observed variable is removed, a third column includes all CAI values except for the removed variable.

As can be observed, reliability of this latent variable is reached from the first iteration, as its CAI value equals 0.801. This means that none of the observed variables is removed, since it would decrease the index value. Therefore, based on information obtained from the second column of Table 10.1, all observed variables remain in the analysis and are part of latent variable *Managerial commitment.*

10.1.2 Work Team Organization

This latent variable is composed of five items previously discussed in Chap. 3. Table 10.2 shows results obtained from the validation process. As in the previous table, the first column includes the items validated, while the second one corresponds to their CAI values if these variables are removed. The third column shows results from the second iteration of the reliability test.

As can be observed, if the five items are considered (first iteration), the CAI value for this latent variable equals 0.636. However, this value can increase up to 0.803 if the item *Improvement groups set goals to comply with improvement programs* is removed. Results from the second iteration thus appear in the third column of the table and imply that no other item should be eliminated to increase the CAI value. Therefore, based on this information, latent variable *Work team organization* is defined by four of the five observed variables, with a CAI = 0.803.

Table 10.1 Validation of latent variable: *Managerial commitment*—Kaizen planning phase

Activity	CAI 1
The management department plans the acquisition of all the resources needed for improvement programs (financial resources, physical space, time)	0.757
The company sets policies, objectives, and the structure of Kaizen events	0.760
Customers' opinions are taken into account when making changes	0.794
The company develops a continuous improvement culture	0.751
The company has a structure to detect failures	0.752
Cronbach's alpha index	0.801

Table 10.2 Validation of latent variable: *Work team organization*—Kaizen planning phase

Activity	CAI 1	CAI 2
Suggestion groups are organized to improve products and processes or solve problems	0.555	0.745
Improvement groups are committed and motivated	0.568	0.758
Improvement groups set goals to comply with improvement programs	0.803	
The company has groups to support Kaizen execution	0.519	0.725
Improvement groups are heterogeneous	0.543	0.764
Cronbach's alpha index	0.636	0.803

10.1.3 Human Resources Training

Four items are initially included in this latent variable associated with training and development opportunities provided to employees. As previously mentioned, these items have been addressed in Chap. 3. Thus, Table 10.3 shows results from the validation process. As it is known, the first column of the table lists the Kaizen activities validated, while the second and third columns include results from the iterations.

According to results from Table 10.3, if all items are considered, the CAI value of this latent variable equals 0.545. Since such a value is lower than the minimum value accepted, item *Members of improvement groups are skilled and experienced* is removed. As a result, CAI increases up to 0.809 units, which shows that no other observed variable ought to be removed. Therefore, it is concluded that latent variable *Human resources training* comprises three of the four items or activities initially observed, and it has a Cronbach's alpha value equals to 0.809.

10.2 Variables at the Kaizen Execution Phase

This phase refers to the active part of implementing Kaizen philosophy. It is when improvement groups actually execute improvement programs and plans previously designed. Chapter 3 identified 24 critical Kaizen activities to be performed at the execution phase. These activities are included in three latent variables:

Table 10.3 Validation of latent variable: *Human resources training*—Kaizen planning phase

Activity	CAI 1	CAI 2
Production operators and administrative staff are trained	0.404	0.737
Managers are trained in teamwork and problem-solving skills	0.422	0.767
The company is seen as a learning organization	0.403	0.712
Members of improvement groups are skilled and experienced	0.809	
Cronbach's alpha index	0.545	0.809

- Easiness to implement proposals
- Human resources integration
- Customer focus.

10.2.1 Successful Implementation of Proposals

This latent variable includes eight items or previously observed variables. Table 10.4 shows the validation process, where the first column lists the Kaizen activities validated, and the second and third columns include results from the iterations run.

After the first iteration, it is observed that the CAI value for this latent variable is already above 0.8 units (CAI = 0.842). However, if item *Restrictions to implement the improvement changes* is removed, the index increases up to 0.845. Thus, the second iteration improves reliability of the latent variable and reveals that no other variable should be eliminated. It is hence concluded that latent variable *Successful implementation of proposals* encompasses seven items with a CAI value that equals 0.845.

10.2.2 Human Resources Integration

This latent variable also contains nine variables previously discussed in Chap. 3. Table 10.5 includes results from the validation process. As discussed in the past sections, the first column of the table includes the validated activities, while the second column contains results from the iteration run as a means to increase reliability of the study.

Table 10.4 Validation of latent variable: *Successful implementation of proposals*—Kaizen execution phase

Activity	CAI 1	CAI 2
Managerial and interdepartmental leadership	0.823	0.809
5S is implemented as a Kaizen strategy	0.840	0.829
Kanban is implemented as a Kaizen strategy	0.845	0.840
Restrictions to implement the improvement changes	0.845	
Collaborators eagerly contribute to continuous improvement changes	0.832	0.823
An internal or external facilitator helps effectively coordinate the improvement program	0.832	0.822
Improvement groups include representatives of different disciplines	0.832	0.825
The PDCA cycle (plan-do-check-act) is used as a Kaizen strategy	0.824	0.813
Cronbach's alpha index	0.842	0.845

Table 10.5 Validation of latent variable: *Human resources integration*—Kaizen execution phase

Activity	CAI 1
Employees are committed and motivated	0.866
Group members are recognized for their achievements and efforts in Kaizen events	0.861
Human resources are integrated	0.865
The company has a well-defined organizational culture	0.876
Administrative staff and operators are self-disciplined	0.867
Job rotation is promoted	0.867
Employees are skilled and experienced	0.862
The intelligence and creativity of workers are used in a productive way	0.866
There is communication across departments	0.862
Cronbach's alpha index	0.879

After the first iteration, the CAI value for this latent variable equals 0.879. However, the analysis shows that such a value cannot be improved if any of these items were removed. Thus, latent variable *Human resources integration* includes nine observed variables or items, and it has a CAI value that equals 0.879.

10.2.3 Customer Focus

This variable initially includes six items. Table 10.6 shows results from the validation process. As in previous cases, the Kaizen activities validated and the results obtained from the iterations run appear in the columns.

As can be observed, the CAI value of the latent variable after the first iteration equals 0.835, and the analysis shows that there is no need to remove any item. Therefore, it is concluded that latent variable *Customer focus* encompasses six observed variables, activities, or items, and it has a CAI value equal to 0.835.

Table 10.6 Validation of latent variable: *Customer focus*—Kaizen execution phase

Activity	CAI 1
The company has methodologies to understand customers	0.817
The company follows a standard operating procedure (SOP)	0.812
The company is customer-focused	0.802
The company focuses on critical processes that definitely influence Kaizen sustainability	0.809
The improvement approach is consistent with the organizational culture	0.806
Internal processes are efficient in checking the effectiveness of proposed solutions	0.805
Cronbach's alpha index	0.835

10.3 Variables at the Kaizen Control Phase

This phase is important since it aims at sustaining Kaizen projects and plans through monitoring and control techniques. Chapter 3 previously identified 14 activities from the literature that are important in this phase. In this book, each one of these activities is included in one of the following latent variables:

- Communication process
- Documentation and evaluation
- Organizational culture.

10.3.1 Communication Process

This latent variable includes only three observed variables or items. The validation process is shown in Table 10.7. The first column lists the validated activities, while the second column shows results from the first iteration run in order to increase reliability of the study.

As can be seen, the CAI value of this latent variable equals 0.832, which is above 0.8 (the minimum value accepted). If any of the items were removed, the value would decrease. Thus, it is concluded that latent variable *Customer focus* includes three observed variables and CAI = 0.832 and there was not necessary to delete any item.

10.3.2 Documentation and Evaluation

Six activities or items are included in this latent variable. As in previous cases, Table 10.8 shows results from the validation process. The first column includes the analyzed variables, while the second and third columns introduce results from the iterations run as a means to increase reliability of the latent variable. Two iterations were required for find a solution.

According to Table 10.8, although CAI of the latent variable is higher than 0.8 (CAI = 0.838) after the first iteration, removing item *Value chains are mapped*

Table 10.7 Validation of latent variable: *Communication process*—Kaizen control phase

Activity	CAI 1
Managers inform operators of their work performance	0.501
Employees are interviewed to identify their needs	0.561
Interdepartmental communication is successful	0.541
Cronbach's alpha index	0.832

Table 10.8 Validation of latent variable: *Documentation and evaluation*—Kaizen control phase

Variables	CAI 1	CAI 2
Forms and/or control records are used to assess activities performance	0.825	0.827
The company applies appropriate control and monitoring techniques	0.800	0.798
The company has an organizational structure to detect failures	0.788	0.793
Value chains are mapped	0.842	
Pending issues are documented and monitored	0.806	0.811
Activities are periodically assessed through performance evaluation systems	0.808	0.818
Cronbach's alpha index	0.838	0.842

would increase the value up to 0.842 units from 0.838 units, increasing only 0.004 units, but eliminating trivial items. Thus, the third column shows results from the second iteration. And it is concluded that latent variable *Documentation and evaluation* comprises five of the six observed variables, and its CAI value equals 0.842 after two iterations.

10.3.3 Organizational Culture

This is the last latent variable studied at the Kaizen control phase, and it integrates five items. Table 10.9 shows results from the validation process, where the first column lists the validated activities, and the second column presents results from the first iteration.

As can be observed from the table, the CAI value for the latent variable is higher than 0.8 from the first iteration. Moreover, it is unnecessary to remove any item, since this would decrease the index value. Thus, latent variable *Organizational culture* encompasses five observed variables, with CAI = 0.828.

Table 10.9 Validation of latent variable: *Organizational culture*—Kaizen control phase

Activity	CAI 1
Progress toward the objectives is continuously measured	0.823
The company has safety programs	0.775
Processes are standardized and measured	0.775
Managers are committed until the end	0.801
Enhancers take Kaizen philosophy to the level sought	0.793
Cronbach's alpha index	0.828

10.4 Kaizen Economic Benefits

Chapter 3 of this book identified 14 economic benefits from Kaizen literature. In this case, a reliability test is performed to each item to determine whether it can remain in the latent variable or should be removed. Results from the validation analysis are shown in Table 10.10, where the first column lists the analyzed benefits. Similarly, the second and third column show results from the iterations run to increment reliability of the latent variable.

Results from the first iteration show that the CAI value of the latent variable is higher than 0.8 (CAI = 0.903). However, if item *Order lead times reduced as close as possible to zero* is removed from the analysis, the index value increases up to 0.943. Thus, the third column of the table shows results from the second iteration, and they indicate that no other item must be eliminated. Thus, latent variable *Kaizen economic benefits* includes 13 observed variables, and CAI = 0.943.

10.5 Kaizen Competitive Benefits

These benefits represent competitive advantages for companies who implement the philosophy. Chapter 3 of this book previously identified 14 Kaizen competitive benefits. Table 10.11 shows results from the validation process. As in the other

Table 10.10 Validation of latent variable: *Kaizen economic benefits*

Benefit	CAI 1	CAI 2
Defective products reduction	0.894	0.940
Unit manufacturing costs reduction	0.894	0.940
Order lead times reduced as close as possible to zero	0.943	
Increased work productivity	0.895	0.941
Compliance with delivery times and quantities	0.894	0.941
Successful material handling	0.892	0.939
Waste reduction (inventories, waiting times, transport, movements from workers)	0.891	0.938
Fewer production process stages	0.892	0.938
Maximized profits	0.893	0.939
Machine failures reduction	0.894	0.939
Increased productivity	0.892	0.938
Shorter design and operating cycles	0.892	0.938
Improved cash flow	0.894	0.940
Increased and improved economic balance	0.893	0.939
Cronbach's alpha index	0.903	0.943

Table 10.11 Validation of latent variable: *Kaizen competitive benefits*

Benefit	CAI 1
The company has the tools to meet customer needs	0.936
New products are more often introduced into the market	0.934
Improved product quality	0.932
Customer needs are met	0.933
Improved employee skills	0.933
Reduction of changeover times	0.934
Systemic and holistic corporate vision	0.932
Process-oriented thinking	0.933
Improved product designs	0.933
Global competition	0.933
Strategic advantage toward competitors	0.930
Experience in and knowledge of organizational processes	0.933
Internal barriers are easily removed, and authentic and powerful work teams emerge	0.933
Continuous adaptation to sudden market changes	0.935
Cronbach's alpha index	0.938

cases, the first column of the table lists the analyzed items, while the second column shows their CAI values.

After the first iteration, results show that the CAI of this latent variable equals 0.938, which is above the minimum value established. Moreover, it seems unnecessary to remove items from the analysis as the index does not increase. Thus, latent variable *Kaizen competitive benefits* includes 14 items with CAI = 0.938.

10.6 Kaizen Benefits for Human Resources

As a lean-manufacturing (LM) tool, Kaizen depends on the work of individuals, which is why it is very important to analyze the advantages that this philosophy brings employees. As in previous cases, Chap. 3 of this book identified 13 of these benefits. Table 10.12 shows results from the validation process.

Results from the first iteration show that the CAI of this latent variable is above 0.8 (CAI = 0.945), and it seems pointless to eliminate any item, as the value would not increase. Thus, it is concluded that latent variable *Kaizen benefits for human resources* is composed of 13 benefits, and its CAI value equals 0.945.

Table 10.12 Validation of latent variable: *Kaizen benefits for human resources*

Benefit	CAI 1
Increased customer satisfaction	0.944
Increased employee motivation	0.941
Improved attitude and work skills	0.939
Increased employee self-esteem	0.940
Fewer cumulative trauma disorders (CTDs) from ergonomic problems	0.940
Increased participation	0.938
Improved communication among administrative levels	0.939
Positive influence on individuals	0.939
Decreased customer attrition and employee turnover	0.942
Improved attitude and skills to address continuous improvement changes	0.938
Participation and collaboration to build a new system	0.941
Attention is focused on the most important issues	0.941
Increased employee responsibility and commitment	0.939
Cronbach's alpha index	0.945

10.7 Conclusions

This chapter discusses results from the validation process of variables and latent variables. These latent variables will be used to propose the models in the following chapters. Conclusions from this section of the book can be formulated as follows:

- Although all Kaizen activities have been previously studied in the same context (García et al. 2014a; García et al. 2013a), results from the analysis show that, in comparison with the past 3 years, latent variables have slightly changed in behavior. Thus, activities that are nowadays not significant have been removed.
- As regards Kaizen benefits, no previous works have addressed them. Thus, their reliability validation is more important. In this book, all Kaizen benefits reported remain in the categories that were initially proposed (economic benefits, competitive benefits, or benefits for human resources. However, one item has been removed.
- Since latent variables have been analyzed and validated in this chapter, they can be used to develop the structural equation models proposed in the following chapters.

Chapter 11
Kaizen Planning Phase Models: Activities and Benefits

In this chapter, we propose three structural equation models to define the relationships between Kaizen activities at the planning phase and its benefits. To achieve this, several hypotheses are proposed and statistically validated in order to relate latent variables discussed in the previous chapters.

The main objective of the models is to quantitatively measure the effects between latent variables, as this can help managers and company executives identify the critical success factors (CSFs) or activities that are essential to their companies to obtain the expected benefits from Kaizen.

Note that hypotheses here proposed are first discussed to justify their inclusion in the model. Then, each structural equation model is developed based on these hypotheses. Finally, each model is validated to determine the statistical significance of the relationships between latent variables and the model reliability. Validation of each model includes

- Model efficiency indices
- Measurement of direct and indirect effects between latent variables
- Direct effects size
- Conclusions.

Finally, it is important to mention that data are analyzed and validated in software SPSS 21, while the model is executed with WarpPLS 5. As a reminder, latent variables involved in the hypotheses have been previously discussed and validated in Chap. 10, which explains why some of their items (Kaizen activities or benefits) have been removed.

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Management and Industrial Engineering, DOI 10.1007/978-3-319-47747-3_11

11.1 Model 1—Kaizen Planning Phase

This model encompasses four latent variables. Two of them concern Kaizen activities at the planning phase, while the remaining two represent the economic and competitive benefits that can be obtained from Kaizen implementation. These variables are:

- Managerial commitment
- Work team organization
- Economic benefits
- Competitive benefits.

To define the relationships that exist among these latent variables, the following paragraphs discuss the proposed hypotheses.

11.1.1 Hypotheses

In this first model, six working hypotheses are proposed to relate the aforementioned latent variables. Figure 11.1 depicts these relationships.

Commitment that managers show in continuous improvement projects has an important impact on the economic performance of a company. If employees and improvement group members do not feel supported and confident, they may withdraw from the projects, and thus improvements will be partially achieved (Gong et al. 2009). Thus, some authors argue that commitment shown and confidence promoted by managers and chief executives represent a strategy to integrate

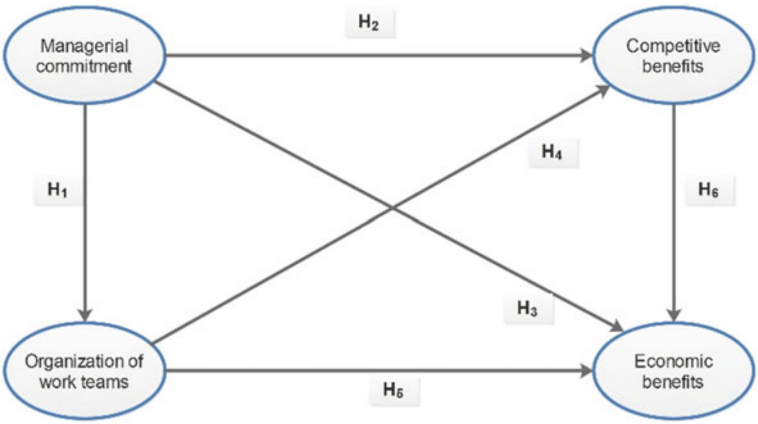


Fig. 11.1 Model 1—Hypotheses proposed

human resources (Cullen et al. 2000), since employees are the ones who truly generate profits and know the production process.

Another responsibility of managers is providing improvement groups all the necessary resources to do their work and achieve their objectives, which must be clear and follow the mission and vision of the company. If Kaizen groups are not properly supported, members can leave the project, as they feel they are the only ones trying to solve the company's problems. Similarly, it is important that managers show groups that they are equally committed to reaching the goals that these groups have established, and that the company always seeks a culture of change for the good of all and not only for the organization.

Two forms of demonstrating commitment and support to employees are using suggestion boxes and seeking external experience in Kaizen planning. On one hand, when employees perceive that their ideas and opinions communicated through the suggestion box have been taken into account, they feel more motivated and integrated. On the other hand, it is wise to look for the support of a Kaizen expert to assist in and guide through the established improvement plans and programs.

Finally, it is important that the management department carefully and clearly states the policies regarding how improvement groups are integrated and should work. As previously mentioned, these groups should be multidisciplinary and heterogeneous to ensure that problems are holistically addressed.

Based on this discussion on managerial commitment, the following hypothesis is proposed:

H_1 In the context of Mexican manufacturing companies implementing Kaizen, *Managerial commitment* has a direct and positive impact on *Human resources integration*.

In addition to human resources integration, managerial commitment has a strong impact on the competitive benefits that companies gain from Kaizen implementation. Managers must encourage and ensure a continuous improvement culture, and, to achieve this they must support and integrate human resources, who as a result improve their performance and attitude.

Some of the competitive benefits gained from a continuous improvement culture as a result of managerial commitment include fast response to customers and improved product quality. Similarly, participation in solving different kinds of problems improves employees' problem-solving skills. Thus, companies become learning organizations that produce and maintain knowledge, but which are also able to transmit it.

Moreover, when a company is able to rapidly solve problems in its production lines, it gains a strategic advantage that its competitors do not have, and thus it can adapt quickly to the sudden, globalized market changes. Likewise, integration of multidisciplinary groups that include members from different hierarchical structures reduces barriers within the company, and solutions implemented are comprehensive, taking into account the opinions and viewpoints of everyone.

Therefore, it is argued that if managers are committed to improvement groups, Kaizen can bring a large number of competitive benefits to the company. For this reason, the second working hypothesis is constructed as follows:

H_2 In the context of Mexican manufacturing companies implementing Kaizen, *Managerial commitment* has a direct and positive impact on the *Competitive benefits* obtained.

Since executives are responsible for justifiably managing the available resources, managerial commitment definitely has an impact on the economic benefits that companies obtain (Huang et al. 2016). It has been demonstrated that managerial commitment improves product quality indices, and, therefore, companies increase their income (Karatepe and Karadas 2012). Likewise, information and communication technologies (ICTs) are better integrated when managerial support is perceived, and this allows companies to have faster production processes with increased flexibility (Quaadgras et al. 2014). This enables to construct the third working hypothesis, which states as follows:

H_3 In the context of Mexican manufacturing companies implementing Kaizen, *Managerial commitment* has a direct and positive impact on *Economic benefits*.

The competitive benefits gained from Kaizen implementation also depend on improvement groups, not only on managerial commitment. That is to say, it has been demonstrated that the fastest way of identifying problems in the production lines is by organizing improvement groups that include, at their core, production operators, since they are more familiar with the production problems than any other employee. Similarly, by participating production operators improve their work skills (Suarez-Barraza and Lingham 2008) at the same time that customer needs are rapidly addressed.

Keeping improvement groups motivated and promoting commitment among their members have shown direct and positive effects on the company's ability to access globalized markets more rapidly and with innovative products (Medinilla 2014c; Livi et al. 2015). Thus, organizations that motivate their employees and set them goals to be achieved will always be strategically better positioned than their competitors (Topuz and Arasan 2013).

Moreover, assistance and guidance from Kaizen experts allow improvement groups to find better solutions to problems. Similarly, when such groups are multidisciplinary and heterogeneous, the corporate vision is systemic and transverse. Thus, barriers are easily removed when making decisions regarding the alternatives to be implemented (Cumbler et al. 2016), since knowledge and the information flow among group members are always stronger.

Considering thus the importance of improvement groups, it is possible to propose the fourth working hypothesis.

H_4 In the context of Mexican manufacturing companies implementing Kaizen, *Work teams organization* has a direct and positive impact on *Competitive benefits*.

Improvement groups that support Kaizen must comply with certain characteristics. Members must be cooperative, and groups have to ensure the appropriate flow of information that makes communication efficient. Likewise, their achievements should bring economic benefits, which is why motivation is key. Several studies have associated motivation in improvement groups with the financial performance of companies (Aga et al. 2016). Thus, keeping groups motivated and providing them with good leadership guarantee their participation in improvement programs, which enables to attain quality and economic objectives (Cumbler et al. 2016).

Furthermore, other authors argue that, since their conception, quality circles, and later on Kaizen events, have constantly offered economic advantages to companies who implement them. Both strategies help effectively solve problems, as they seek to improve the use of available production resources. Consequently, productivity increases and profits are maximized (Ratnawati et al. 2016). Moreover, when these groups focus on solving problems with the materials flow, studies have found a strong relationship between total productive maintenance (TPM) programs and a company's income (Cua et al. 2001). Moreover, changeover problems solved by improvement groups have always reported improved and increased availability of production machinery and equipment. This simplifies the materials flow, which consequently leads to economic savings (Singh et al. 2013; Prabhuswamy et al. 2013).

In conclusion, since improvement groups influence on the economic performance of firms, the fifth working hypothesis can be proposed as follows:

H_5 In the context of Mexican manufacturing companies implementing Kaizen, *Work teams organization* has a direct and positive impact on *Economic benefits*.

Manufacturing companies always seek to be competitive in the global markets in which they sell their products, as this represents for them a higher income or greater economic benefits (Das et al. 2014; Boothby et al. 2010; van den Heuvel et al. 2015). For instance, giving adequate and quick response to customers leads to increasing sales, and perhaps recommendations. Also, improving product quality and reducing design and operating cycles help maximize profits.

From a similar perspective, it is important to consider communication and integration as profit sources. When attitude and communication barriers are easily removed, improvement changes are more easily implemented. This streamlines the production system and increases its availability, since when improvement teams work efficiently, implementing changes is not time-consuming (van den Heuvel et al. 2015).

Finally, the ability to rapidly design innovative products is a strategic advantage worth being acknowledged. However, it strongly depends on the technological resources installed and the intellectual capacities and training of employees (Huenteler et al. 2016). From this discussion regarding the relationship between competitiveness and profits in the manufacturing context, the sixth work hypothesis is proposed:

H_6 In the context of Mexican manufacturing companies implementing Kaizen, *Competitive benefits* have a direct and positive impact in *Economic benefits.*

11.1.2 Model Evaluation

The model proposed in Fig. 11.1 is evaluated according to the research methodology described in Chap. 4. However, it is important to remember that:

- The model integrates four latent variables.
- The model is run in WarpPLS 5 software for its evaluation.
- Inferences are statistically significant at a 95 % of confidence level.

Figure 11.2 shows results from the model evaluation. Each hypothesis or segment connecting one latent variable to another includes a beta (β) value and a P (p) value. The former indicates the dependency measure of the direct effect, while the latter is the value to perform the statistical hypothesis testing, with a significance level of 0.05. Also, an R-squared (R^2) value is shown for each dependent latent variable. This value represents the amount of variance explained by independent latent variables.

As can be observed, one of the hypotheses is depicted by a dotted arrow, while the remaining five are solid lines. Solid arrows illustrate statistically significant relationships between two latent variables, since the p value is lower than 0.05. On the other hand, the dotted arrow is not a statistically significant relationship, as the p value is higher than 0.05. The following section details the validation process of latent variables.

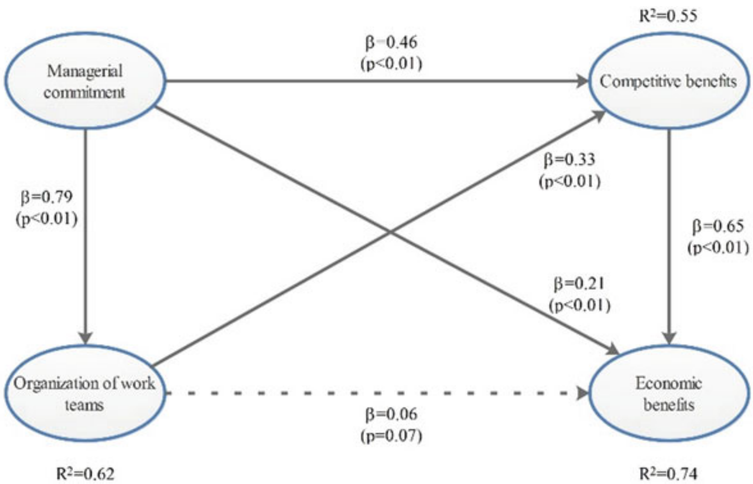


Fig. 11.2 Model 1—Validated hypotheses

11.1.2.1 Validation of Variables

Before interpreting the model, it is important to validate each latent variable. This validation process includes the analysis of seven indices previously described in the research methodology (see Chap. 4). Table 11.1 shows results obtained from the analysis.

First, note that values of R^2, adjusted R^2, and Q^2 are higher than 0.2 in all cases. This proves that, from parametric and non-parametric perspectives, all dependent latent variables have enough predictive validity. Likewise, considering the Cronbach's alpha and the composite reliability index, it is concluded that every latent variable analyzed has enough internal validity.

As for the average variance extracted (AVE), Table 11.1 shows that all values are higher than 0.5, demonstrating sufficient convergent and discriminant validity in every latent variable. Finally, all VIF values are lower than 5, the maximum accepted value. In conclusion, all latent variables analyzed have enough validity to remain in the model and can be interpreted.

11.1.2.2 Efficiency Indices—Model 1, Kaizen Planning Phase

After latent variables are analyzed, the model as a whole must be also evaluated. To achieve this, the following efficiency indices are taken into account:

- Average path coefficient (APC) = 0.416, $P < 0.001$.
- Average R-squared (ARS) = 0.638, $P < 0.001$.
- Average adjusted R-squared (AARS) = 0.636, $P < 0.001$.
- Average block VIF (AVIF) = 2.617, acceptable if ≤ 5, ideally ≤ 3.3
- Average full collinearity VIF (AFVIF) = 3.430, acceptable if ≤ 5, ideally ≤ 3.3.
- Tenenhaus GoF (GoF) = 0.604, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36.
- Sympson's paradox ratio (SPR) = 1.000, acceptable if ≥ 0.7, ideally = 1.

Table 11.1 Validation of latent variables—Model 1 (Kaizen planning phase)

	Managerial commitment	Work teams organization	Economic benefits	Competitive benefits
R-squared (R^2)		0.622	0.741	0.551
Adjusted R-squared		0.621	0.74	0.549
Composite reliability	0.864	0.869	0.946	0.942
Cronbach's alpha	0.803	0.8	0.938	0.933
AVE	0.56	0.625	0.563	0.538
VIF	3.204	2.884	3.775	3.859
Q-squared (Q^2)		0.622	0.743	0.552

- R-squared contribution ratio (RSCR) = 1.000, acceptable if ≥ 0.9, ideally = 1.
- Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7.
- Nonlinear bivariate causality direction ratio (NLBCDR) = 1.000, acceptable if ≥ 0.7.

Based on results above, note that APC, ARS, and AARS have a p value that is below 0.001. Therefore, with 99.9 % confidence, the model is valid and appropriate for its analysis and evaluation. Likewise, R^2 and adjusted R^2 values are above 0.6, and they both have a p value that is below 0.001. This shows that, with 99.9 % confidence, the model has enough predictive validity.

As for collinearity, it is observed that AVIF and AFVIF coefficients are lower than 5, and they are thus appropriate for the analysis. Moreover, the Tenenhaus GoF index has a value higher than 0.36 (Tenenhaus GoF = 0.604), which provides the model with explanatory power. Finally, values of SPR, RSCR, SSR, and NLBCDR are equal to 1, which frees them model from such problems.

11.1.2.3 Direct Effects of Model 1—Kaizen Planning Phase

Direct effects prove the hypotheses previously formulated (see Fig. 11.1). Based on results shown in Fig. 11.2, the following conclusions can be proposed regarding the direct effects between latent variables. Note that, when valid, relationships are statistically significant at a 95 % confidence level.

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Managerial commitment* has a direct and positive impact on *Work teams organization*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable also increases by 0.79 units.

H_2 In the environment of Mexican maquiladoras implementing Kaizen, there is enough statistical evidence to declare that *Managerial commitment* has a direct and positive impact on *Competitive benefits*, because when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.46 units.

H_3 In the environment of Mexican maquiladoras implementing Kaizen, there is enough statistical evidence to declare that *Managerial commitment* has a direct and positive impact on *Economic benefits*, because when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.21 units.

H_4 In the environment of Mexican maquiladoras implementing Kaizen, there is enough statistical evidence to declare that *Work teams organization* has a direct and positive impact on *Competitive benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.33 units.

H_5 In the environment of Mexican maquiladoras implementing Kaizen, there is not enough statistical evidence to declare that *Work teams organization* has a direct and positive impact on *Economic benefits*, since the p value for the statistical hypothesis testing equals 0.07, while the maximum accepted value is 0.05. However, in the following sections we will analyze the indirect effects that do exist between these latent variables through *Competitive benefits*.

H_6 In the environment of Mexican maquiladoras implementing Kaizen, there is enough statistical evidence to declare that *Competitive benefits* have a direct and positive impact on *Economic benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter also increases by 0.65 units.

11.1.2.4 Effects Size of Model 1—Kaizen Planning Phase

Figure 11.2 shows that three of the four latent variables have a R^2 value, since they depend on one or more latent variables. Thus, when a dependent latent variable is affected by only one independent latent variable, the percentage of explained variance comes only from such independent variable. However, if the explained variance comes from two or more independent latent variables, the R^2 value must be decomposed. Table 11.2 thus shows the decomposed effect sizes for each dependent latent variable.

According to information presented in Table 11.2, the following conclusions can be drawn:

- Latent variable *Work teams organization* is 62 % explained by latent variable *Managerial commitment*.
- Latent variable *Economic benefits* has a dependence value that equals 0.74, and depends on all the other latent variables. First, it is explained by *Managerial commitment* in 0.153 units. Second, *Work teams organization* explains 0.041 units. Third, *Competitive benefits* explain 0.547 units. Even though all effects are positive, if companies wish to reach or maintain their economic stability, they must focus on increasing *Competitive benefits*, as they seem to have the greatest effect on *Economic benefits*.

Table 11.2 Effect sizes—Model 1—Planning phase

To	From			R^2
	Managerial commitment	Work teams organization	Competitive benefits	
Work teams organization	0.62			0.62
Economic benefits	0.153	0.041	0.547	0.74
Competitive benefits	0.326	0.225		0.55

- Latent variable *Competitive benefits* is 55 % explained by two latent variables. On the one hand, *Managerial commitment* explains 0.326 units of the variance, while *Work teams organization* explains 0.225 units. It is therefore concluded that *Managerial commitment* is of greater importance to gain *Competitive benefits* than *Work teams organization.*

11.1.2.5 Sum of Indirect Effects

Indirect effects between two latent variables occur through a third latent variable or more called mediators, and they are given by two segments or more. To simplify their interpretation, Table 11.3 introduces the sum of all indirect effects between latent variables. Each β value shows the dependence measure between variables, while the p value is associated with the hypothesis statistical test. Finally, the effect size (ES) is the amount of explained variance in dependent latent variables.

Based on the information above, we can conclude the following:

- Three relationships between variables have indirect effects through moderator variables. All these effects are statistically significant at a 99.9 % confidence level, for their p values are below 0.001.
- The largest indirect effect occurs between *Managerial commitment* and *Economic benefits*. Such an effect is much higher than the direct effect (0.21). This means that when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable also increases 0.513 units. Moreover, *Managerial commitment* explains *Economic benefits* up to 37 %.
- *Managerial commitment* has an indirect effect on *Competitive benefits*, and its value equals 0.259 units. Therefore, when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.259 units. Similarly, *Managerial commitment* explains up to 18 % of *Competitive benefits* according to the effect size.
- The third indirect effect is given between *Work teams organization* and *Economic benefits*. The value of such an effect is 0.213 units, which implies that when the standard deviation of the independent latent variable increases by one unit, the standard deviation of the dependent latent variable increases 0.213

Table 11.3 Sum of indirect effects—Model 1 (Kaizen planning phase)

To	From	
	Managerial commitment	Work teams organization
Economic benefits	0.513 ($P < 0.001$) ES = 0.370	0.213 ($P < 0.001$) ES = 0.142
Competitive benefits	0.259 ($P < 0.001$) ES = 0.185	

units. In addition, *Work teams organization* explains up to 14.2 % of *Economic benefits,* according to the effect size indicated.

11.1.2.6 Total Effects—Model 1 (Kaizen Planning Phase)

Total effects are the sum of direct and indirect effects between two latent variables. They provide a general perspective on how these variables are related to one another. Table 11.4 includes the β value, the p value, and the effect size (ES) for every relationship among variables in this model.

As can be observed, all total effects are statistically significant at a 99.9 % confidence level, since all p values are lower than 0.001. Likewise

- The largest total effect in this model can be seen between *Managerial commitment* and *Work teams organization*. However, note that this total effect equals the direct effect, as there is no indirect effect between these latent variables. Moreover, *Managerial commitment* explains up to 62 % of *Work teams organization*.
- The second biggest effect occurs through *Managerial commitment* and *Economic benefits*. Figure 11.2 shows that the direct effect between these two latent variables equals 0.21, while the indirect effect has a higher value. In other words, companies must ensure appropriate *Work teams organization* and generate *Competitive benefits*, so that *Managerial commitment* can impact on *Economic benefits.*
- The third most salient relationship is given between *Managerial commitment* and *Competitive benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.715 units. Also, as in previous cases, the independent latent variable explains up to 51 % of the variability of the dependent latent variable.
- The relationship between *Competitive benefits* and *Economic benefits* has a total effect size that equals the direct effects size. There are no indirect effects between these latent variables.

Table 11.4 Sum of total effects—Model 1 (Kaizen planning phase)

To	From		
	Managerial commitment	Work teams organization	Competitive benefits
Work teams organization	0.788 ($P < 0.001$) ES = 0.622		
Economic benefits	0.726 ($P < 0.001$) ES = 0.523	0.275 ($P < 0.001$) ES = 0.183	0.65 ($P < 0.001$) ES = 0.547
Competitive benefits	0.715 ($P < 0.001$) ES = 0.510	0.328 ($P < 0.001$) ES = 0.225	

- Finally, note that the direct effect of *Work teams organization* on *Economic benefits* is statistically insignificant. However, their indirect and total effects are significant.

11.1.2.7 Conclusions and Industrial Implications—Model 1 (Kaizen Planning Phase)

This first model integrates four latent variables, two of them representing Kaizen planning activities, while the remaining two stand for Kaizen economic and competitive benefits. The conclusions proposed after the model analysis and evaluation are the following:

- *Managerial commitment* is an essential element to Kaizen planning. A lack of commitment and responsibility from managers is immediately perceived among continuous improvement groups, and it will be impossible to integrate their members.
- *Managerial commitment* has a direct and positive impact on *Work teams organization*, the *Economic benefits*, and the *Competitive benefits* that companies obtained from Kaizen implementation.
- Although there is not an observable direct relationship between *Work teams organization* and *Economic benefits* gained from Kaizen implementation, there is a significant indirect effect between these two variables given by *Competitive benefits*. That is to say, work teams must focus on reaching standards that make the company more competitive. Consequently, profits will be maximized.
- Kaizen *Competitive benefits* have a direct and positive impact on *Economic benefits*. Moreover, the former explains the greatest percentage of the variability of the latter.

Conclusions presented above have the following industrial implications for the Mexican manufacturing sector:

- Company managers must be responsible in two ways. First, they must strive to integrate members of improvement groups, since united groups are able to better solve problems arising in the production lines. Second, they are accountable for providing work teams all the necessary resources to complete their tasks.
- Competitiveness depends on the success of *Work teams organization* and the *Managerial commitment* offered.
- Manufacturing companies must work through improvement groups in order to reach standards that make them more competitive in the globalized market.
- Only those manufacturing companies with strong *Managerial commitment* and high competitiveness, gained thanks to *Work teams organization*, will be able to obtain *Economic benefits*.

11.2 Model 2—Kaizen Planning Phase

This second model focuses on the human aspects of the Kaizen planning phase. In this model, we include the following four latent variables:

- Managerial commitment
- Human resources training
- Human resources benefits
- Economic benefits.

Since both *Managerial commitment* and *Economic benefits* have been studied in Model 1, the hypothesis referring to their relationship has also been discussed and thus will not be examined once more.

11.2.1 Hypotheses

First, it is assumed that *Managerial commitment* is the latent variable upon which all the remaining latent variables depend. For this reason, it is located at the top left part of the model. Similarly, all the efforts from managers and human resources are expected to reflect on the economic benefits gained by the company, otherwise Kaizen implementation will have no justification whatsoever.

In this section, we propose six hypotheses to statistically validate the second model developed for the Kaizen planning phase. These hypotheses are depicted in Fig. 11.3.

Lean manufacturing (LM) is a set of novel tools, including Kaizen, that are often not fully understood. For this reason, managers usually provide the necessary

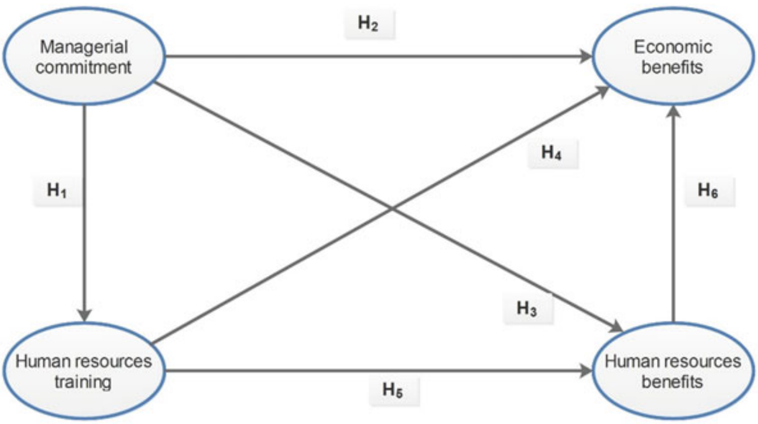


Fig. 11.3 Model 2—Kaizen planning phase

training. Studies have proved that Kaizen training should not be exclusive to production operators. Administrators must be equally prepared to achieve continuous improvements in the company (Akroyd et al. 2009).

From their initial stage, many improvement projects address aspects related to work environment quality, especially safety. These projects are usually the first to be implemented in a continuous improvement program. Training provided specially to address occupational hazards (Huang et al. 2012b) and implement security measures and procedures (Liu and Wang 2016) are of extreme importance. However, the final objective must always be to adopt a work culture associated with safety and training.

Training and human resources development are associated with *Managerial commitment*, as managers must guarantee employees all the necessary resources to successfully complete their tasks. Moreover, it is important to promote problem-solving skills. In this way, companies become learning organizations that transfer knowledge both horizontally and vertically, as they work under continuous improvement cultures (Higuchi et al. 2015b). All this allows operators to develop a wide range of abilities to perform in different positions (Paşaoğlu 2015).

Finally, it has been argued that the most important asset of a company is knowledge from each and all the employees, which will reflect on the organization's performance (McCrie 2016a). Thus, considering the importance of management commitment for human resources training, the following hypothesis is proposed:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, *Managerial commitment* has a direct and positive impact on *Human resources training*.

The second hypothesis of this model (H_2) refers to the relationship between *Managerial commitment* and Kaizen *Economic benefits*. This relationship has already been discussed and validated in the first model through the third hypothesis (see H_3). Thus, it will not be addressed again, and we proceed to discuss hypotheses three of this second model.

To generate good products, companies need to invest in the production process and human resources. It is therefore important that managers set clear objectives that indicate the production problems to be solved. Likewise, each continuous improvement group member must be assigned a particular task to be individually completed (Karatop et al. 2015). The best investment that companies can make is training their human resources. If employees perceive such a commitment from top departments, their motivation increases, and this improves their attitudes and work skills (Lu et al. 2014).

One of the main advantages of improvement groups is that occupational hazards and cumulative trauma disorders (CTDs) are easily identified and minimized. This makes employees feel integrated and protected, and they become more involved in problem-solving situations (Boothby et al. 2010; Alipour 2011). Thus, when human resources feel more satisfied and motivated, employee retention increases, avoiding intellectual losses.

Another aspect that managers should bear in mind is communication. They must promote and ensure both horizontal and vertical communication along improvement groups, for this facilitates understanding and reduces resistance to implement the proposed changes (Deering et al. 2011; Rico and Cohen 2005; Huang et al. 2012a).

In conclusion, *Managerial commitment* and the resources managers provide have a strong effect on the *Human resources benefits* that Kaizen implementation can offer to companies. For this reason, the third hypothesis of Model 2 can be proposed as follows:

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, *Managerial commitment* has a direct and positive impact on *Human resources benefits*.

Training programs are seen as an investment for the future, as companies expect to obtain benefits from a skilled workforce. For instance, workers with enough training and expertise are able to perform different work positions. This guarantees the production system flow and improves delivery times, since stoppages due to employee absenteeism decrease (Esteban-Lloret et al. 2014). Moreover, studies have demonstrated a direct and positive relationship between the amount of training (in hours) offered to production operators and a firm's economic performance (Higuchi et al. 2015b).

Companies that do not invest in human resources training struggle to participate in globalized systems and markets. Some of them even disappear due to their inability to manage and apply knowledge, and because they are unable to correctly react to problems arising in their systems (McCrie 2016a). Only those companies capable of effectively generating and managing knowledge can survive in the current markets (Quigley 2015). However, to benefit from the economic advantages sought, it is also important to communicate such knowledge in both horizontal and vertical ways. Having production operators that know much but can transmit nothing is as useless as having no knowledge at all (Deering et al. 2011; Pfoh 2009).

Finally, the *Economic benefits* gained from appropriate human resources training also reflect the amount of defective products. When operators have expertise, they know how to do their work with a minimum of errors. Fewer defects consequently reduce manufacturing costs and increase productivity. In the end, all this is translated into profits (Utsunomiya and Hodota 2011; García-Alcaraz et al. 2015). This discussion regarding the impact of human resources on the financial performance of companies enables to construct the fourth working hypothesis of Model 2 as follows:

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources training* have a direct and positive impact on *Economic benefits*.

In addition to bringing economic benefits, training and development programs must also have advantages for employees, otherwise people would lose their motivation to participate in improvement projects and continue learning. It would be unfair that organizations be the only ones to benefit from such programs.

Training courses give employees the possibility of being promoted. Moreover, new knowledge acquired makes human resources gain more confidence in their work performance, especially when certifications and accreditations officially recognize their aptitudes (Dwivedula and Bredillet 2010; ÖZlen and Hadžiahmetović 2014). In the end, all this also enhances their attitude.

However, one of the most important benefits of training is safety. Knowledge allows workers to avoid and diminish the risk of occupational accidents that could affect their physical integrity (Esperne 2010; Lu et al. 2014). For instance, some manufacturing companies nowadays acknowledge, and usually economically reward, departments for being the safest area in the company.

Finally, it is important that companies communicate the achievements of all the improvement groups to the entire organization. Such acknowledgement is a source of social motivation to those group members who managed to effectively and remarkably solve any kind of problem arising in the production lines (Deering et al. 2011). Moreover, it increases commitment.

This discussion regarding the relationship between the performance of human resources and their benefits helps us propose the fifth working hypothesis for this second model

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources training* has a direct and positive impact on *Human resources benefits*.

Training advantages for human resources definitely influence on the economic benefits of companies. When employees are highly motivated, they are more capable of solving production problems with efficiency, which thus increases the financial performance of organizations (Cheser 1998b; Cumbler et al. 2016; Dan et al. 2011). Furthermore, motivation promotes participation, which in turn promotes communication among all members and the flow of constructive ideas grows.

Nevertheless, one of the most important implications of employee expertise is the reduction of CTDs and other occupational accidents. When fewer employees are hurt, absenteeism, and health insurance costs decrease (Huang et al. 2012a), which is directly translated into savings. Therefore, the sixth working hypothesis of this second model can be proposed as follows:

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources benefits* have a direct and positive impact on the *Economic benefits* gained.

11.2.2 Model Evaluation

The model depicted in Fig. 11.3 is evaluated with WarpPLS 5 software. It is important to remember that:

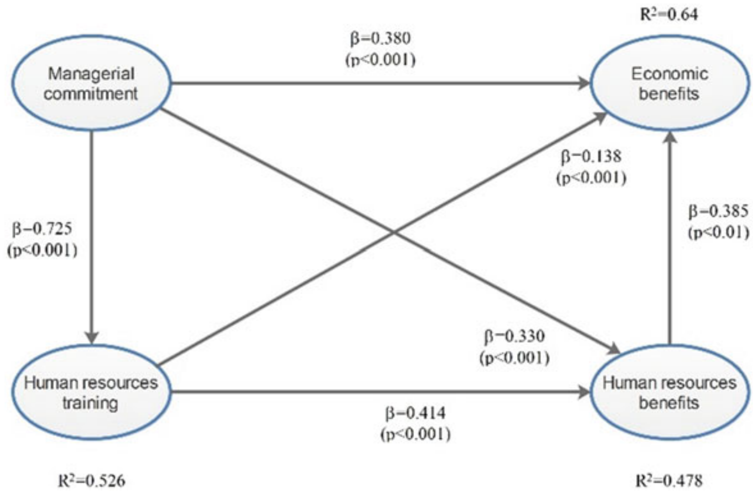


Fig. 11.4 Model 2 Evaluation—Kaizen planning phase

- The model integrates four latent variables. Two of them are new if compared with the first model presented in the chapter.
- Relationships must be statistically significant at a 95 % confidence level. Thus, the highest p value accepted is 0.05.

Figure 11.4 depicts the model evaluated according to the research methodology described in Chap. 4. As in the first model, every relationship between latent variables includes the value of the β parameter and a p value for the statistical hypothesis test. Likewise, all dependent latent variables include a R^2 value to show the amount of explained variance.

11.2.2.1 Validation of Variables—Model 2 (Kaizen Planning Phase)

Model 2 of Kaizen planning phase integrates four latent variables. Two of them represent Kaizen planning activities, while the remaining two stand for the benefits that can be obtained from Kaizen implementation. Prior to the model analysis, latent variables must be analyzed to determine whether they must be modified or can remain in the model as they are. Chapter 10 previously analyzed all latent variables through the Cronbach's alpha. However, other indices must be employed to improve reliability. Such indices are listed in Table 11.5.

Results obtained show that all latent variables can remain in the model, as they all have enough validity. Considering R^2 and adjusted R^2 indices, it is concluded that all latent variables have enough predictive validity from a parametric perspective, since in all cases the values are higher than 0.2. Likewise, values of the Q^2

Table 11.5 Validation of latent variables—Model 2 (Kaizen planning phase)

	Managerial commitment	Human resources training	Economic benefits	Human resources benefits
R-squared (R^2)		0.526	0.64	0.477
Adjusted *R*-squared		0.525	0.638	0.475
Composite reliability	0.864	0.891	0.946	0.952
Cronbach's alpha	0.803	0.837	0.938	0.945
AVE	0.56	0.672	0.563	0.605
VIF	2.654	2.485	2.726	2.304
Q-squared (Q^2)		0.527	0.642	0.477

index are close to zero and very similar to R^2 and adjusted R^2 values. This implies that all latent variables have enough predictive validity from a non-parametric perspective.

As regards the Cronbach's alpha and the composite reliability index, all values are above 0.7, the minimum value accepted. Therefore, there is enough internal validity in each latent variable. In terms of AVE, its value is above 0.5 in all cases, although latent variables *Managerial commitment* and *Economic benefits* show the lowest coefficients. However, they still have enough convergent validity. Finally, VIF coefficients free latent variables from collinearity problems, since all values are all lower than 5, the maximum accepted value. They are even below 3.3, which is the ideal value for this index.

11.2.2.2 Efficiency Indices—Model 2, Kaizen Planning Phase

Once all latent variables are validated, ten indices are used to analyze the general efficiency of the model. Results from such indices are listed below

- Average path coefficient (APC) = 0.395, $P < 0.001$
- Average *R*-squared (ARS) = 0.548, $P < 0.001$
- Average adjusted *R*-squared (AARS) = 0.546, $P < 0.001$
- Average block VIF (AVIF) = 2.148, acceptable if ≤ 5, ideally ≤ 3.3
- Average full collinearity VIF (AFVIF) = 2.542, acceptable if ≤ 5, ideally ≤ 3.3
- Tenenhaus GoF (GoF) = 0.573, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36
- Sympson's paradox ratio (SPR) = 1.000, acceptable if ≥ 0.7, ideally = 1
- *R*-squared contribution ratio (RSCR) = 1.000, acceptable if ≥ 0.9, ideally = 1
- Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7
- Nonlinear bivariate causality direction ratio (NLBCDR) = 1.000, acceptable if ≥ 0.7.

The APC value equals 0.395, while its p value is below 0.001. This means that the average value of β in the direct relationships between variables is 0.395. Likewise, both ARS and AARS have a p value that is also lower than 0.001, which proves that the model has enough predictive validity.

In terms of collinearity, AVIF and AFVIF values are both below 3.3, which shows that there are no collinearity problems among (not inside) latent variables. In addition, the value of the Tenenhaus GoF index equals 0.573, which is high enough to conclude that the model has predictive power. Finally, SPR, RSCR, and NLBCDR values equal 1 and free the model from such problems.

11.2.2.3 Direct Effects of Model 2—Kaizen Planning Phase

Direct effects prove the hypotheses previously formulated, and relate the different latent variables of the model. Based on results shown in Fig. 11.4, the following conclusions can be proposed regarding the direct effects between latent variables. When valid, these relationships are statistically significant at a 95 % confidence level:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Managerial commitment* has a direct and positive impact on *Human resources training*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the latent variable increases by 0.725 units.

H_2 This hypothesis has been previously discussed in model 1 (see Model 1, hypothesis 3).

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Managerial commitment* has a direct and positive impact on *Human resources benefits,* since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable also increases by 0.330 units.

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Human resources training* has a direct and positive impact on *Economic benefits,* since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.138 units.

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Human resources training* has a direct and positive effect on *Human resources benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.414 units.

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Human resources* *benefits* have a direct and positive impact on *Economic benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter decreases by 0.385 units.

11.2.2.4 Effect Sizes of Model 2—Kaizen Planning Phase

Figure 11.4 shows that three of the four latent variables are dependent. These are *Human resources training*, *Human resources benefits,* and *Economic benefits*, and they thus include a R^2 value that indicates their amount of variance that is explained by other latent variables. As in the previous model, when two or more independent latent variables are involved in the variance of a dependent latent variable, the R^2 is decomposed. Table 11.6 shows such a decomposition.

As regards *Human resources training*, it only depends on one latent variable: *Managerial commitment.* However, note that the situation is different for *Human resources benefits* and *Economic benefits.*

Results from Table 11.6 allow to conclude that

- Since *Managerial commitment* is an independent latent variable, and thus is located at the top left part of model 2, it has an impact on all the remaining latent variables. Therefore, it explains part of their variability.
- *Managerial commitment* is the only latent variable having an impact on *Human resources training*. It thus explains 52.6 % of the variability of the dependent latent variable, while the effect size is 0.526 units.
- Since *Economic benefits* are the latent variable that depends upon all the other latent variables, it is located at the top right part of model 2. It is 64 % explained by the remaining three latent variables, and its R^2 value equals 0.64. On the one hand, *Managerial commitment* explains 0.274 of the variability. On the other hand, *Human resources training* explains 0.091. Finally, *Human resources training* explains 0.275. The sum of these three effects equals 0.64, and latent variables *Managerial commitment* and *Human resources benefits* have the largest explanatory power of *Economic benefits.*

Table 11.6 Decomposed effect sizes of Model 2—Kaizen planning phase

To	From			R^2
	Managerial commitment	Human resources training	Human resources benefits	
Human resources training	0.526			0.526
Economic benefits	0.274	0.091	0.275	0.64
Human resources benefits	0.208	0.27		0.478

- *Human resources benefits* has a R^2 value equal to 0.478 units. Latent variable *Managerial commitment* explains 0.208 of the variability, whereas *Human resources training* explains 0.270. This shows that trained human resources are more important than commitment from managers to obtain *Human resources benefits*.

11.2.2.5 Sum of Indirect Effects—Model 2 (Kaizen Planning Phase)

The model presented in Fig. 11.4 also shows indirect effects occurring between two latent variables through moderators. Table 11.7 shows the sum of indirect effects for model 2. As in the previous model, each effect shows a measure of its magnitude, its p value for the statistical hypothesis test, and the effect size (ES) to measure the percentage of explained variance.

Results from Table 11.7 help propose that the following conclusions are regarding the indirect effects between latent variables

- There are three indirect effects between latent variables. All of them are statistically significant with 99.9 % confidence, as their p value is below 0.001.
- Latent variable *Managerial commitment* has indirect effects on latent variables *Economic benefits* and *Human resources benefits.*
- Latent variable *Managerial commitment* has an indirect impact on *Economic benefits* that equals 0.343. Such an effect occurs through mediator latent variables *Human resources training* and *Human resources benefits*. Moreover, Managerial *commitment* explains up to 24.7 % of the variability of *Economic benefits*, as the effect size is 0.247.
- Latent variable *Managerial commitment* has an indirect effect on *Human resources benefits* through *Human resources training*. The value of the effect is 0.300, and the independent latent variable explains up to 18.9 % of the variability of the dependent latent variable, since the effect size is 0.189.
- Latent variable *Human resources training* has an indirect effect on *Economic benefits* through *Human resources benefits*, which equals 0.159. Moreover, *Human resources training* explains up to 10.5 % of the variability of *Economic benefits*.

Table 11.7 Sum of indirect effects—Model 2 (Kaizen planning phase)

To	From	
	Managerial commitment	Human resources training
Economic benefits	0.343 ($P < 0.001$) ES = 0.247	0.159 ($P < 0.001$) ES = 0.105
Human resources benefits	0.3 ($P < 0.001$) ES = 0.189	

Table 11.8 Total effects—Model 2 (Kaizen planning phase)

To	From		
	Managerial commitment	Human resources training	Human resources benefits
Human resources training	0.725 ($P < 0.001$) ES = 0.526		
Economic benefits	0.723 ($P < 0.001$) ES = 0.522	0.298 ($P < 0.001$) ES = 0.197	0.385 ($P < 0.001$) ES = 0.275
Human resources benefits	0.63 ($P < 0.001$) ES = 0.396	0.414 ($P < 0.001$) ES = 0.270	

11.2.2.6 Sum of Total Effects—Model 2 (Kaizen Planning Phase)

The sum of direct and indirect effects between two latent variables equals their total effects. Table 11.8 presents the total effects for model 2. As in the previous model, the β value, the table shows the β value, the p, value, and the size of the effect (ES).

Considering data from Table 11.8, we can conclude that:

- There are six effects between latent variables analyzed, and all of them are statistically significant, as their p value for the hypothesis test is below 0.001. Thus, inferences are made with 99.9 % confidence.
- Latent variable *Managerial commitment* has total effects on all the other latent variables. Also, its effects are the biggest appreciated in the model.
- The largest total effect or impact occurs in the relationship between *Managerial commitment* and *Human resources training*. Such an effect is direct and has been discussed in the first hypothesis of this model.
- The second largest total effect is given between latent variables *Managerial commitment* and *Economic benefits*. The magnitude of this effect equals 0.723, and the first latent variable can explain up to 52.2 % of the variability of the second latent variable, as the effect size is 0.522.
- *Managerial commitment* has a total effect on *Human resources benefits*, which is given by *Human resources training*. The magnitude of the effect is 0.630, and the first latent variable explains up to 39.6 % of the variability of the second latent variable, since the effect size is 0.396.
- *Human resources training* has a total effect on *Economic benefits* that equals 0.298. In addition, the former explains up to 19.7 % of the variability of the latter, because the effect size is 0.197.
- Total effects between *Human resources training* and *Human resources benefits* and between *Human resources benefits* and *Economic benefits* are direct effects previously discussed in the hypotheses section.

11.2.2.7 Conclusions and Industrial Implications—Model 2 (Kaizen Planning Phase)

Model 2 of this chapter integrates four latent variables. Two of them represent Kaizen activities carried out at the planning phase (*Managerial commitment* and *Human resources training*), while the remaining two stand for the Kaizen economic and human resources benefits that can be obtained. Interpreting the model shown in Fig. 11.4 allows us to propose the following general conclusions as regards this second model:

- *Managerial commitment* is the basis for successful Kaizen implementation, which is why it influences *Human resources training*, *Human resources benefits,* and *Economic benefits* that Kaizen offers. Hence, if managers do not offer the appropriate support to improvement projects, these will be poorly implemented, since workers will not be adequately trained. Consequently, Kaizen benefits will not be obtained.
- Companies must undoubtedly analyze all relationships between *Managerial commitment* and the *Human resources benefits* that they are gaining from Kaizen implementation. In this research, while the direct effect in this relationship has a value of 0.33, the indirect effect equals 0.30. This indicates that *Human resources training*—the moderator variable—is key to maximize profits. However, such a training is only effective if top departments are committed to offering it and promoting professional development for their human resources. Just as customer satisfaction, employee satisfaction is crucial to gain economic benefits. In fact, the direct effect of *Human resources benefits* on *Economic benefits* is the largest direct effect, with a value equal to 0.390 units, indicating its importance.
- One of the lowest relationships, in terms of its value (0.14 units), includes latent variables *Human resources training* and *Economic benefits.* However, the indirect effect that the former has on the latter through *Human resources benefits* is noticeably important. Therefore, the significance of this relationship becomes as important as the others.

Regarding the industrial implications that results have on the Mexican manufacturing industry, we conclude that:

- Mexican manufacturing companies must strive to maintain adequate training and development programs to offer their employees the skills and tools needed to compete in the current market situations. More specifically, it is important that operators share knowledge acquired of the production process in both ways: horizontally and vertically.
- Although customers are reason why manufacturing companies exist, it is important to support and acknowledge employees. They must obtain direct benefits from any improvement plan implemented and training program provided.

- If managers demonstrate the benefits that companies are offering to human resources, they will obtain direct economic benefits.
- Training programs provided must definitely benefit all employees, especially operators. There is a direct relationship between human resources training and a company's economic benefits. However, the role of human resources benefits in such relationship is crucial in this relationship.

11.3 Integrative Model—Kaizen Planning Phase

In total, we have identified three latent variables associated with Kaizen planning activities: *Managerial commitment*, *Human resources training*, and *Work teams organization.* Through two structural equation models, all of them have proved to impact on three types of benefits: *Economic benefits*, *Human resources benefits*, and *Competitive benefits.* In this last section of the chapter, we present an integrating structural equation model (SEM), proposed through a second-order factor analysis. In this model, the three latent variables associated with Kaizen planning activities are integrated into a single latent variable named *Kaizen planning*. Such a final latent variable is directly associated with the three types of benefits already mentioned. The latent variables comprised in this third and final model for this phase are:

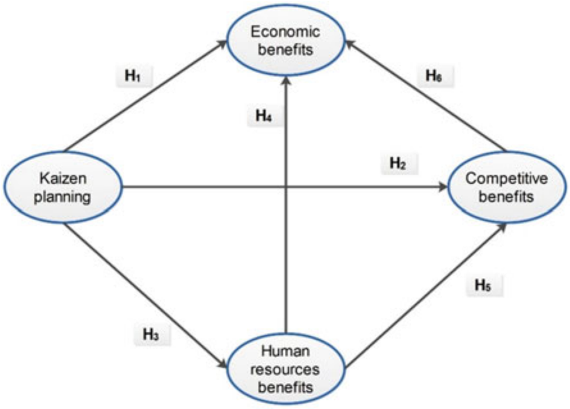
- Kaizen planning
  - Managerial commitment
  - Work teams organization
  - Human resources training
- Human resources benefits
- Competitive benefits
- Economic benefits.

11.3.1 Hypotheses—Integrative Model (Kaizen Planning Phase)

As in the two previous models, relationships here are statistically validated. This model assumes that the Kaizen planning phase has a direct and positive impact on all the benefits obtained after the implementation of the philosophy. Figure 11.5 depicts the model proposed.

It is worth mentioning that some of the hypotheses appearing in this model have been discussed and analyzed in the past two models. For instance, model 1 has studied the relationship between Kaizen *Competitive benefits* and Kaizen *Economic*

Fig. 11.5 Integrative model —Kaizen planning phase



benefits through its sixth hypothesis (H_6). Likewise, the rapport between *Human resources benefits* and *Economic benefits* has been discussed in model 2 through its fourth hypothesis (H_4).

Such relationships previously studied remain in the model in order to calculate the indirect effects between the analyzed latent variables. If one of these relationships were removed, it would be impossible to estimate their total effects.

Training provided to human resources, especially operators and improvement group members, is one of the cornerstones of Kaizen success, since it equips people with the necessary skills to efficiently and effectively solve problems (Al-Johani 2015; Suarez-Barraza and Lingham 2008). However, such training and all the other work resources depend to a great extent on the *Managerial commitment* that exists within the company. The opinion of senior and middle managers is important in any project. Besides, it demonstrates how well integrated managers are with the rest of the organization (Karatepe and Karadas 2012). Companies whose employees are not united to attain clear goals and objectives are very likely to disappear due to a low income, which is why managers must work to ensure such an integration.

In addition to integration, another important element to focus the employee's efforts on the company's most important goals is through programs that monitor and motivate such objectives (ÖZlen and Hadžiahmetović 2014). Some studies advise hiring experts during the Kaizen planning phase, since this is usually the only way to obtain the economic benefits sought when the company has not enough experience in implementing the Kaizen philosophy. In fact, lack of experience from managers and group leaders can be the leading cause of desertion among improvement group members, which is an impediment to solving the economic issues that affect the company (Yamamoto et al. 2008; Sandoval-Arzaga and Suárez-Barraza 2010).

Therefore, in order to contribute to the discussion regarding the importance of the Kaizen planning phase to obtain the economic benefits gained from continuous improvement programs, the following hypothesis is proposed as follows:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, proper *Kaizen planning* has a direct and positive effect on the *Economic benefits* gained.

The quality of Kaizen planning does not only impact in economic terms. It also reflects on the *Competitive benefits* to be obtained. For instance, the opinions of managers always help to rapidly detect problems in the production lines, which increases productivity, and thus allows for a faster response to customer demands.

Stone and Kerno (2010), Livi et al. (2015). Likewise, when improvement groups are heterogeneous and properly trained, their work capabilities are enhanced. Consequently, quality of operations and products is improved.

Furthermore, both communication and the characteristics of improvement groups are important. On the one hand, companies must ensure enough and adequate interaction among all hierarchical levels, for this promotes knowledge transfer, both vertically and horizontally, and, as a result, solutions to problems are comprehensive and systemic (Magnier-Watanabe 2011). On the other hand, improvement groups ought to be heterogeneous, multidisciplinary, and their members must be united towards a same goal. In the end, both communication and integration remove barriers, mainly misunderstandings and inappropriate attitudes, when solutions are implemented, thus ensuring authentic teamwork.

From a similar perspective, it is important to establish a united and structured front to detect failures and problems that commonly affect the material flow along the whole production system. In fact, when organizations adopt process-oriented thinking, they manage to enhance their production systems. Such improvements reflect on the product quality in terms of its characteristics and technical specifications.

Finally, training must be seen as the means to gain a new competitive advantage, as it will help the company adopt a continuous improvement culture (Kane et al. 2005; Gagnon et al. 2015). Companies that invest in professional development opportunities for their human resources are able to survive, since they have the tools to rapidly adapt to the sudden market changes. Therefore, if organizations underestimate the effects of properly trained operators and do not promote knowledge sharing and generation, they will struggle to reach their objectives. Moreover, continuous improvement groups will be in trouble, since their integration would be poor. Hence, knowledge would be only of the person who has it and not of the company (Magnier-Watanabe 2011; Choo et al. 2015).

In order to contribute to this discussion, and because we believe that Kaizen planning activities have a strong influence on the *Competitive benefits* to be gained when implementing the philosophy, below we propose the second working hypothesis for the final model of this chapter:

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, proper *Kaizen planning* has a direct and positive impact on the *Competitive benefits* gained.

The basis of *Kaizen planning* is to have clear goals and objectives to be attained by making improvement changes. However, company and improvement group leaders must never forget that employees also have their own objectives and purposes, which ought to be integrated into the daily work activities, otherwise employees will lose their motivation. That is to say, they can feel companies are taking advantage of their capabilities without actually considering them (Pyotsia 2014).

Therefore, perhaps the most effective way to show employees that they are important to solve problems is to listen to them. This includes considering their opinions and suggestions regarding their work. Nevertheless, managers and group leaders are equally responsible for identifying the personal needs and objectives of employees. In the end, this improves their attitude, and thus their motivation. Consequently, workers try to make a better job and thus perfect their aptitudes (Topuz and Arasan 2013; Dwivedula and Bredillet 2010).

Another important element regarding improvement groups is increased participation. During the Kaizen planning phase, group leaders should expect more constant collaboration and active involvement from group members in the planning process. This will allow employees to develop a series of skills and capabilities that can be useful for their personal and professional lives, not only for the company (Topuz and Arasan 2013). Similarly, training must focus on improving life quality. Industrial safety must be emphasized as a means to reduce occupational accidents, especially CTDs.

Sensitization at the Kaizen planning phase makes communication grow and improve along the entire organization. If employees are exposed to the objectives of Kaizen philosophy, and its benefits for the company and for them, they feel confident to express the problems that they perceive in the production lines (Deering et al. 2011). However, in addition to motivate improvement group members, companies must also acknowledge them and reward them for their accomplishments and the results obtained by the group. This is an effective way to impact on the employees' attitude and self-esteem.

In conclusion, if organizations manage to effectively integrate their human resources to achieve their goals and meet their objectives, they will be building a brand new work system. For this reason, we believe that Kaizen planning can have some effect on the human resources of companies. Thus, the third working hypothesis of model 3 is proposed as follows:

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, proper *Kaizen planning* has a direct and positive impact on the *Human resources benefits* gained.

Figure 11.4 of model 2 validates the direct and positive relationship between Kaizen *Human resources benefits* and *Economic benefits* through its sixth hypothesis (see H_6 of Fig. 11.4). In this integrative model, such a relationship is also established in hypothesis 4 (see Fig. 11.5); however, it will not be discussed again.

As regards the fifth hypothesis, we consider that *Human resources benefits* gained from Kaizen implementation have an impact on the *Competitive benefits* of companies. First, it is known that employee motivation increases the quality of a product and makes it possible to meet all its technical specifications (Tjosvold and Tjosvold 2015). Moreover, unmotivated improvement groups do not contribute, in any significant way, to the competitiveness of the company. Nevertheless, when there is self-esteem, businesses are capable of competing in globalized environments and adapting to unexpected market changes in a more rapid way (Medinilla 2014b).

Also, when reducing the number of occupational hazards and work accidents (including CTDs), companies save resources that, otherwise, would be spent on health insurance costs or lost as a result of employee absenteeism and productivity loss. Moreover, they will stand out as organizations concerned about the safety and integrity of their employees, and this will make them attractive to both clients and potential employees (Esperne 2010).

From a similar perspective, when all employees—including managers—adopt a more positive attitude, many barriers within the company can be easily removed. Consequently, it is easier and faster to implement proposals and solutions in the production system, which reduces setup times and thus improves product deliveries (Taleghani 2012; Giauque 2015). Finally, knowledge is important to simplify and effectively perform work. However, it should be shared, both horizontally and vertically, as a form of collaboration. When this happens, the whole system is improved, including product design (Wang et al. 2016).

Considering the influence of Kaizen benefits for human resources on activities on the competitive levels of companies, the fifth working hypothesis is constructed as follows:

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources benefits* have a direct and positive impact on the *Competitive benefits* obtained.

Regarding the sixth hypothesis (H_6) depicted in Fig. 11.5, the direct and positive relationship between Kaizen *Competitive benefits* and *Economic benefits* has been previously proposed and validated in model 1 (see Figs. 11.1 and 11.2). Therefore, it will not be discussed again. Readers are invited to consult the corresponding section again to know the direct effects obtained from analyzing this relationship.

11.3.2 Evaluation of Model 3—Kaizen Planning Phase

The model proposed in Fig. 11.5 has been evaluated according to the research methodology described in Chap. 4. Still, it is important to remember the following aspects about model 3:

- This is an integrative model that includes the three latent variables previously studied in a single latent variable: *Kaizen planning* and that is why this is a second-order model.
- Estimations regarding hypotheses are obtained with 95 % confidence. Thus, the maximum *p* value allowed is 0.05.

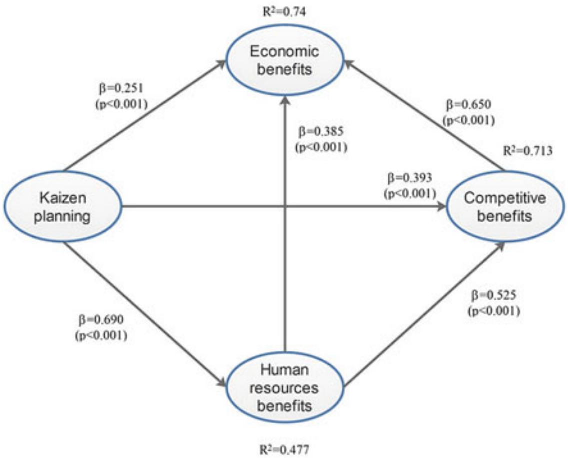


Fig. 11.6 Integrative model evaluated—Kaizen planning phase

Figure 11.6 shows model 3 after its evaluation. As in previous models, each relationship or hypothesis includes a β value and the p value for the statistical hypothesis test.

11.3.2.1 Validation of Latent Variables

This integrative model includes four latent variables in total. The first one represents Kaizen planning, while the remaining three stand for the different types of Kaizen benefits that can be obtained. Before interpreting the model, these latent variables must be analyzed through different indices. Table 11.9 presents results obtained from the analysis.

Table 11.9 Validation of latent variables—Integrative model (Kaizen planning phase)

	Economic benefits	Competitive benefits	Human resources benefits	Kaizen planning
R-squared (R^2)	0.741	0.551	0.526	
Adjusted *R*-squared	0.739	0.638	0.549	
Composite reliability	0.946	0.942	0.891	0.942
Cronbach's alpha	0.938	0.933	0.837	0.907
AVE	0.563	0.538	0.672	0.843
VIF	2.726	3.859	2.485	2.629
Q-squared (Q^2)	0.642	0.552	0.527	

From information presented in the table, it is possible to conclude the following regarding latent variables validity:

- All latent variables included in the integrative model have enough predictive validity from a parametric point of view, since values of the R^2 and adjusted R^2 are above 0.2 in all cases.
- All values of Q^2 are also higher than 0.2, which proves that all latent variables have enough predictive validity from a non-parametric perspective.
- Both the composite reliability index and the Cronbach's alpha show values higher than 0.7 in all cases. Therefore, all latent variables have enough internal validity.
- As regards, AVE values, they show enough convergent validity in the four latent variables, since they are above 0.5
- Finally, VIF coefficients free all the latent variables from collinearity problems inside of them, since values are lower than 5 in all cases.

These results demonstrate that all variables analyzed in this integrative model have enough statistical validity, so they must remain in the model.

11.3.2.2 Model Efficiency Indices—Integrative Model (Kaizen Planning Phase)

The following step is to analyze the model as a construct through ten model fit indices. Results from the analysis are listed below

- Average path coefficient (APC) = 0.421, $P < 0.001$
- Average R-squared (ARS) = 0.644, $P < 0.001$
- Average adjusted R-squared (AARS) = 0.642, $P < 0.001$
- Average block VIF (AVIF) = 2.497, acceptable if ≤ 5, ideally ≤ 3.3
- Average full collinearity VIF (AFVIF) = 3.539, acceptable if ≤ 5, ideally ≤ 3.3
- Tenenhaus GoF (GoF) = 0.640, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36
- Sympson's paradox ratio (SPR) = 1.000, acceptable if ≥ 0.7, ideally = 1
- R-squared contribution ratio (RSCR) = 1.000, acceptable if ≥ 0.9, ideally = 1
- Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7
- Nonlinear bivariate causality direction ratio (NLBCDR) = 1.000, acceptable if ≥ 0.7.

On one hand, the p values of APC, ARS, and AARS are lower than 0.001, which implies that the model as a whole has enough predictive validity. On the other hand, note that AVIF and AFVIF indices associated with the variance inflation of variables have values below 3.3. Such results free the model from collinearity problems.

Similarly, the model's goodness of fit measured through the Tenenhaus GoF index has a value that equals 0.573. Such a value is visibly higher than the minimum accepted value (0.36). Thus, it is concluded that the model has been properly adjusted from a statistical point of view. Finally, results from the SPR, RSCR, SSR, and NLBCDR tests show values equal to 1, which free the model from such problems, as these values obtained are ideal.

11.3.2.3 Direct Effects of the Integrative Model—Kaizen Planning Phase

Once the relationships proposed in Fig. 11.5 have been analyzed, results appear in Fig. 11.6. Both the β values and the p values allow us to make inferences regarding these relationships. However, it is suitable to remember that merely four of these relationships are discussed in this section, since the remaining two have already been addressed by the previous two models. Thus, the four hypotheses state as follows:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical validation to declare that *Kaizen planning* has a direct and positive impact on the *Economic benefits* obtained, since when the former increases its standard deviation by one unit, the latter increases by 0.251 units.

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical validation to declare that *Kaizen planning* has a direct and positive impact on the *Competitive benefits* obtained, since when the former increases its standard deviation by one unit, the latter increases by 0.393 units.

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical validation to declare that *Kaizen planning* has a direct and positive impact on the *Human resources benefits* obtained, since when the former increases its standard deviation by one unit, the latter increases by 0.690 units.

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical validation to declare that *Human resources benefits* have a direct and positive impact on the *Competitive benefits* obtained, because when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.525 units.

11.3.2.4 Direct Effects Size of the Integrative Model—Kaizen Planning Phase

Readers can observe from Fig. 11.6 that some dependent latent variables are explained by more than one independent latent variable. In this case, the R^2 value is

Table 11.10 Decomposed direct effects—Integrative model (Kaizen planning phase)

A	De			
	Competitive benefits	Human resources benefits	Kaizen planning	R^2
Economic benefits	0.515	0.039	0.189	0.74
Competitive benefits		0.417	0.296	0.713
Human resources benefits			0.477	0.477

decomposed into the number of explicative latent variables. Each portion of the R^2 for a dependent latent variable is thus the amount of variance explained by each independent latent variable. Therefore, the total variance of each dependent latent variable is decomposed in Table 11.10.

As can be observed from the table, the total variance of *Economic benefits* is 74 %, as the value of R^2 is 0.74 units. However, this variance is explained by three latent variables. On the one hand, *Competitive benefits* is responsible for 0.515. On the other hand, *Human resources benefits* explains 0.039 of the variance. Finally, *Kaizen planning* explains 0.189. Since latent variable *Competitive benefits* has the largest explanatory power, it is concluded that for Mexican manufacturing companies, their competitiveness is crucial to obtain economic benefits.

However, to obtain such *Competitive benefits*, companies must ensure the wellbeing and development of their human resources. In fact, Table 11.10 shows that latent variable *Human resources benefits* has the largest explanatory power in *Competitive benefits* (ES = 0.417), although *Kaizen planning* also plays a role.

From a different perspective, note that latent variable *Human resources benefits* is only explained by *Kaizen planning* in 47.7 %, as the value of R^2 is 0.477. In this case, the variance is not decomposed, as merely one independent latent variable explains the dependent latent variable. Nevertheless, it is concluded that the way to provide employees with the benefits that Kaizen offers is through its appropriate planning.

Thus, Fig. 11.6 shows the crucial role of appropriate *Kaizen planning* to obtain the expected advantages from a continuous improvement. In fact, the model proves that Kaizen planning is critical to obtain its expected *Human resources benefits,* which are in turn essential to obtain the *competitive benefits* desired that eventually bring significant *Economic benefits.*

11.3.2.5 Sum of Indirect Effects—Integrative Model (Kaizen Planning Phase)

Figure 11.6 also shows that it is possible to reach one latent variable through more than one segment. These segments are called indirect effects, and they always originate from the latent variables located on the right side of the model.

Table 11.11 Sum of indirect effects—Integrative model (Kaizen planning phase)

To	From	
	Human resources benefits	Kaizen planning
Economic benefits	0.321 ($P < 0.001$) ES = 0.229	0.500 ($P < 0.001$) ES = 0.372
Competitive benefits		0.362 ($P < 0.001$) ES = 0.273

Table 11.11 shows the sum of indirect effects between latent variables for the integrative model using mediator variables.

Results from Table 11.11 reflect the following conclusions regarding the indirect effects between latent variables:

- There are three indirect effects, and they are all statistically significant, since the *p* values are below 0.001. This means that inferences can be made at a 100 % confidence level.
- *Human resources benefits* has an indirect effect on *Economic benefits* through *Competitive benefits*. The value of such an effect is 0.321, and the former latent variable can explain up to 22.9 % of the variability of the latter latent variable, since the effect size value is 0.229.
- *Kaizen planning* has an indirect effect on *Economic benefits* through *Human resource benefits*. The value of this effect is 0.500. Moreover, the first latent variable explains up to 0.372 of the variability of the second latent variable, since the effect size value is 0.372. Also, another interesting phenomenon occurs between *Kaizen planning* and *Economic benefits*. While the value of its direct effect is 0.25, its indirect effect is two times higher.
- Finally, *Kaizen planning* has an indirect effect on *Competitive benefits* through *Human resources benefits*. The value of such an effect is 0.362, and the first latent variable explains up to 27.3 % of the variability of the second latent variable, since the effect size value is 0.273.

11.3.2.6 Sum of Total Effects—Integrative Model (Kaizen Planning Phase)

Table 11.12 introduces the total effects between latent variables. Total effects are the sum of direct and indirect effects.

Data presented in the table above imply the following conclusions:

- There are six total effects between latent variables. All of them are statistically significant, since the *p* values are all lower than 0.001. This means that inferences are made at a 99.9 % confidence level.
- Latent variable *Kaizen planning* has both direct and indirect effects on the remaining latent variables, which is why it is located on the right side of the model.

Table 11.12 Sum of total effects—Integrative model (Kaizen planning phase)

To	From		
	Competitive benefits	Human resources benefits	Kaizen planning
Economic benefits	0.611 ($P < 0.001$) ES = 0.515	0.706 ($P < 0.001$) ES = 0.468	0.751 ($P < 0.001$) ES = 0.558
Competitive benefits		0.525 ($P < 0.001$) ES = 0.417	0.756 ($P < 0.001$) ES = 0.569
Human resources benefits			0.69 ($P < 0.001$) ES = 0.477

- Of special interest is the relationship between *Kaizen planning* and *Competitive benefits*, as it shows the largest total effects (0.756 units). However, note that whereas the value of the direct effect is 0.393, the indirect effect is almost as high. Moreover, such an indirect effect is given through latent variable *Human resources benefits* that explains up to 56.9 % of the variability of *Competitive benefits.*
- The second most significant relationship, in terms of the total effects magnitude, occurs between *Kaizen planning* and *Economic benefits.* When the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.751 units. Nevertheless, in this relationship the direct effect is noticeably lower, with a value that equals 0.25, than the indirect effect. In addition, *Kaizen planning* explains up to 55.8 % of the variability of *Economic benefits.*
- In the relationship between *Kaizen planning* and *Human resources benefits*, when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.69 units. However, this total effect is also a direct effect (see H_3 of this model).
- Finally, the total effects between *Competitive benefits* and *Economic benefits* is equally relevant, although this is a direct effect that has been previously analyzed in the section of direct effects (see H_6 of this model).

11.3.2.7 Conclusions and Industrial Implications—Integrative Model (Kaizen Planning Phase)

Based on the integrative model proposed in Fig. 11.5, and whose results are shown in Fig. 11.6, we can conclude the following regarding the role of Kaizen planning in obtaining expected benefits from continuous improvements:

- Six hypotheses are evaluated, four of them are new, while the remaining two have been discussed in the previous models. All direct effects are statistically significant.
- As regard the effects magnitude, it is demonstrated that proper *Kaizen planning* is essential to obtain *Human resources benefits*, since it is the variable that affects the most.
- *Human resources benefits* must be ensured, as they are strongly related to the amount and quality of both *Competitive benefits* and *Economic benefits* that companies can obtain from Kaizen implementation.
- Since *Human resources benefits* have a stronger effect on *Competitive benefits* than on *Economic benefits*, it is important to ensure the advantages of Kaizen to employees as a means to obtain competitive indices that turn into a strategic advantage.
- Since *Competitive benefits* has the strongest impact on *Economic benefits* than any other latent variable, manufacturing companies must strive to reach *Competitive benefits* and indices that allow them to increase their economic performance.
- The critical path in the integrative model regarding the impact of Kaizen planning on *Economic benefits* can be stated as follows: *Kaizen planning—Human resources benefits—Competitive benefits—Economic benefits.* Figure 11.6 depicts the relationships between such latent variables and their effects magnitude.

11.4 Conclusion on Kaizen Planning

Kaizen planning is crucial for guaranteeing the *Economic benefits* of the philosophy. In this chapter, we propose three structural equation models to evaluate such a relationship. On one hand, the first two models decompose the Kaizen planning phase into its three latent variables and associate them with the different types of Kaizen benefits. On the other hand, the third model is an integrative construct that includes the three Kaizen planning latent variables into a single latent variable, and it relates this new latent variable to the three types of Kaizen benefits. Results obtained from the three models allow us to conclude the following:

- The planning phase must include clear description and statement of the goals and objectives sought to reach with a continuous improvement program, otherwise results from such a project may not follow the corporate vision and mission.
- Before analyzing any problem, one must have enough statistical evidence at hand to justify its solution. Similarly, issues must be solved under a customer-focused that also has economic justification and does not affect employee wellbeing.

- Kaizen is a LM tool whose basis is collaboration. For this reason, managers must ensure *Human resources training*, since it is the only way to guarantee the *Human resources benefits* and *Economic benefits* sought.
- *Managerial commitment* among improvement groups is key to obtain all the benefits that Kaizen offers to companies.
- *Human resources training* guarantees *Competitive benefits*. Although it seems that employee work skills have no direct impact on a company's *Economic benefits*, both variables are strongly related in an indirect way.

Chapter 12
Kaizen Execution Phase Models: Activities and Benefits

In this chapter, we present three structural equation models to study the impact of the Kaizen execution phase on the company benefits. The latent variables analyzed in these models are:

- *Successful implementation of proposals*
- *Human resources integration*
- *Customer focus*
- *Competitive benefits*
- *Human resources benefits*
- *Economic benefits.*

As previously discussed, the execution phase initially comprises 24 Kaizen activities or items integrated in three latent variables. However, after the validation process (see Chap. 10), some items were removed. Similarly, two of the models here presented study the Kaizen execution phase latent variables in a separate way, while the third model integrates these three latent variables into a single one in order to define the impact of all Kaizen execution activities on Kaizen benefits. All models have been evaluated with WarpPLS 5 software, making inferences at a 95 % confidence level.

The structure of this chapter is as follows:

- Hypotheses are discussed and justified. Then, we propose a preliminary model.
- The preliminary model is evaluated:
  - Latent variables are statistically validated
  - Direct, indirect, and total effects are estimated.
- Conclusions for each model are presented.

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Management and Industrial Engineering, DOI 10.1007/978-3-319-47747-3_12

12.1 Model 1—Kaizen Execution Phase

This model associates four latent variables through six working hypotheses. Two of these latent variables represent activities carried out within improvement groups at the Kaizen execution phase, whereas the remaining two represent company benefits. More specifically, the latent variables studied are:

- *Human resources integration*
- *Successful implementation of proposals*
- *Competitive benefits*
- *Economic benefits.*

12.1.1 Hypotheses of Model 1—Kaizen Execution Phase

In this model, we assume that *Human resources integration* is the most important latent variable upon which *Successful implementation of proposals* depends. Thus, it is located on the top left side of the model. As in Chap. 11, latent variable *Economic benefits* is considered as the dependent latent variable. Figure 12.1 depicts the proposed hypotheses for this first model, which are later discussed and supported.

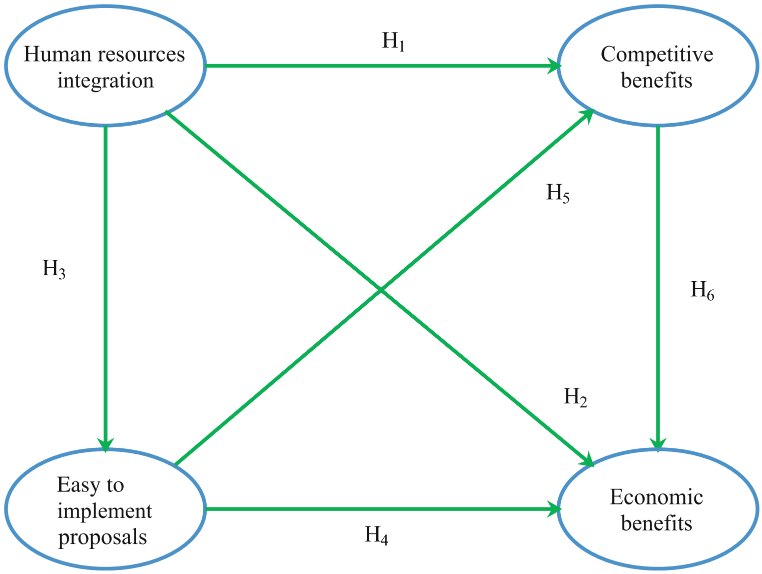

Fig. 12.1 Hypotheses proposed for Model 1—Kaizen execution phase

Recently, there has been a growing interest in studying *Human resources integration* as a strategic advantage (Becker and Huselid 1998). Most research has been characterized by analyzing how such a strategy is ensured within the managing process. Similarly, other studies have demonstrated the influence of the human resources system in company performance. Analyzing human resources integration within strategic and continuous improvement processes can differ depending on the focus of the study (Khatri and Ng 2000), making a distinction between macro-and micro approaches.

A company has competitive advantages when it is more capable than its competitors in terms of retaining customers and defend itself from competition (García et al. 2013c). Many Kaizen *Economic benefits* are derived from appropriate human integration. Some of them include: high-quality products, improved customer service, cost reduction, better geographic location, and improved product performance (Vento et al. 2016). Therefore, to collaborate in the discussion about the impact of *Human resources integration* on business competitiveness, we propose the first working hypothesis for Model 1:

H$_1$ In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources integration* has a direct and positive impact on the obtained *Competitive benefits*.

In addition to bringing competitive advantages, it has been argued that *Human resources integration* also has an effect on the *Economic benefits* that companies can gain (García et al. 2013c; Glover et al. 2014; Oropesa et al. 2016b). In fact, it has been demonstrated that, as human resources integration increases, productivity and quality levels also increase, and thus companies improve their economic performance (Doolen et al. 2008).

As regards Kaizen, Lefcovich (2007) argues that the main advantage of this philosophy is its ability to reduce work accidents, inventories, machine failures, work in process, and setup times, while promoting process-oriented thinking and increasing inventory turnover. Since such benefits have also been identified by Suárez-Barraza et al. (2011b) through an empirical study among different Mexican manufacturing companies, we can thus propose the following working hypothesis for Model 1:

H$_2$ In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources integration* has a direct and positive impact on the obtained *Economic benefits.*

According to (Valles et al. 2009), another factor that can be related to *Human resources integration* during Kaizen implementation is a *Successful implementation of proposals.* In other words, Kaizen simplifies the implementation of proposals by providing human resources the tools and skills to properly perform their jobs. In this sense, experience and knowledge leads to improvement.

Companies that seek excellence in their products and services must promote human resources integration. Moreover, they have to provide employees all the necessary resources to properly follow the improvement proposals applied in the production process (Tapias and Correa 2010). In this sense, proposals refer to the implementation of any improvement tool, including 5S, assembly line balancing, Kanban, and Just In Time (JIT), among others. Therefore, to contribute to such a discussion regarding the role of human resources in the implementation of proposals, the third working hypothesis of Model 1 is proposed as follows:

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources integration* has a direct and positive impact on *Successful implementation of proposals*.

When proposals are easily implemented, and sufficient time and resources are provided, companies work under improvement-based production models derived from appropriate integration of employees. Therefore, human resources are key to building sustainable improvement programs. Operators must be integrated and trained in teamwork, leadership, communication, and collaboration skills, allowing them to perform different positions, organize suggestion groups, and solve problems. All this reflects on the *Economic benefits* that companies obtain (Valencia Patiño 2014). To support such a discussion, the fourth working hypothesis is proposed as follows:

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, *Successful implementation of proposals* has a direct and positive impact on the obtained *Economic benefits*.

The top competitive benefits that Kaizen offers are: overall changes in the organizational culture, flexibility, and agility to respond to customer demands, while avoiding final product inventory, 3.4 defect parts per million (PPM) opportunities, cost reduction up to 40 %, and substantial increase of cash flow (Velázquez Valadez 2007).

One way of developing a strong competitive advantage is by offering an outstanding customer service. However, this is only achieved through complete human resources organization, participation, and training. Similarly, employees must develop a sense of belonging to the company and should be involved in continuous improvement. For this reason, the fifth working hypothesis for Model 1 states as follows:

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, *Successful implementation of proposals* has a direct and positive impact on the obtained *Competitive benefits*.

The sixth hypothesis (H_6) for this model relates Kaizen *Competitive benefits* with *Economic benefits*. Since such a relationship has been previously addressed in Chap. 11 (see Figs. 11.1 and 11.3), it will not be discussed again. This hypothesis is constructed as follows:

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, *Competitive benefits* have a direct and positive impact on the obtained *Economic benefits*.

12.1.2 *Evaluation of Model 1—Kaizen Execution Phase*

Results from the evaluation of the preliminary model depicted in Fig. 12.1 are presented in Fig. 12.2. Every relationship includes its corresponding hypothesis, represented by an arrow, a beta (*β*) value, and a *P* (*p*) value for the statistical hypothesis test. Likewise, it is important to remember that:

- The model integrates four latent variables. The two on the left side represents Kaizen execution activities, while the two on the right side represents Kaizen benefits.
- All hypotheses are tested at a 95 % confidence level, which is why the *p* value must not be higher than 0.05.
- Statistical evaluations are run with WarpPLS5 software.

12.1.2.1 Validation of Variables—Model 1 (Kaizen Execution Phase)

Before interpreting the model depicted in Fig. 11.2, the four latent variables must be analyzed to determine their validity. These latent variables only include items validated in Chap. 10. Table 12.1 therefore presents the results from the validation

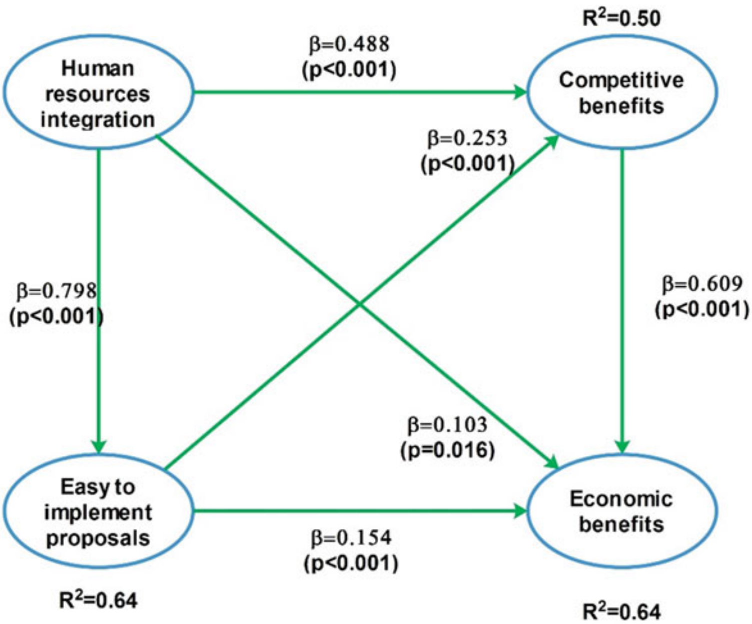

Fig. 12.2 Model 1 evaluated—Kaizen execution phase

Table 12.1 Validation of latent variables—Model 1 (Kaizen execution phase)

	Successful implementation of proposals	Human resources integration	Economic benefits	Competitive benefits
R-squared (R^2)	0.637		0.636	0.498
Adjusted *R*-squared	0.636		0.633	0.495
Composite reliability	0.886	0.901	0.926	0.923
Cronbach's alpha	0.852	0.874	0.909	0.906
AVE	0.595	0.532	0.612	0.572
VIF	2.914	3.17	2.731	3.008
Q-squared (Q^2)	0.637		0.636	0.5

process. As can be observed, the seven indices described in the research methodology (see Chap. 4) have been employed.

According to Table 12.1, we can conclude that all latent variables are statistically significant and must remain in the model for its analysis. First, note that all latent variables have enough predictive validity from parametric and nonparametric perspectives. On the one hand, R^2 and adjusted R^2 values are above 0.2, which is the maximum value allowed in this research. On the other hand, every Q^2 value is higher than 0 and very similar to R^2 and adjusted R^2 values.

From a similar perspective, all values of the composite reliability index and the Cronbach's alpha are above 0.7. In addition, AVE shows values higher than 0.5, the minimum value established, in all the latent variables. This indicates that latent variables have enough convergent validity. Finally, as regards VIF coefficients, they are all lower than 5 or 3.3. Such values free latent variables from collinearity problems inside of them.

12.1.2.2 Efficiency Indices—Model 1 (Kaizen Execution Phase)

Since latent variables are statistically significant, the model can now be analyzed to determine its validity as a whole construct. The following ten model efficiency indices are used:

- Average path coefficient (APC) = 0.401, $P < 0.001$
- Average *R*-squared (ARS) = 0.590, $P < 0.001$
- Average adjusted *R*-squared (AARS) = 0.588, $P < 0.001$
- Average block VIF (AVIF) = 2.586, acceptable if ≤ 5, ideally ≤ 3.3
- Average full collinearity VIF (AFVIF) = 2.956, acceptable if ≤ 5, ideally ≤ 3.3
- Tenenhaus GoF (GoF) = 0.571, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36
- Sympson's paradox ratio (SPR) = 1.000, acceptable if ≥ 0.7, ideally = 1

- R-squared contribution ratio (RSCR) = 1.000, acceptable if ≥ 0.9, ideally = 1
- Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7
- Nonlinear bivariate causality direction ratio (NLBCDR) = 1.000, acceptable if ≥ 0.7.

Results from the evaluation reveal that the model has enough explanatory power, and its interpretation is reliable. First, APC results show that the average value of the β parameter in each direct relationship equals 0.401. Moreover, since the p value is lower than 0.001, relationships between latent variables are significant at a 99.9 % confidence level. Furthermore, values of ARS and AARS equal 0.590 and 0.588, respectively, while their p values are also lower than 0.001. Therefore, it is concluded that the model in general has predictive validity.

As for AVIF and AFVIF values, they are below 5, so they free latent variables from collinearity problems among them. Likewise, note that the Tenenhaus GoF shows a value noticeably higher than 0.36, the minimum accepted value, which is why we can conclude that the model has enough explanatory power. Finally, since SPR, RSCR, SSR, and NLBCDR coefficients equal 1, we conclude that the model is free from problems related to such indices.

12.1.2.3 Direct Effects—Model 1 (Kaizen Execution Phase)

Direct effects validate the hypotheses depicted in Fig. 12.1 and evaluated in Fig. 12.2. Conclusions regarding these hypotheses are:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Human resources integration* has a direct and positive impact on *Competitive benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.488 units.

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Human resources integration* has a direct and positive impact on *Economic benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.103 units.

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Human resources integration* has a direct and positive impact on *Successful implementation of proposals*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.798 units.

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Successful implementation of proposals* has a direct and positive impact on

Economic benefits, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.154 units.

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Successful implementation of proposals* has a direct and positive impact on *Competitive benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.254 units.

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Competitive benefits* have a direct and positive impact on *Economic benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.609 units.

12.1.2.4 Effects Size—Model 1 (Kaizen Execution Phase)

Figure 12.2 shows that all dependent latent variables have an R^2 value that indicates their amount of variance explained by independent latent variables. When such a variance is due to more than one independent latent variable, R^2 must be decomposed. Table 12.2 introduces results from such a decomposition.

According to information presented in Table 12.2, it is possible to conclude the following regarding the effects size:

- Latent variable *Human resources integration* explains up to 64 % of latent variable *Successful implementation of proposals*, since in this case $R^2 = 0.64$.
- Latent variable *Competitive benefits* can be 50 % explained by two latent variables, since in this case $R^2 = 0.50$. On the one hand, *Successful implementation of proposals* explains up to 0.162 units. On the other hand, *Human resources integration* explains 0.336 units. Thus, it is concluded that in order to gain *Competitive benefits*, companies must above all ensure appropriate *Human resources integration.*

Table 12.2 Effects size—Model 1 (Kaizen execution phase)

To	From			R^2
	Successful implementation of proposals	Human resources integration	Competitive benefits	
Customer focus		0.64		0.64
Economic benefits	0.096	0.066	0.474	0.64
Competitive benefits	0.162	0.336		0.50

- Latent variable *Economic benefits* is 64 % explained by three latent variables, since in this case $R^2 = 0.64$. While *Successful implementation of proposals* explains 0.096, *Human resources integration* explains 0.066, and *Competitive benefits* explain 0.474. Since this last latent variable has the highest effect value, we can conclude that if companies wish to gain *Economic benefits*, they must focus their efforts on gaining *Competitive benefits*.

12.1.2.5 Sum of Indirect Effects—Model 1 (Kaizen Execution Phase)

Dependent latent variables can be indirectly affected by independent latent variables through mediator variables, thus employing two or more segments from the model. Table 12.3 introduces the sum of those indirect effects for latent variables *Economic benefits* and *Competitive benefits*.

Based on the data presented in Table 12.3, the following conclusions can be proposed regarding the indirect effects between latent variables of Model 1 here presented:

- There are three indirect effects, and all of them are statistically significant, for their p values are below 0.001. This means that inferences are made at a 99.9 % confidence level.
- The largest indirect effect occurs between *Human resources integration* and *Economic benefits* through latent variables *Successful implementation of proposals* and *Competitive benefits.* In this case, the independent latent variable explains up to 39.8 % of the variance of the dependent latent variable, as the effect size is 0.398. This relationship is important to be noticed, since the direct effect (0.103) is lower than the indirect effect (0.544).
- The second largest indirect effect has a value equal to 0.203. It involves latent variables *Human resources integration* and *Competitive benefits*, which are indirectly associated through latent variable *Successful implementation of proposals.* Similarly, the independent latent variable can explain up to 14 % of the variability of the dependent latent variable, because the effect size for that effect equals 0.14.

Table 12.3 Sum of indirect effects—Model 1 (Kaizen execution phase)

To	From	
	Successful implementation of proposals	Human resources integration
Economic benefits	0.155 ($P < 0.001$) ES = 0.096	0.544 ($P < 0.001$) ES = 0.398
Competitive benefits		0.203 ($P < 0.001$) ES = 0.140

- The indirect effect of *Successful implementation of proposals* on *Economic benefits* is given through *Competitive benefits*. In this case, the indirect effect has a value equal to 0.155, and the independent latent variable can explain up to 9.6 % of the variability of the dependent latent variable, since the effect size for that effect is 0.096.

12.1.2.6 Sum of Total Effects—Model 1 (Kaizen Execution Phase)

As in Chap. 11, total effects between latent variables are estimated based on the direct and indirect effects. Table 12.4 introduces such total effects.

Based on data presented in Table 12.4, the following conclusions can be proposed regarding the total effects between latent variables of Model 1:

- There are six total effects, and all of them are statistically significant at a 99.9 % confidence level, since their p values are below 0.001.
- The largest total effects are given by *Human resources integration*. This latent variable is located on the left side of the model and has an impact on all the other latent variables.
- The largest total effect occurs from *Human resources integration* to *Successful implementation of proposals*. The value of such an effect equals 0.798, and it is also a direct effect previously discussed and validated in the third hypothesis (see H_3) of the model.
- The second largest effect occurs between *Human resources integration* and *Competitive benefits*. The value of this effect equals 0.691, and the independent latent variable explains up to 47.5 % of the variability of the dependent latent variable, since the effect size is 0.475.
- The total effect between *Human resources integration* and *Economic benefits* is the third most important in terms of magnitude (0.647). The former latent

Table 12.4 Total effects—Model 1 (Kaizen execution phase)

To	From		
	Successful implementation of proposals	Human resources integration	Competitive benefits
Successful implementation of proposals		0.798 ($P < 0.001$) ES = 0.637	
Economic benefits	0.309 ($P < 0.001$) ES = 0.192	0.647 ($P < 0.001$) ES = 0.414	0.609 ($P < 0.001$) ES = 0.474
Competitive benefits	0.254 ($P < 0.001$) ES = 0.162	0.691 ($P < 0.001$) ES = 0.475	

variable explains 41.4 % of the variability of the latter, as the effect size is 0.414.

- Note that the total effect between *Competitive benefits* and *Economic benefits* is also a direct effect, since no indirect effects were found in this relationship.
- The total effect between latent variables *Successful implementation of proposals* and *Economic benefits* has a value equal to 0.309. In addition, the former explains up to 19.2 % of the variability of the latter, because the effect size equals 0.192.
- Finally, the lowest total effect occurs from latent variable *Successful implementation of proposals* to *Competitive benefits.* This is another example of total effects that equal direct effects, as no indirect effects were found in this relationship.

12.1.2.7 Conclusions and Industrial Implications—Model 1 (Kaizen Execution Phase)

The first model of this chapter studies the impact of Kaizen execution activities on economic and competitive benefits. After having evaluated the model, we present the following conclusions:

- Mexican manufacturing companies must strive to ensure appropriate *Human resources integration*, since this study demonstrates the effects of this variable on the *Competitive benefits* and *Economic benefits* to be gained.
- The success of proposals to be implemented depends on appropriate *Human resources integration.* In this study, the relationship between *Human resources integration* and *Successful implementation of proposals* has the largest direct and total effects of Model 1.
- In order to obtain the expected Kaizen *Economic benefits* from appropriate *Human resources integration,* companies must focus on obtaining *Competitive benefits*. When employees feel motivated, it becomes easier to implement the proposals selected for improvements.
- *Competitive benefits* are the latent variable with the largest effect on *Economic benefits*. Therefore, Mexican manufacturing companies must guide improvement groups toward reaching standards that can make them more competitive.
- To gain competitiveness, Mexican manufacturing companies must guarantee proper *Human resources integration*, since this is the latent variable with the largest direct effect. This implies promoting motivation and acknowledging employees for their performance and achievements. Companies have to promote an organizational culture that encourages self-discipline and establish effective policies that allow human resources to use their skills and experiences in different positions, thus encouraging their creativity.

12.2 Model 2—Kaizen Execution Phase

In this section, we present a second structural equation model that also integrates four latent variables. As in the previous model, the first two of them represent Kaizen execution activities carried out by improvement groups, while the other two stand for Kaizen benefits. More specifically, latent variables integrated in this model include:

- *Successful implementation of proposals*
- *Customer focus*
- *Human resources benefits*
- *Economic benefits.*

12.2.1 Hypotheses of Model 2—Kaizen Execution Phase

In this model, we assume that latent variable *Successful implementation of proposals* is the most important upon which the remaining latent variables depend—which is why it is considered the independent latent variable and is located on the top left side of the model. Likewise, we contemplate latent variable *Economic benefits* as the one affected by all latent variables. Thus, it is placed on the bottom right side of the model. Figure 12.3 illustrates the raised hypotheses. Then, these hypotheses are supported in the following paragraphs.

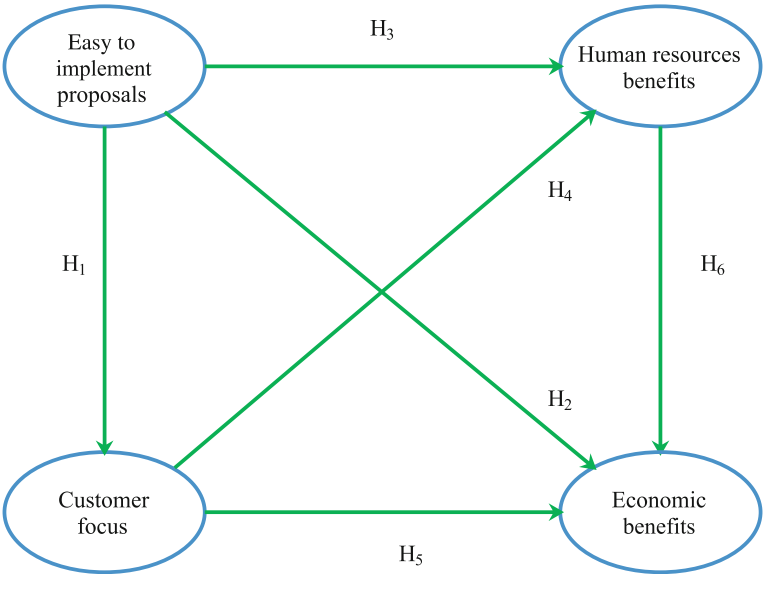

Fig. 12.3 Model 2—Kaizen execution phase

Mexican manufacturing companies must focus their efforts and resources on proposing solutions that are beneficial to the product, its production process, and customers, since, in the end, clients pay for the cost incurred (Maarof and Mahmud 2016). However, it is equally important to ensure work place safety and hygiene when implementing improvement changes, although, again, customers must be top priority (Rani et al. 2015).

Similarly, organizations must always analyze how easily solutions can be implemented and executed. Therefore, leadership—in both the whole company and inside improvement groups—is key. Likewise, some studies argue that Kaizen, as a lean manufacturing (LM) tool, should seek the support from other LM tools, such as 5S and Kanban (Nelson 2016) as a means to eliminate barriers that may prevent from effectively working (Murata and Katayama 2010), and to promote multidisciplinary integration of improvement groups.

Finally, another essential aspect to ensure successful proposals implementation is guidance from a Kaizen expert during the planning phase. Hiring an expert in the philosophy will allow companies to effectively focus the work and efforts of improvement group members (García et al. 2013a; García et al. 2014a). Therefore, considering the importance of proposals implementation to the company, the first working hypothesis for Model 2 is proposed:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, *Successful implementation of proposals* has a direct and positive impact on the *Customer focus* adopted by companies.

Companies which are able to efficiently implement the selected improvement proposals, which are also customer-focused, are more likely to gain economic benefits (Visuwan 2010). However, many organizations commonly face resistance and opposition from employees when changes begin to appear. Thus, they must make more investments to facilitate the implementation process of such changes.

Fortunately, there are many ways to avoid resistance. First, it is important to inform all employees directly affected on the benefits of such improvements. Second, companies must ask for the opinion of these people, otherwise employees would feel that changes in the company have a negative impact on them (Medinilla 2014d). In this sense, the role of improvement group leaders is crucial, as they must have the correct abilities and skills to keep group members motivated to work under a holistic approach that seeks the benefits of all (Ghicajanu 2011).

For all these reasons, manufacturing companies must invest time and economic resources to remove such barriers that prevent from effectively implementing proposals. If this is not handled from the early stages of the execution phase, the economic benefits sought will be hardly obtained, and organizations will spend more in the future to try to solve problems that will not be solved on time. Therefore, in order to contribute to such a discussion regarding the impact of proposals implementation on the economic benefits gained by companies, we propose the second hypothesis for Model 2 as follows:

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, *Successful implementation of proposals* has a direct and positive impact on the obtained *Economic benefits.*

Companies must never forget that the true proposal generators are human resources. In other words, employees are the ones who find solutions and make organizations better. Therefore, in addition to bringing economic benefits, improvement plans must be beneficial to all human resources (Popescu 2015). The extent to which proposals can be implemented usually relies on managerial and interdepartmental leadership, which is generally measured by employees in terms of the resources and materials provided (Paul and Suresh 1992; AL-Tahat and Jalham 2015).

If continuous improvement groups are asked to give results, but they are not provided with the appropriate tools to successfully make changes, employees can think the company is only looking for its own benefit, while ignoring the importance of human resources. Hence, improvement group leaders must find ways of satisfying and motivating group members by always offering something in return, such as productivity bonuses and safety and hygiene benefits, among others.

Considering thus the importance of proposals implementation on human resources benefits, the third hypothesis of Model 2 is constructed as follows:

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, *Successful implementation of proposals* has a direct and positive impact on *Human resources benefits*.

One of the questions I am usually asked when working with Mexican continuous improvement groups is how group members can actually obtain any kind of benefit when proposals are focused on the customer and not on themselves (Tetteh 2012). What I answer is that while customers are the reason why companies exist, human resources are actually the means to generate a product that clients purchase. In that sense, a product bought represents an income for the company, and employees will thus benefit from a stable job and source of income (Medinilla 2014d). However, it is also important to explain two realities: in the end, customers pay for the whole production process, and human resources always have a prioritized position in the improvement proposals implemented, as improvement groups will always seek the benefit of the entire organization.

Another essential activity for reaching appropriate customer focus is working on quality management systems (Paraschivescu and Cotirlet 2015). In such systems, it must be established that customers are the reason why companies exist, and human resources are integrated in order to meet identified customer needs (Miller et al. 2014). Thus, considering that *Customer focus* inside improvement groups is to some extent related to *Human resources benefits*, the fourth working hypothesis of Model 2 is proposed below:

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, *Customer focus* has a direct and positive impact on *Human resources benefits*.

All LM tools are focused on improving the production process as a means to obtain economic benefits for the company. In fact, economic benefits allow companies to grow. Thus, since Mexican manufacturing companies generate a product with the only goal of gaining economic benefits for shareholders, they must above all successfully identify and address customer needs (Visuwan 2010; Rof 2011). This is why Kaizen has a customer focus, as this is one way if supporting its implementation (Kumashiro 2011; Vieira et al. 2012b).

When implementing Kaizen, companies simultaneously start quality management programs. Such programs chiefly focus on improving products and standardizing processes, so that all employees can perform their activities by following a manual. In general, everything handled by quality management systems is guided toward obtaining economic benefits, which is why we propose the fifth hypothesis for Model 2:

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, *Customer focus* has a direct and positive impact on *Economic benefits*.

The sixth hypothesis (H_6) of this model has already been studied in previous models. However, the structure of this model is very different, if compared with the other constructs. Thus, instead of removing H_6, it is important to keep it to, so it can be studied under a different scenario. The hypothesis thus states as follows:

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources benefits* have a direct and positive impact on *Economic benefits*.

12.2.2 Evaluation of Model 2—Kaizen Execution Phase

The model illustrated in Fig. 12.3 has been evaluated according to the research methodology described in Chap. 4. Results obtained from the evaluation are shown in Fig. 12.4. Note that each relationship between variables has a beta (β) value, and a P (p) value for the statistical hypothesis test. Likewise, it is important to remember that:

- The model integrates four latent variables. The two on the left represents Kaizen activities carried out at the execution phase, whereas the two on the right are the Kaizen benefits that can be obtained.
- All inferences must be statistically valid at a 95 % confidence level. Thus, the significance level is 5 %, and p values must be lower than or equal to 0.05.
- The model is evaluated using statistical software WarpPLS 5.

12.2.2.1 Validation of Variables—Model 2 (Kaizen Execution Phase)

To validate latent variables, we consider only the items or observed variables accepted after the internal validity analysis carried out in Chap. 10. In addition, we

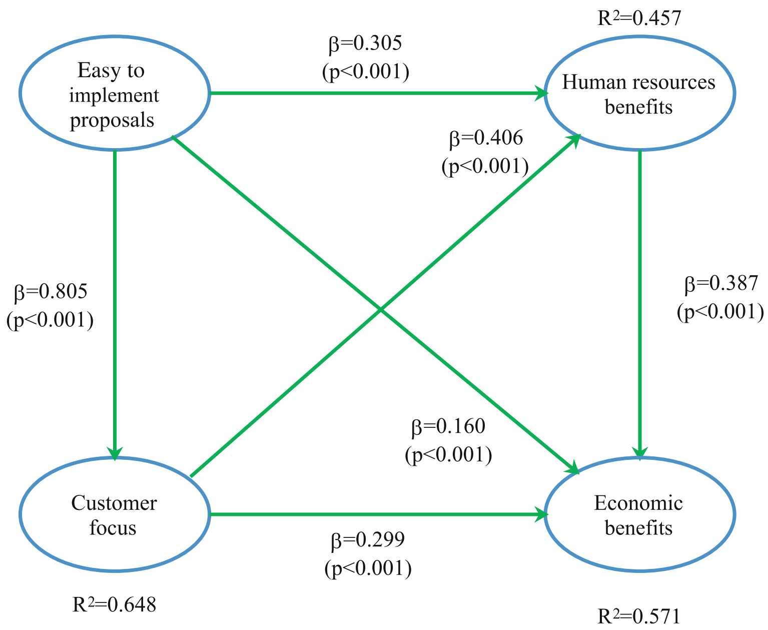

Fig. 12.4 Model 2 evaluated—Kaizen execution phase

Table 12.5 Validation of latent variables—Model 2 (Kaizen execution phase)

	Successful implementation of proposals	Customer focus	Economic benefits	Human resources benefits
R-squared (R^2)	0.696	0.645	0.503	
Adjusted *R*-squared	0.694	0.643	0.501	
Composite reliability	0.942	0.925	0.948	0.954
Cronbach's alpha	0.930	0.908	0.939	0.928
AVE	0.641	0.608	0.646	0.874
VIF	3.227	3.971	2.819	2.463
Q-squared (Q^2)	0.697	0.645	0.504	

employ six more indices to determine whether more items or variables must be removed. Table 12.5 lists these indices, including the Cronbach's alpha, and shows results from the validation process.

According to information presented, all latent variables are valid. Consider first values of R^2, Adjusted R^2, and Q^2. Since they are all above 0.2 (the minimum value accepted), we can conclude that all latent variables have enough predictive validity from parametric and nonparametric perspectives. Likewise, the composite reliability index and the Cronbach's alpha show values higher than 0.7—the minimum accepted value. As for the average variance extracted, the analysis show values above 0.5. Finally, VIF values are all lower than 3.3, which frees latent variables from collinearity problems inside of them.

12.2.2.2 Efficiency Indices of Model 2 (Execution Phase)

Before interpreting the relationships between the analyzed latent variables, we must evaluate the efficiency of the model as a whole construct. To achieve this, ten efficiency indices are used. These indices and their results are listed below:

- Average path coefficient (APC) = 0.394, $P < 0.001$
- Average R-squared (ARS) = 0.558, $P < 0.001$
- Average adjusted R-squared (AARS) = 0.556, $P < 0.001$
- Average block VIF (AVIF) = 2.688, acceptable if ≤ 5, ideally ≤ 3.3
- Average full collinearity VIF (AFVIF) = 2.709, acceptable if ≤ 5, ideally ≤ 3.3
- Tenenhaus GoF (GoF) = 0.566, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36
- Sympson's paradox ratio (SPR) = 1.000, acceptable if ≥ 0.7, ideally = 1
- R-squared contribution ratio (RSCR) = 1.000, acceptable if ≥ 0.9, ideally = 1
- Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7
- Nonlinear bivariate causality direction ratio (NLBCDR) = 1.000, acceptable if ≥ 0.7.

Results indicate that the model is appropriate and can be interpreted. APC results show that the average value of the β parameter in each direct relationship between latent variables equals 0.394 units. Similarly, since the p value is below 0.001, all relationships established as hypotheses are statistically significant at a 99.9 % of confidence level.

Furthermore, values associated with ARS and AARS are equal to 0.558 and 0.556, respectively. Moreover, both indices have a p value that is lower than 0.001, which indicates that the model has enough predictive validity. As for AVIF and AFVIF indices, results show values below 3.3, the idealized value. Therefore, it is concluded that the model is free from collinearity problems among latent variables.

As regards the model goodness of fit, the Tenenhaus index shows a value above 0.36, which provides the model with large predictive power. Finally, SPR, RSCR, SSR, and NLBCDR values equal 1, and they thus free the model from problems related to such indices.

12.2.2.3 Direct Effects—Model 2 (Kaizen Execution Phase)

Evaluation of direct effects illustrated in Fig. 12.4 serve to validate each hypothesis proposed in Fig. 12.3. The validation considers each p value associated with each β coefficient. Thus, conclusions regarding the direct effects between latent variables of Model 2 are as follows:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Successful implementation of proposals* has a direct and positive impact on *Customer focus*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.805 units.

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Successful implementation of proposals* has a direct and positive impact on *Economic benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.160 units.

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Successful implementation of proposals* has a direct and positive impact on *Human resources benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.305 units.

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Customer focus* has a direct and positive impact on *Human resources benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.406 units.

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Customer focus* has a direct and positive impact on *Economic benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.299 units.

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Human resources benefits* have a direct and positive impact on *Economic benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.387 units.

12.2.2.4 Effect Size—Model 2 (Kaizen Execution Phase)

Figure 12.4 shows and R^2 value for each dependent latent variable. Such a value represents the amount of variance explained by independent latent variables. When two or more independent latent variables are involved in the variance of a dependent latent variable, the R^2 value must be decomposed. Table 12.6 shows the decomposed variance of each dependent latent variable.

Data presented in Table 12.6 allow us to propose the following conclusions regarding the explained variance of dependent latent variables in Model 2:

- There are three dependent latent variables associated with an R^2 value.
- Latent variable *Customer focus* is 64.8 % explained by *Successful implementation of proposals*, since the effect size equals 0.648 units. In this case total effects equal direct effects, as no indirect effects exist in this relationship between variables.
- Latent variable *Human resources benefits* is 45.7 % explained by two latent variables, and the effect size equals 0.457 units. *Successful implementation of proposals* explains 19.3 % of the variance, whilst *Customer focus* explains 26.4 %. This shows that *Customer focus* is the most significant variable to *Human resources*, because it explains the greatest percentage of variance.
- Latent variable *Economic benefits* is 57.1 % explained by all other latent variables, as the effect size equals 0.571. First, *Successful implementation of proposals* explains 10.3 % of the variance. Second, *Customer focus* explains 20.3 %. Third, *Human resources benefits* are responsible for 26.5 %. This implies that in order to obtain *Economic benefits*, companies must guarantee benefits for their human resources.

12.2.2.5 Sum of Indirect Effects—Model 2 (Kaizen Execution Phase)

As previously mentioned, latent variables can be indirectly related between them through mediator variables, and this occurs through two or more segments depicted in the model (see Fig. 12.4). In the case of indirect effects, p values also help determine their statistical significance and the amount of variance explained. Table 12.7 introduces the sum of indirect effects between latent variables of Model 2.

As can be concluded from the table:

- There are three indirect effects, and all of them are statistically significant at a 99.9 % confidence level, because the p values are all below 0.001.
- The largest indirect effect occurs between latent variables *Successful implementation of proposals* and *Economic benefits* (0.486) through latent variables *Customer focus* and *Human resources benefits*. Moreover, the first latent variable explains up to 31.2 % of the second latent variable, as the effect size equals

Table 12.6 Effects size—Model 2 (Kaizen execution phase)

To	From			R^2
	Successful implementation of proposals	Customer focus	Human resources benefits	
Customer focus	0.648			0.648
Economic benefits	0.103	0.203	0.265	0.571
Human resources benefits	0.193	0.264		0.457

Table 12.7 Sum of indirect effects—Model 2 (Kaizen execution phase)

To	From	
	Successful implementation of proposals	Customer focus
Economic benefits	0.486 (*P* < 0.001) ES = 0.312	0.157 (*P* < 0.001) ES = 0.107
Human resources benefits	0.326 (*P* < 0.001) ES = 0.206	

0.312. Furthermore, it is important to mention that while the direct effect between these variables is low, the indirect effect is particularly higher.

- The second most important effect in terms of magnitude involves latent variables *Successful implementation of proposals* and *Human resources benefits*. In this case, the value of the effect is 0.326 units, and the moderator variable is *Customer focus*. Likewise, *Successful implementation of proposals* explains 20.6 % of *Human resources benefits* variability, as the effect size is 0.206. As in the previous relationship, the indirect effect is higher than the direct effect (0.305).
- Finally, latent variable *Customer focus* has an indirect effect in *Economic benefits* through *Human resources benefits*. The value of the effect is 0.157, and the former latent variable explains up to 10.7 % of the variability of the latter (ES = 0.107).

12.2.2.6 Total Effects—Model 2 (Kaizen Execution Phase)

Table 12.8 shows the total effects between latent variables. As in previous sections, each result includes the magnitude of the beta (β) parameter, and the P (p) value for the hypothesis test.

Based on information presented in the table, we can conclude the following as regards the total effects between latent variables of Model 2.

Table 12.8 Total effects—Model 2 (Kaizen execution phase)

To	From		
	Successful implementation of proposals	Customer focus	Human resources benefits
Customer focus	0.805 (*P* < 0.001) ES = 0.648		
Economic benefits	0.646 (*P* < 0.001) ES = 0.415	0.457 (*P* < 0.001) ES = 0.310	0.387 (*P* < 0.001) ES = 0.265
Human resources benefits	0.631 (*P* < 0.001) ES = 0.399	0.406 (*P* < 0.001) ES = 0.264	

- There are six total effects, and they are all statistically significant at a 99.9 % confidence level, since the p values are below 0.001.
- Latent variable *Successful implementation of proposals* has effects on all the other latent variables, since it is considered the independent variable of the model.
- In term of magnitude, the largest effect (0.805 units) occurs in the relationship between *Successful implementation of proposals* and *Customer focus*. However, note that in this case, the total effects equal the direct effect, as no indirect effects exist in this relationship.
- The largest total effect involves *Successful implementation of proposals* and *Economic benefits*. Its value equals 0.646, and the former explains up to 41.5 % of the variability of the latter, because the effect size is 0.415. Likewise, in this relationship total effects involve the direct effect and two indirect effects, given through *Customer focus* and *Human resources benefits.*
- The total effect of latent variable *Successful implementation of proposals* on *Human resources benefits* equals 0.631. The former explains 39.9 % of the variability of the latter, being the effect size 0.399. Also, the total effect accounts for the direct effect and the indirect effect given by *Customer focus.*
- Latent variable *Customer focus* has a total effect over *Economic benefits*, which is equal to 0.457. The former explains 31 % of the variability of the latter, being ES = 0.310. As in the previous two relationships, the total effects include the direct effect between these latent variables, and the indirect effect occurring trough *Human resources benefits*.
- Finally, *Customer focus* has a total effect on *Human resources benefits* that measures 0.406 units. In this case, the total effect equals the direct effect, as no indirect effects are found in this relationship.

12.2.2.7 Conclusions and Industrial Implications—Model 2 (Kaizen Execution Phase)

Results from the model evaluation, including its validation and the analysis of direct, indirect, and total effects, allow for the following conclusions to be proposed:

- The success of Kaizen plans and programs depends on several factors, being *Successful implementation of proposals* one of the most salient. Therefore, senior managers must strive to create a work environment that promotes communication and removes barriers among departments. This is what actually supports and guarantees that employees accept and contribute in the implemented proposals.
- Proposals must be customer-focused in order to obtain the expected *Economic benefits* and *Human resources benefits.* In these sense, employees and their well-being are important because workers are the true generators of ideas and improvement achievers.

- When analyzing variable *Human resources benefits* (see Fig. 12.4), we conclude that *Customer focus* is the most significant element to ensure employee benefits, since it affects *Human resources benefits* the most.
- Because latent variable *Human resources benefits* has the largest effect on *Economic benefits*, it is again demonstrated that Mexican manufacturing companies have to care for the well being, satisfaction, motivation, performance, and professional development of their employees, otherwise they will not achieve the economic performance they wish to achieve.
- Finally, note that relationships studied in previous models offer different results in this model, as their behavior changes under different conditions and scenarios.

12.3 Integrative Model—Kaizen Execution Phase

The first two structural equation models relate Kaizen execution latent variables to Kaizen benefits. However, as in Chap. 11, the third and last model is an integrative construct in which, thanks to a second-order factor analysis, all the latent variables associated with Kaizen execution activities are combined into a single latent variable: *Kaizen execution.* Then, the model associates this new latent variable with the three types of Kaizen benefits: *Economic benefits, Human resources benefits,* and *Competitive benefits.* Thus, the integrative model includes the following latent variables:

- *Kaizen execution*
  - *Successful implementation of proposals*
  - *Customer focus*
  - *Human resources integration.*
- *Economic benefits*
- *Human resources benefits*
- *Competitive benefits.*

12.3.1 Hypotheses of the Integrative Model—Kaizen Execution Phase

This model comprises six hypotheses relating the four latent variables. Nevertheless, relationships connecting Kaizen benefits among them have already been discussed and supported. Therefore, even though they will not be reviewed again, these hypotheses must remain in the model to study their behavior, as this model is a new scenario that could change their characteristics. Figure 12.5 hence shows the model with the proposed hypotheses, which will be discussed below.

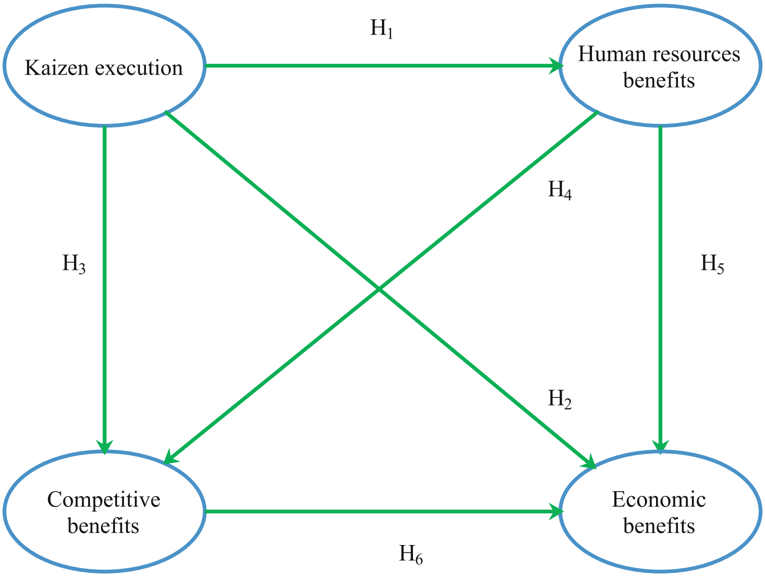

Fig. 12.5 Integrative model—Kaizen execution phase

Kaizen plans and programs must be beneficial to both companies and employees who plan and implement them, otherwise improvements would be unsuccessful (Medinilla 2014d). Although we have already discussed that modifications must be customer-focused, it is important not to underestimate the value of human resources.

One of the benefits that Kaizen offers employees is visible reduction of work accidents and cumulative trauma disorders (CTDs) that result from incorrect work postures and movements and constant effort (James et al. 2014b). Nevertheless, people also need to feel integrated and must see that the company listens to them, their concerns, and their suggestions for improvements. This increases self-esteem and motivation, and thus, employees keep positively participating in improvement groups. Moreover, their attitude changes, and makes them more prone to improving their work skills, which makes it easier to embrace new changes (Audenino 2012).

If all improvement groups collaborate to solve problems arising in the production lines, the company will continuously build a new system and paradigm, especially in terms of its relationships with employees (Wittenberg 1994). Therefore, we can propose the first hypothesis of the integrative model as follows:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, *Kaizen execution* has a direct and positive impact on *Human resources benefits.*

The reason why all LM tools exist is because they can guarantee a number of economic benefits for companies that are otherwise impossible to gain. Being

Kaizen a LM technique, its main objectives remain the same as other LM tools. Moreover, it also allows for professional and personal growth.

Several studies have demonstrated the positive impact of Kaizen plans and programs on the economic performance of companies. In general terms, researchers and scholars have studied Kaizen implementation costs (Visuwan 2010), investments, and methods (Visuwan 2010). Likewise, it has been argued that initial investments are one of the leading obstacles to Kaizen implementation (Maarof and Mahmud 2016), which very often does not occur.

While companies usually focus on the economic impact, they must not underestimate Kaizen benefits in terms of knowledge constructed and shared and experience gained. In fact, knowledge can directly become one of the most important economic assets (Koichi et al. 2014; Machikita et al. 2016b). Thus, in order to contribute to the discussion supporting the role of Kaizen in business economic performance, the second hypothesis of the integrative model is constructed:

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, *Kaizen execution* has a direct and positive impact on *Economic benefits.*

It is very common to think that as soon as we implement Kaizen, we will automatically see economic improvements; however, it is not like that. First, companies must focus on reaching competitiveness, which will allow them to respond faster and better to the demand, with products that customers actually want to purchase. This is why Kaizen is known as continuous improvement, as success does not happen overnight.

When companies focus on competitiveness, they are forced to identify the problems in the production lines and solve them in a collaborative way. In such situations, employee skills constantly develop and improve, as knowledge is shared and transferred. In this sense, knowledge transfer is a very important element, although very often ignored and difficult to be measured. However, it is one of the most important competitive benefits that companies can obtain.

Likewise, when problems are jointly addressed and knowledge is created and shared among employees, suggestions and ideas come from different approaches and points of views, which make it easier to find and implement a holistic and integrative solution. Consequently, companies adapt faster to demand changes, which become a competitive advantage to rapidly access new markets.

To support the discussion regarding the impact of Kaizen execution on the competitive benefits of companies, we propose the third working hypothesis:

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, *Kaizen execution* has a direct and positive impact on the gained *Competitive benefits.*

Hypotheses H_4, H_5, and H_6 have been addressed in previous models and relate Kaizen benefits among them. However, we remind readers that these relationships must remain in this model to study their behavior under a different scenario. Thus, although they will not be supported again, they state as follows:

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources benefits* have a direct and positive impact on *Competitive benefits.*

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources benefits* have a direct and positive impact on *Economic benefits.*

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, *Competitive benefits* have a direct and positive impact on *Economic benefits*.

12.3.2 Evaluation of the Integrative Model—Kaizen Execution Phase

Figure 12.6 shows results from the model proposed in Fig. 12.5. As in previous cases, the model is analyzed following the research methodology described in Chap. 4. Also, each hypothesis shows a beta (β) value, and a P (p) value for the statistical hypothesis test, while every dependent latent variable has an R^2 value to indicate its explained variance. Finally, it is important to remember that:

- Statistical inferences are valid at a 95 % confidence level. Thus, the p value cannot be higher than 0.05, since the significance level is set to 5 %.
- The three latent variables associated with Kaizen execution activities have been integrated into a single latent variable: *Kaizen execution.*

12.3.2.1 Validation of Variables—Model 2 (Kaizen Execution Phase)

Before interpreting the results provided by the model in Fig. 12.6, all latent variables must be analyzed to determine their validity. Chapter 10 previously tested their validity using the Cronbach's alpha index. However, six more indices must be used to determine full validity, as sometimes we need to remove items within the latent variables to avoid collinearity problems. Table 12.9 hence lists all indices used, including the Cronbach's alpha.

Results obtained from the validation process indicate that all latent variables have enough validity to remain in the model without making any changes. On the one hand, values of R^2 and Adjusted R^2 are higher than 0.2, the maximum value accepted. This proves that all latent variables have enough predictive validity from a parametric perspective. On the other hand, since the values of Q^2 are also higher than 0.2 and very similar to R^2 and Adjusted R^2, we can conclude that, from a nonparametric perspective, there is enough predictive validity in all latent variable.

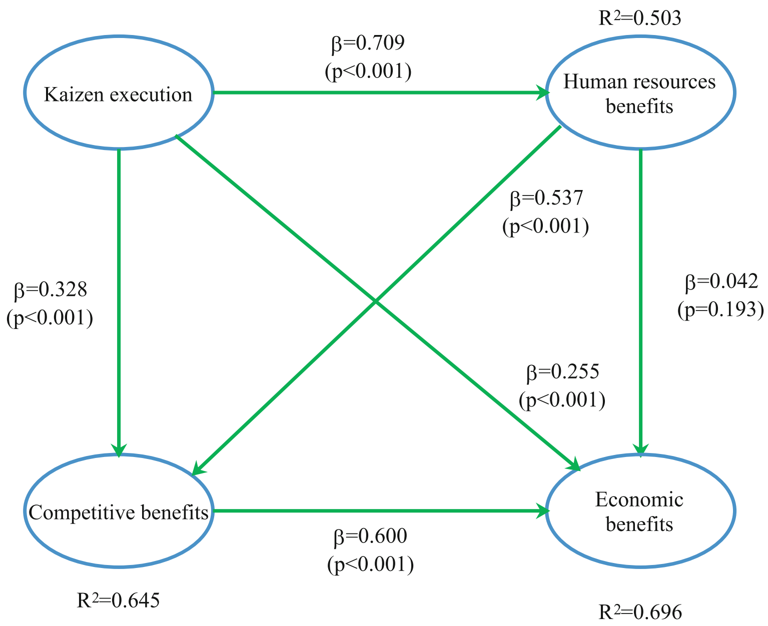

Fig. 12.6 Integrative model evaluated—Kaizen execution phase

Table 12.9 Validation of latent variables—Integrative model (Kaizen execution phase)

	Economic benefits	Competitive benefits	Human resources benefits	Kaizen execution
R-squared (R^2)	0.696	0.645	0.503	
Adjusted *R*-squared	0.694	0.643	0.501	
Composite reliability	0.942	0.925	0.948	0.954
Cronbach's alpha	0.930	0.908	0.939	0.928
AVE	0.641	0.608	0.646	0.874
VIF	3.227	3.971	2.819	2.463
Q-squared (Q^2)	0.697	0.645	0.504	

In addition, values of the Cronbach's alpha and the composite reliability index are higher than 0.7 in all cases, which reveals sufficient internal validity in the latent variables. As for convergent validity, it is ensured by AVE values, which are above 0.5. Finally, note that VIF values are lower than 5 and thus free all latent variables from collinearity problems inside of them.

12.3.2.2 Efficiency Indices of the Integrative Model (Kaizen Execution Phase)

Since latent variables are statistically significant, the model should be analyzed to determine its validity as a whole construct. The following ten model efficiency indices are used:

- Average path coefficient (APC) = 0.412, $P < 0.001$
- Average R-squared (ARS) = 0.614, $P < 0.001$
- Average adjusted R-squared (AARS) = 0.613, $P < 0.001$
- Average block VIF (AVIF) = 2.380, acceptable if ≤ 5, ideally ≤ 3.3
- Average full collinearity VIF (AFVIF) = 3.120, acceptable if ≤ 5, ideally ≤ 3.3
- Tenenhaus GoF (GoF) = 0.652, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36
- Sympson's paradox ratio (SPR) = 1.000, acceptable if ≥ 0.7, ideally = 1
- R-squared contribution ratio (RSCR) = 1.000, acceptable if ≥ 0.9, ideally = 1
- Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7
- Nonlinear bivariate causality direction ratio (NLBCDR) = 1.000, acceptable if ≥ 0.7.

Results from the evaluation validate the model proposed in Fig. 12.6. First, as regards APC, it is shown that the average value of β in each direct relationship from Fig. 12.6 equals 0.412. Moreover, since the p value is lower than 0.001, such inferences are significant at a 99.9 % confidence level. As for ARS and AARS, their p values are also below 0.001, which implies that the model as a construct has enough predictive validity.

Based on AVIF and AFVIF values, which are lower than 3.3, there are no collinearity problems among latent variables. Furthermore, the Tenenhaus index shows a value equal to 0.652, which is noticeably higher than the minimum value established (0.36). Thus, the model is acceptable. Finally, SPR, RSCR, SSR, and NLBCDR values free the model from problems related to such indices.

12.3.2.3 Direct Effects—Integrative Model (Kaizen Execution Phase)

Direct effects validate hypotheses proposed in Fig. 12.5 and evaluated in Fig. 12.6. Considering the p values of these hypotheses, the following conclusion can be proposed regarding the direct effects between latent variables of the integrative model.

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Kaizen execution* has a direct and positive impact on *Human resources benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.709 units.

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Kaizen execution* has a direct and positive impact on *Economic benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.255 units.

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Kaizen execution* has a direct and positive impact on *Competitive benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases by 0.328 units.

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Human resources benefits* have a direct and positive impact on *Competitive benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.537 units.

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, there is not enough statistical evidence to declare at a 95 % confidence level that *Human resources benefits* have a direct and positive impact on *Economic benefits*, since the *p* value associated with this relationship is above 0.1 (0.193).

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare at a 95 % confidence level that *Competitive benefits* have a direct and positive impact on *Economic benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.600 units.

12.3.2.4 Effects Size—Integrative Model (Kaizen Execution Phase)

As shown in Fig. 12.5, some dependent latent variables can be explained by one independent latent variable or more. In this case, Fig. 12.6 includes an R^2 value for each one of these dependent variables, indicating the amount of explained variance. However, when two or more independent variables are involved in the variance of a dependent variable, the R^2 value must be decomposed. Table 12.10 shows results from the decomposition process.

According to data obtained from the table, we can conclude the following regarding the effects size or explained variance of dependent latent variables in the integrative model:

- There are three dependent latent variables in the model: *Competitive benefits*, *Human resources benefits*, and *Economic benefits*, all of them are associated with an R^2 value.
- Latent variable *Kaizen execution* can explain up to 50.3 % of *Human resources benefits,* since in this case the R^2 value equals 0.503.

Table 12.10 Decomposed effects—Integrative model (Kaizen execution phase)

To	From			R^2
	Competitive benefits	Human resources benefits	Kaizen execution	
Economic benefits	0.487	0.029	0.180	0.696
Competitive benefits		0.413	0.232	0.645
Human resources benefits			0.503	0.503

- Latent variable *Competitive benefits* is 64.5 % (R^2 = 0.645) explained by *Human resources benefits* and *Kaizen execution.* While *Human resources benefits* explain 0.413 units of the variance, *Kaizen execution* explains 0.232. This shows that the former variable is more important to explain the *Competitive benefits* of companies.
- Latent variable *Economic benefits* is 69.6 % explained by three latent variables, since in this case R^2 = 0.696. Latent variable *Competitive benefits* explains 0.487 units, while *Human resources benefits* is responsible for 0.029 units. Meanwhile, *Kaizen execution* contributes in 0.180 units. This implies that if companies which to gain the *Economic benefits* sought, they must focus on their competitiveness.

12.3.2.5 Sum of Indirect Effects—Integrative Model (Kaizen Execution Phase)

The model depicted in Fig. 12.6 shows that some latent variables are indirectly related between them thanks to mediator variables. This occurs through more than two segments seen in the model. Analyzing indirect effects is important due to the model structure, as direct effects sometimes are not significant, but indirect effects can be relevant. In this section, Table 12.11 introduces results from the analysis of indirect effects between latent variables of the integrative model.

Table 12.11 allows us to conclude the following regarding the indirect effects between latent variables of the integrative model:

- There are three indirect effects between latent variables. All of them are statistically significant at a 99.9 % confidence level, since their p values are lower than 0.001.
- In terms of magnitude, the largest indirect effect occurs between latent variables *Kaizen execution* and *Economic benefits* through two mediator variables: *Competitive benefits* and *Human resources benefits*. The indirect effect has a value equal to 0.455. Moreover, *Kaizen execution* explains up to 32.1 % of the variability of *Economic benefits*, since the effect size is 0.321.
- The second largest effect occurs between *Kaizen execution* and *Competitive benefits*. It has a value equal to 0.381 and the first latent variable explains up to

Table 12.11 Sum of indirect effects—Integrative model (Kaizen execution phase)

To	From	
	Human resources benefits	Kaizen execution
Economic benefits	0.322 ($P < 0.001$) ES = 0.220	0.455 ($P < 0.001$) ES = 0.321
Competitive benefits		0.381 ($P < 0.001$) ES = 0.270

27 % of the variability of the second latent variable (ES = 0.270). Similarly, this indirect relationship occurs through *Human resources benefits.*

- Latent variable *Human resources benefits* has an indirect effect on *Economic benefits*, and it explains up to 22 % of the variability in the dependent latent variable. Such an indirect effect occurs through latent variable *Competitive benefits.*

12.3.2.6 Total Effects—Integrative Model (Kaizen Execution Phase)

The sum of direct and indirect effects between latent variables is shown in Table 12.12. Data include the β value, the p value for the statistical hypothesis test, and the size of each effect or explained variance.

Based on results introduced by Table 12.12, the following conclusions can be proposed regarding the total effects between latent variables in the integrative model:

- There are six total effects, and all of them are statistically significant at a 99.9 % confidence level. The p value is below 0.001 in all cases.
- Latent variable *Kaizen execution* has total effects on all the other latent variables, since it is located on the left side of the model. Also, note that all these effects are impressively similar in magnitude, differences are barely noticeable.

Table 12.12 Total effects of the integrative model (Kaizen execution phase)

To	From		
	Competitive benefits	Human resources benefits	Kaizen execution
Economic benefits	0.600 ($P < 0.001$) ES = 0.487	0.364 ($P < 0.001$) ES = 0.249	0.710 ($P < 0.001$) ES = 0.501
Competitive benefits		0.357 ($P < 0.001$) ES = 0.413	0.708 ($P < 0.001$) ES = 0.501
Human resources benefits			0.709 ($P < 0.001$) ES = 0.503

- In three relationships, total effects equal direct effects, as no indirect effects are found. These relationships are: *Competitive benefits*—*Economic benefits*, *Human resources benefits*—*Competitive benefits*, and *Kaizen execution*—*Human resources benefits*. They will not be discussed in this section, because they have been previously addressed in the direct effects section.
- The relationship between *Kaizen execution* and *Economic benefits* has a total value equal to 0.710. The former can explain up to 50.1 % of the variability of the latter, since the effects size is 0.501. In this case, total effects comprise the direct effect and the indirect effects given by *Competitive benefits* and *Human resources benefits*. Interestingly, the sum of indirect effects is higher than the direct effect (0.255).
- In the relationship between *Kaizen execution* and *Competitive benefits*, the total effect equals 0.708. Also, the former explains up to 50.1 % of the variability of the latter, since the effects size is once more 0.501. In this case, the total effect comprises the direct effect and the indirect effects occurring through *Human resources benefits*. As in the previous relationship, the indirect effect is higher than the direct effect. This highlights the importance of *Human resources benefits* for *Competitive benefits*.
- Latent variable *Human resources benefits* has total effects on *Economic benefits*, and it explains up to 24.9 % of the variability. Note that the direct impact in this relationship is not statistically significant. Nevertheless, the total effect equals 0.364 units. This supports our argument that companies must always ensure *Human resources benefits* to gain the *Economic benefits* that they expect to gain.

12.3.2.7 Conclusions and Industrial Implications—Integrative Model (Kaizen Execution Phase)

Results from the model evaluation—including its validation and the analysis of direct, indirect, and total effects between latent variables—allows us to propose the following conclusions and industrial implications:

- Even though previous models demonstrate a direct effect between *Human resources benefits* and *Economic benefits*, in this model such a direct relationship becomes statistically significant when it involves variable *Competitive benefits*. However, it does become an indirect effect. Such a phenomenon implies that before focusing on *Economic benefits, Competitive benefits* must be the main concern of senior managers. Nevertheless, competitiveness is only achieved through *Human resources benefits*.
- One of the largest effects occurs in the relationship between *Kaizen execution* and *Economic benefits*. Even though the direct effect is low (0.255), the total effect increases when we consider *Human resources benefits* and *Competitive benefits*. This means that both are key to obtaining the expected Kaizen *Economic benefits*.

- The way *Kaizen execution* is approached definitely impacts on *Human resources benefits.* This relationship shows the largest effect in the model, with a value that equals 0.709 units. This phenomenon denotes the importance of promoting a continuous improvement culture that supports proposals implementation. Also, senior managers must strive to integrate human resources and must show them that they are also benefitted when contributing to making improvements.
- According to Table 12.12, we can establish a critical path in the model: *Kaizen execution—Human resources benefits—Competitive benefits—Economic benefits.* In other words, Mexican manufacturing companies must ensure proper execution of improvement plans and programs, and they must promote a continuous improvement culture focused on solving problems arising in the production lines. All these practices bring a number of important *Human resources benefits*. Employees who are motivated by the results they bring perform better. Consequently, productivity increases, and economic benefits increase as well.

Chapter 13
Kaizen Control Phase Models: Activities and Benefits

Through the past chapters, we have discussed Kaizen implementation in its three phases—planning, execution, and control—and its impact on different Kaizen benefits (economic, competitive, and for human resources). Likewise, while Chap. 11 has assessed the impact of the Kaizen planning phase (and activities) on these benefits, Chap. 12 focused on the relationship between Kaizen execution phase (and activities) and the same Kaizen advantages. Therefore, in this last chapter, we still propose three structural equation models. However, they assess the impact of the Kaizen control phase on Kaizen benefits obtained by Mexican manufacturing companies. As in Chaps. 11 and 12, the first two models include latent variables associated with Kaizen control activities, whilst the third model integrates these latent variables into a single one.

Latent variables at the Kaizen control phase include:

- *Communication process*
- *Documentation and evaluation*
- *Organizational culture.*

Kaizen benefits analyzed in this chapter include:

- *Economic benefits*
- *Human resources benefits*
- *Competitive benefits.*

Latent variables studied in this chapter have been previously analyzed in Chap. 10 using the Cronbach's alpha index. Also, the Kaizen control phase initially comprised 14 activities or items encompassed in three latent variables (see Chap. 3). However, one item from latent variable *Documentation and evaluation* has been removed based on its Cronbach's alpha index obtained during the variables validation process (Chap. 10).

The models proposed are run using WarpPLS 5 software according to specifications discussed in the research methodology in Chap. 4. Statistical inferences

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regarding the model hypotheses are validated at a 95 % confidence level, being 5 % the significance level. Moreover, in every model presented, we provide the following information:

- Six hypotheses are statistically validated, and they represent the relationships between latent variables.
- In addition to using the Cronbach's alpha, latent variables are validated in this chapter through six more indices previously addressed in Chap. 4.
- The model is validated through ten efficiency indices.
- Direct, indirect, and total effects are estimated in every relationship between latent variables, and the *p* value is used for the statistical hypothesis test.
- Conclusions and industrial implications for the Mexican manufacturing industry are discussed.

13.1 Model 1—Kaizen Control Phase

This model associates four latent variables to determine their impact. Two of them represent activities carried out at the Kaizen control phase, while the remainder stand for Kaizen benefits to be gained by manufacturing companies. More specifically, latent variables studied in this first model are:

- *Communication process*
- *Documentation and evaluation*
- *Competitive benefits*
- *Economic benefits.*

As previously mentioned, to relate these variables we propose sixth working hypotheses supported and stated in the following section.

13.1.1 Hypotheses of Model 1—Kaizen Control Phase

In this model we consider *Communication process* as the independent latent variable, upon which all the others depend. For this reason, it is placed on the top left side of the model, while latent variable *Economic benefits* is located on the bottom right side, because we assume it is the dependent latent variable.

The model initially proposed is illustrated by Fig. 13.1. Note that some relationships between latent variables have been previously studied in Chaps. 11 and 12. Instead of being removed, they must remain in the model as their behavior, and thus their effects, can change under a different scenario or model structure. In these cases, hypotheses are not reviewed or supported again, but are stated once more as a remainder.

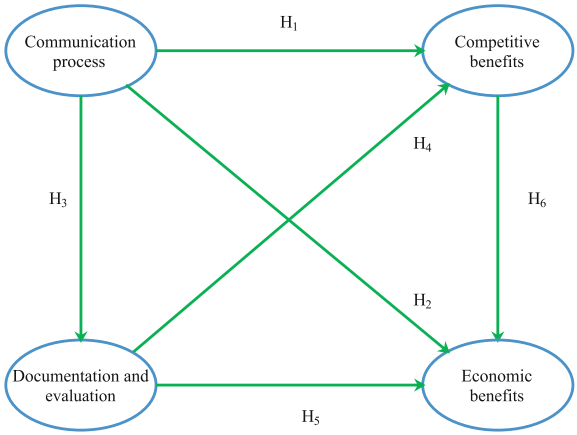


Fig. 13.1 Model 1 proposed—Kaizen control phase

Kaizen only works through collaboration, which means that, in order to solve problems in the production lines, people directly involved in the issues must be successfully integrated, so that solutions be provided from a holistic perspective (Alukal and Manos 2006). Such a collaborative work therefore involves an elevated communication process. In these processes managers are responsible for clearly conveying the corporate vision and mission, as this ensures that work plans and programs are properly directed (García et al. 2013a; Maarof and Mahmud 2016).

Also, improvement group leaders must survey group members to identify their needs. Likewise, it is important to organize two types of meetings. The first must be informative reunions to address the needs of group members in a direct way, not through surveys. The second must be analytical meetings where improvement groups discuss all struggles at work that prevent them from achieving the objectives settled (Liu et al. 2015b). In these meetings it is important that group members define and demand all the resources they need to get their work done and achieve the objectives set.

Another relevant aspect is that communication inside improvement groups, and companies in general, must be focused on quick problem solving, thus allowing organizations to gain competitive advantage (Borkowski et al. 2011). Also, training and knowledge transfer among and inside groups must aim to enhance not only product quality, but also employee skills, and remove all kinds of barriers (communication, attitude, aptitudes, motivation, etc.) that may prevent improvement groups from quickly implementing proposals (Higuchi et al. 2015a).

Considering thus the essential role of communication, both inside and outside improvement groups, for gaining competitiveness, the first model hypothesis is proposed as follows:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* has a direct and positive impact on *Competitive benefits*.

We have already highlighted the fact that most companies beginning Kaizen implementation do not have the experience and tools to make it effective. In such cases, it is suitable to hire the services of external experts to support the implementation process. These experts can help build an efficient and effective communication process and guide companies through the path of a better economic performance (Sandoval-Arzaga and Suárez-Barraza 2010). Also, Kaizen experts facilitate knowledge transfer and simplify goals achievement.

However, perhaps the most important activity that Kaizen experts carry out is organizing meetings as a means to share information (Audenino 2012). These gatherings are periodically organized and may be rescheduled in case something happens (Øvergård et al. 2015). However, it is important to timely convey information. That is to say, people must be fast, clear, and concise. Such a dynamics of communication promotes economic growth, since production and design problems are identified on time, thus reducing the amount of defective products (Paraschivescu and Cotirlet 2015; Knechtges and Decker 2014b).

Another advantage of communication is that proposals are quickly implemented. When every employee that is directly involved in the problem is properly informed of the changes, there is little or no resistance or opposition. This streamlines the production process and thus increases productivity (Milgram et al. 1999; Radharamanan et al. 1996). Therefore, since we consider that communication clearly has an impact on the economic indices of companies, we construct the second working hypothesis of Model 1:

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* has a direct and positive impact on *Economic benefits*.

In Kaizen work environments, knowledge generated over time must be first evaluated. Then, if deemed relevant, it must be filed in any physical or electronic means, so that other work groups can consult it and use it (Machikita et al. 2016b). It is therefore important that improvement groups use logs to register all problems arising and the solutions provided (Tucker 2014; Melnyk et al. 1998). Such information must remain accessible and available to all other improvement groups, managers, and administrators, as this would ensure both vertical and horizontal communication (Medinilla 2014b).

Both control and monitoring are key when knowledge is being shared and documented. These techniques guide and supervise how the value chain is mapped to identify opportunity areas and all other activities carried out during meetings. However, it is also crucial to record all those aspects that cannot be solved—since they represent opportunity areas for other groups (Farris et al. 2009b)—as well as the activities carried out, their percentage of completion, the people in charge, and their due date. To achieve this, companies usually employ a set of pre-established forms that summarize information (Doolen et al. 2008).

Considering the importance of communication for process documentation and evaluation, the third working hypothesis of Model 1 is proposed:

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* has a direct and positive impact on *Documentation and evaluation* processes carried out at the Kaizen control phase.

Undoubtedly, knowledge generation is one of the most important assets that businesses can have, although it is usually difficult to be measured from an economic point of view. However, what is known for sure is that results from such knowledge, created and shared to address production issues, can rapidly translate into competitive benefits. For instance, if a problem arises in the production lines, and operators do not know how to handle it, companies must seek assistance outdoors. The production would thus be put on hold, and operators would stop working. In the opposite scenario, if operators are efficiently trained and familiar with the production process, they are more likely to solve problems by themselves, thus ensuring the material flow.

Yet, when operators do not know how to solve a problem, it is important that they consult the company records, since such a problem has surely been resolved before. This simplifies and speeds up problem solving and reduces idle times in machines and workers. In fact, although documentation may seem tedious and boring, it should always be explicative. That is to say, records must detail the complete problem solving process in such a way that is clear and understandable to all. Having this kind of information at hand not only speeds up solutions, but it also helps reduce idle times in the production lines. Consequently, machine productivity increases, and this is important to companies in order to remain competitive. Therefore, since documenting and evaluating Kaizen activities is key to obtain competitive benefits, the fourth working hypothesis of Model 1 states as follows:

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, *Documentation and evaluation* of Kaizen activities have a direct and positive impact on *Competitive benefits*.

We have previously discussed that documentation and evaluation of processes and other Kaizen activities brings competitive benefits. However, the advantages of keeping records and assessing improvement events also reflect on the economic performance of businesses thanks to the knowledge that is transferred.

Not only must companies document results from Kaizen evaluation, but it is also important to set down and standardize every methodology used to solve every problem, and to clearly detail forms and techniques employed. Also, in order to gain the expected economic benefits, companies must develop organizational structures responsible for (1) identifying and impeding failures and (2) assigning one solution to each problem. Likewise, value chain maps must be properly recorded, as this would allow other improvement groups to quickly identify opportunity areas without wasting time identifying the problems causes and variables.

Finally, there is a moment at which documentation becomes pointless: when it is not updated. Organizations must carry out periodical updates to their records, as it is the only way to ensure fresh and useful knowledge. Thus, considering the impact of documentation and evaluation of Kaizen activities on the economic performance of companies, we propose the fifth working hypothesis as follows:

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, *Documentation and evaluation* of Kaizen activities have a direct and positive impact *Economic benefits*.

The sixth hypothesis relates *Competitive benefits* to *Economic benefits*. However, since it has been previously discussed in other models (see Chaps. 11 and 12), it will not be addressed again. Still, it is important to keep this hypothesis in the model as its behavior may change under a different scenario or model structure. The hypothesis thus states as follows:

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, *Competitive benefits* have a direct and positive impact *Economic benefits*.

13.1.2 Evaluation of Model 1—Kaizen Control Phase

The model introduced in Fig. 13.1 to propose the hypotheses or relationships between latent variables is evaluated based on the research methodology described in Chap. 4 using WarpPLS 5 software. Results from the evaluation process are presented by Fig. 13.2, where each hypothesis includes a beta (β) value, and a P (p) value for the statistical hypothesis test. Likewise, dependent latent variables show an R^2 value indicating the amount of explained variance.

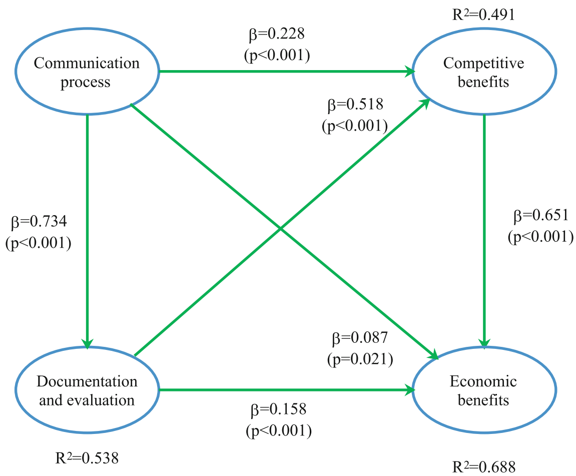


Fig. 13.2 Model 1 evaluated —Kaizen control phase

13.1.2.1 Validation of Variables—Model 1 (Kaizen Control Phase)

Before interpreting the model shown in Fig. 13.2, the four latent variables included in the model must be validated. Certainly, in Chap. 10 we evaluated them based on the Cronbach's alpha index. Nevertheless, to increase reliability of the study, six more indices are estimated. Table 13.1 lists these indices, including the Cronbach's alpha, and results from the validation processes. Minimum and maximum values accepted have been mentioned in the research methodology (see Chap. 4).

Data provided by the table demonstrates that all latent variables have enough validity and can remain in the model to interpret their relationships. First, note that R^2, adjusted R^2, and Q^2 indices are higher than 0.2. Moreover, Q^2 values are similar to R^2 values. All this information implies that every latent variable has enough predictive validity from parametric and nonparametric perspectives.

Also, results from the composite reliability index and the Cronbach's alpha index show that all latent variables have enough internal validity, since all the values are above 0.7 (the minimum value established). AVE coefficients also provide latent variables with enough convergent validity to remain in the model, since values are above 0.5 in all cases. Finally, VIF values are below 5; they are even lower than de ideal value: 3.3. Therefore, there are no collinearity problems inside of latent variables.

13.1.2.2 Model Efficiency Indices—Model 1 (Kaizen Control Phase)

When latent variables meet all validity indices, the model has to be to determine its general reliability. To perform such an evaluation, ten efficiency indices—listed below—are employed.

- Average path coefficient (APC) = 0.396, $P < 0.001$
- Average R-squared (ARS) = 0.572, $P < 0.001$

Table 13.1 Validation of latent variables—Model 1 (Kaizen control phase)

	Organizational culture	Human resources benefits	Communication process	Economic benefits
R-squared (R^2)		0.538	0.688	0.491
Adjusted R-squared		0.537	0.685	0.489
Composite reliability	0.858	0.910	0.942	0.925
Cronbach's alpha	0.751	0.880	0.931	0.908
AVE	0.668	0.627	0.643	0.608
VIF	2.257	2.759	3.194	3.287
Q-squared (Q^2)		0.538	0.688	0.492

- Average adjusted *R*-squared (AARS) = 0.571, $P < 0.001$
- Average block VIF (AVIF) = 2.234, acceptable if ≤ 5, ideally ≤ 3.3
- Average full collinearity VIF (AFVIF) = 2.874, acceptable if ≤ 5, ideally ≤ 3.3
- Tenenhaus GoF (GoF) = 0.604, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36
- Sympson's paradox ratio (SPR) = 1.000, acceptable if ≥ 0.7, ideally = 1
- *R*-squared contribution ratio (RSCR) = 1.000, acceptable if ≥ 0.9, ideally = 1
- Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7
- Nonlinear bivariate causality direction ratio (NLBCDR) = 1.000, acceptable if ≥ 0.7.

Results from the evaluation demonstrate that the model is reliable and efficient to interpret relationships among the latent variables studied. On the one hand, APC results imply that the average value of the beta parameter in every relationship equals 0.396. Moreover, since the *p* value is lower than 0.001, there is enough statistical evidence to declare with 99.9 % of confidence that values associating latent variables are above 0, and thus, such variables must remain in the model. These results will help validate hypotheses proposed in Fig. 13.1

As regards ARS and AARS, their values equal 0.572 and 0.571, respectively, while their *p* values are both lower than 0.001. We can thus infer with 99.9 % of confidence that the model has enough predictive validity. Moreover, AVIF and AFVIF values free the model from collinearity problems among latent variables, since they are lower than 5; or even lower than 3.3, which represents an ideal value.

The Tenenhaus index, used to assess the model goodness of fit, shows a value remarkably higher than 0.36, the minimum value accepted. Therefore, we can conclude that the model is appropriate. Finally, SPR, RSCR, SSR, and NLBCDR values equal 1, and they thus free the model from problems related to such indices.

13.1.2.3 Direct Effects—Model 1 (Kaizen Control Phase)

Since latent variables, and the model as a whole, have been validated, results from the hypotheses analysis can be interpreted. In this section, we describe the direct effects found through the β and *p* values obtained, as they serve to statistically prove the hypotheses initially proposed. Thus, based on the model depicted in Fig. 13.2, we can conclude the following:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* at the control phase has a direct and positive impact on *Competitive benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.228 units.

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* at the control phase has a direct and positive impact on *Economic benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.087 units.

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* at the control phase has a direct and positive impact on *Documentation and evaluation* of Kaizen events, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.734 units.

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, *Documentation and evaluation* at the control phase has a direct and positive impact on *Competitive benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.518 units.

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, *Documentation and evaluation* at the control phase has a direct and positive impact on *Economic benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.158 units.

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, *Competitive benefits* at the control phase have a direct and positive impact on *Economic benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.651 units.

13.1.2.4 Effects Size—Model 1 (Kaizen Control Phase)

As can be observed in Fig. 13.2, dependent latent variables have an R^2 value indicating their amount of variance that is explained by independent latent variables. When this variance is explained by two or more independent latent variables, the R^2 value must be decomposed. This is the case of *Competitive benefits* and *Economic benefits*, which are explained by two or three latent variables. Table 13.2 shows the decomposed variance—or effect size—for each latent variable.

Table 13.2 Decomposition of direct effects—Model 1 (Kaizen control phase)

To	From			R^2
	Communication process	Documentation and evaluation	Competitive benefits	
Documentation and evaluation	0.538			0.538
Economic benefits	0.052	0.106	0.530	0.688
Competitive benefits	0.138	0.354		0.491

Based on data provided by Table 13.2, we can conclude the following regarding the effects size of Model 1:

- There are three dependent latent variables associated with an R^2 value. These variables are explained by one independent latent variable or more.
- Latent variable *Communication process* is the only one affecting *Documentation and evaluation.* It explains 53.8 % of the variability of the dependent latent variable, since in this case $R^2 = 0.538$.
- Latent variable *Competitive benefits* is 49.1 % explained by two latent variables, since $R^2 = 0.491$. On the one hand, *Communication process* explains 0.138 units. On the other hand, *Documentation and evaluation* is responsible for 0.354 units. This demonstrates that *Documentation and evaluation* is the most important variable to gain *Competitive benefits*, since it has the largest effect size.
- Latent variable *Economic benefits* is 68.8 % explained by three latent variables, since $R^2 = 0.688$. First, *Communication process* contributes in 0.052 units. Second, *Documentation and evaluation* is responsible for 0.106 units. Finally, *Competitive benefits* explain 0.530 units of the variability. Therefore, competitiveness is the key to gaining *Economic benefits*.

13.1.2.5 Sum of Indirect Effects—Model 1 (Kaizen Control Phase)

As can be observed in Fig. 13.1, some latent variables can be indirectly associated through mediator variables, thus employing two or more segments or paths. Table 13.3 introduces the sum of these indirect effects between latent variables. As in previous tables, each effect includes a β value, the p value for the statistical hypothesis test, and the effect size (ES) that indicates the percentage of explained variance.

The following conclusions can be proposed regarding indirect effects between latent variables in Model 1:

- There are three indirect effects between latent variables. All of them are statistically significant, since the p values are lower than 0.001. Therefore, there is enough statistical evidence to confirm with 99.9 % of confidence that the sum of indirect effects between latent variables is different from 0.

Table 13.3 Sum of indirect effects—Model 1 (Kaizen control phase)

To	From	
	Communication process	Documentation and evaluation
Economic benefits	0.511 ($P < 0.001$) ES = 0.306	0.337 ($P < 0.001$) ES = 0.226
Competitive benefits	0.380 ($P < 0.001$) ES = 0.230	

- In terms of magnitude, the most salient indirect effect occurs between *Communication process* and *Economic benefits*. The value of this effect equals 0.511 units and is given through latent variables *Documentation and evaluation* and *Competitive benefits*. Also, *Communication process* explains 30.6 % of the variability of *Economic benefits,* since $R^2 = 0.306$. Finally, note that in this relationship the indirect effect is remarkably higher than the direct effect (0.087), which highlights how ineffective it is to establish a proper *Communication process* without carrying out adequate *Documentation and evaluation* of the production processes.
- Latent variable *Communication process* has an indirect effect on *Competitive benefits* through *Documentation and evaluation*. The magnitude of the effect is 0.380, and the first latent variable explains up to 23 % of the variability of the second latent variable. Such results demonstrate that the *Communication process* must lead to proper *Documentation and evaluation* of the production process if companies seek to gain *Competitive benefits*. Statistical assessments and metrics must be employed to compare the before and after of problems found, since this would allow companies to timely take corrective actions.
- Latent variable *Documentation and evaluation* has an indirect effect on *Economic benefits* through *Competitive benefits*. The value of the effect is 0.337 units, and the first latent variable explains up to 22.6 % of the variability in the second latent variable. This indirect relationship shows that in order to generate *Economic benefits*, *Documentation and evaluation* of the production process must first aim at gaining *Competitive benefits*. This argument is supported by more statistical evidence when noticing that the indirect effect in this relationship is higher than the direct effect (0.158).

13.1.2.6 Sum of Total Effects—Model 1 (Kaizen Control Phase)

The sum of both direct and indirect effects between latent variables (see Fig. 13.1 and Table 13.3) is shown in Table 13.4. As in previous analyses, the table introduces a β value, a p value, and the effect size for each relationship. The effect size indicates the amount of variance explained by independent latent variables.

Table 13.4 Total effects—Model 1 (Kaizen control phase)

To	From		
	Communication process	Documentation and evaluation	Competitive benefits
Documentation and evaluation	0.734 ($P < 0.001$) ES = 0.538		
Economic benefits	0.598 ($P < 0.001$) ES = 0.358	0.495 ($P < 0.001$) ES = 0.332	0.651 ($P < 0.001$) ES = 0.530
Competitive benefits	0.608 ($P < 0.001$) ES = 0.367	0.518 ($P < 0.001$) ES = 0.354	

Information provided by Table 13.4 helps conclude the following regarding the total effects between latent variables in Model 1:

- There are six total effects between latent variables, and all of them are statistically significant, since the p values are below 0.001. Therefore, there is enough statistical evidence to infer at a 99.9 % confidence level that total effects values are different from 0.
- In three relationships, total effects equal direct effects, as no indirect effects are found. These relationships are not discussed in this section but refer to:
  - *Communication process* and *Documentation and evaluation*
  - *Documentation and evaluation* and *Competitive benefits*
  - *Competitive benefits* and *Economic benefits*.
- In terms of magnitude, *Communication process* has the most significant of all total effects on *Competitive benefits*. The effect measures 0.608 units, and the first latent variable explains up to 36.7 % of the variability of the second latent variable. The indirect effect in this relationship is given by latent variable *Documentation and evaluation*.
- The most noticeable total effect occurs in the relationship between *Communication process* and *Economic benefits*, and its value equals 0.598 units. The first latent variable explains up to 35.8 % of the variability of the second latent variable, and the indirect effect in this relationship occurs through latent variable *Documentation and evaluation*.
- Finally, latent variable *Documentation and evaluation* has a total effect on *Economic benefits* measuring 0.495 units. The first latent variable explains up to 33.2 % of the variability of the second latent variable, and the indirect effect in this relationship occurs through latent variable *Competitive benefits*.

13.1.2.7 Conclusions and Industrial Implications—Model 1 (Kaizen Control Phase)

In this first section of the chapter we propose, test, and analyze a model to study and determine the relationships between two Kaizen control activities (communication process and documentation and evaluation) and competitive and economic benefits. Results from the model analysis allow us to conclude the following:

- Mexican manufacturing companies implementing Kaizen must focus their efforts on generating knowledge of the production processes. However, such knowledge must also be transferred and shared in both ways: horizontally and vertically, otherwise it helps improve nothing. Several ways to promote knowledge include meetings, gatherings, casual work reunions, and conferences.
- All knowledge that is generated must be applied and properly documented and evaluated. The evaluation process must compare the situation before and after

improvement changes. Then, there must be some type of intervention. Kaizen groups must carry logbooks to record each and every one of the activities carried out within the implementation and monitoring processes of plans and programs. Such logbooks contribute to the documentation process and can be consulted by any other group in case they need it.

- To obtain the expected *Competitive benefits,* the *Communication process* must lead to appropriate *Documentation and evaluation* of the production process. Moreover, all these variables have important effects on *Economic benefits*. Although the direct relationship between *Communication process* and *Economic benefits* is considerably small in magnitude, its significance increases when considering latent variable *Documentation and evaluation*.
- The critical path to be followed in the model shown in Fig. 13.2 can be described as follows: *Communication process—Documentation and evaluation —Competitive benefits—Economic benefits.*

13.2 Model 2—Kaizen Control Phase

In this model, we have removed two latent variables studied in Model 1 and added two different ones. Nevertheless, the model still associates two types of Kaizen control activities with two kinds Kaizen benefits. The four latent variables integrated and studied are:

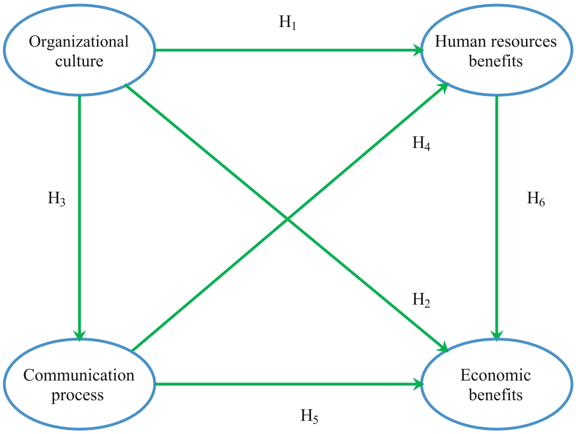
- *Organizational culture*
- *Communication process*
- *Human resources benefits*
- *Economic benefits*.

As in previous models, latent variables are related to one another through six working hypotheses to be tested from a statistical point of view. Such hypotheses are discussed and supported in the following subsection.

13.2.1 Hypotheses of Model 2—Kaizen Control Phase

In this model we consider *Organizational culture* as the independent latent variable. It is thus placed on the top left side of the model, since it affects the remaining three latent variables. Similarly, *Economic benefits* is still considered as the dependent latent variable, and it is located on the bottom right side of the model. Note that both latent variables associated with Kaizen control activities are purely administrative. Thus, they largely depend on the amount and quality of leadership and managerial commitment provided to improvement groups. Hypotheses formulated for this model can be appreciated in Fig. 13.3 and are supported below.

Fig. 13.3 Model 2 proposed —Kaizen control phase



As a lean manufacturing (LM) tool, Kaizen relies on collaboration and team work to achieve its objectives and offer the benefits that every company expects. In this sense, the organizational culture is a key factor in guarantee the expected benefits. From their beginning, Japanese production and improvement philosophies were thought to be exclusive to the Eastern culture and unable to be adopted by Western societies and businesses. However, time has demonstrated that any company can implement Eastern philosophies and obtain significant benefits. Barriers due to cultural aspects of business approaches and philosophies can be easily overcome through serious and vigorous education and training processes (Tsao et al. 2015).

Perhaps the most important cultural features that Western companies have had to triumph over are related to leadership and worker-manager relationships (Miller et al. 2014). Managers must work hard to demonstrate their commitment not only to meeting the company's objectives, but also to human resources. Companies must be seen as a means for professional development and not only as a profit generator. Another important aspect of the organizational culture includes employee attitudes and skills (Macpherson et al. 2015a). Employees must have their own personal goals, and companies have no obligation whatsoever to provide them a life destination or change their goals. Every employee must be able to express and integrate his/her personal interests with those of the company.

Therefore, considering the importance of the organizational culture as a means to obtain human resources benefits, the first working hypothesis of Model 2 states as follows:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, the *Organizational culture* has a direct and positive impact on *Human resources benefits*

Economic benefits are one of the main reasons why companies chose to adopt LM tools to their production processes. However, results obtained by Eastern companies are often different from those reported in the West, as cultural and organizational aspects mark the difference. Fortunately, several studies have focused on analyzing the impact of organizational culture on the economic performance of businesses.

Leaderships is an element widely studied from different perspectives. Research has focused on analyzing the different ways managers give orders and maintain the organizational structure (Kıyak et al. 2011). Similarly, many investigations have described how autocratic and dictatorial leadership remains in companies, and how it is sometimes favorable to business consolidation and maturity (De Hoogh et al. 2015). Furthermore, other researchers have analyzed the effects of paternalism from both governments and industrial sectors (De Hoogh et al. 2015).

In the past, Western companies used to identify production and errors when products were finished, even when they had wasted too much time in the assembly process. Such an inspection approach failed to guarantee product quality, since it only identified defective or unsuitable products (Saleem et al. 2012). Nowadays, as part of any organizational culture, and in order to ensure the greatest economic benefits possible, each production operator is his/her own inspector. Waste is thus reduced and profits are maximized. Also, not only do companies save material, but they also increase customer satisfaction by ensuring timely product deliveries (Paraschivescu and Cotirlet 2015).

When production operators are capable of solving issues in the production lines, machine failures are reduced and their availability increases, which also translates into economic benefits (Sachit and Pardeep 2014; Prabhuswamy et al. 2013). However, empowering operators has been one of the biggest challenges for Western managers. Companies in the West have a rather vertical organizational structure, while Eastern companies are more horizontal, which implies that employees are more often acknowledged and empowered (Recht and Wilderom 1998). Considering thus the importance of organizational cultural aspects for obtaining economic benefits, the second hypothesis of Model 2 is proposed as follows:

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, *Organizational culture* has a direct a positive impact on *Economic benefits*.

Communication is key to knowledge transfer and generation inside of companies. Nevertheless, its effectiveness depends the organizational structure established. When knowledge is not shared, certain efficiency indices can be affected, especially quality (Mahl et al. 2015). Moreover, besides being detrimental to the communication process, uncommunicative attitudes may go beyond and influence the work environment.

Some authors argue that leadership and knowledge transfer as organizational culture elements have a strong impact on the innovation process. Companies that communicate progress made and goals accomplished increase their capabilities to better adapt to unexpected market changes; thus, they reach a higher innovative level (Hussein et al. 2016). Such a phenomenon has given birth to what is called "organizational agility," which refers to the ability of companies to adapt to market fluctuations to remain competitive (Felipe et al. 2016).

Organizational agility is proportional to the amount of communication ensured. Companies that communicate little to nothing the progresses and goals achieved make employees unaware of the organization's current situation. Thus, they have fewer chances to improve (Putthiwanit 2015; Naranjo-Valencia et al. 2016).

In order to contribute to the discussion regarding the importance of organizational culture in the communication process, the third working hypothesis of Model 2 states as follows:

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, *Organizational culture* has a direct and positive impact on the *Communication process*.

Human communication is perhaps the key ability that people have, and we should always use it for our own benefit. Companies must thus rely on appropriate communication systems to spread information and knowledge in all senses: horizontal and vertical. In fact, many studies have associated the communication process with company benefits such as performance (McFarlan 1982) and the amount of knowledge generated and disseminated (Brownell 2003). Also, it has been recognized that communication is different depending on the genre. For instance, female managers seem to be more explicit than men when proposing an idea or project (Birdsall 1980).

Bureaucracy is another factor under study that becomes relevant to companies located in developing countries. It has been demonstrated that sometimes information remains exclusive to top positions, since it is considered as organizational or industrial secrets (Suchan and Colucci 1991). However, education is the basis for effective communication, which means that employees must be trained to communicate information and make decisions by themselves. Furthermore, communication reflects integration. That is to say, workers who are familiar with the project implemented or the progress made will always feel integrated into considered in the decision-making process. As a result, they feel motivated, knowing that their skills and knowledge actually contribute to the change process (Oropesa-Vento et al. 2015b).

Therefore, since we consider the communication process as an important element for human resources, the fourth working hypothesis of Model 2 can be proposed below:

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* has a direct and positive impact on *Human resources benefits*.

Hypotheses H_5 and H_6 have been addressed in the past models and, therefore, will not be discussed again. Still, they must remain in the model, as their behavior can change under a different scenario. This means that the β and p values may vary under a new model structure. Therefore, direct, indirect, and total effects may not be the same as those previously discussed. Hypotheses H_5 and H_6 state as follows:

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* has a direct and positive impact on the *Economic benefits*.

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, *human resources benefits* have a direct and positive impact on *Economic benefits*.

The model proposed in Fig. 13.3 depicts the hypotheses to be validated, and which have been supported above. The validation process of latent variables is carried out according to the research methodology discussed in Chap. 4. As in the other models, Model 2 at the Kaizen control phase is run using WarpPLS 5 software. Figure 13.4 shows results obtained.

13.2.1.1 Validation of Latent Variables—Model 2 (Kaizen Control Phase)

The objective of the validation process is to estimate the validity indices that improve reliability of the latent variables. Although in Chap. 10 we analyzed these variables based on the Cronbach's alpha, six more indices must be estimated before interpreting the model. Table 13.5 lists these indices and introduces results from the validation process.

According to data provided by Table 13.5, we can conclude that all latent variables can be used to interpret the model without making any modifications to their structure (i.e., removing variables). First note that all R^2, adjusted R^2, and Q^2 values are higher than 0.2. Moreover, Q^2 values are similar to R^2, adjusted R^2

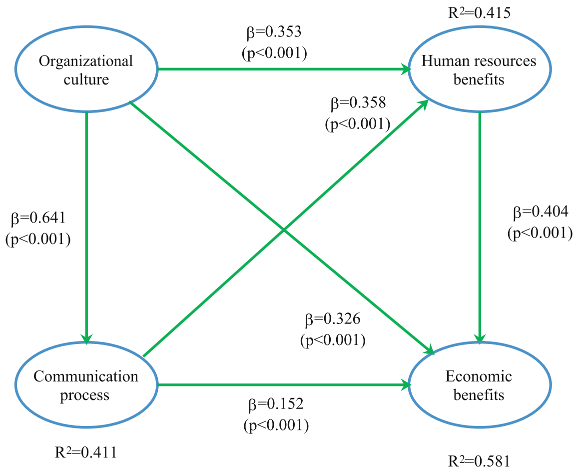


Fig. 13.4 Model 2 evaluated —Kaizen control phase

Table 13.5 Validation of latent variables—Model 2 (Kaizen control phase)

	Organizational culture	Human resources benefits	Communication process	Economic benefits
R-squared (R^2)		0.415	0.411	0.582
Adjusted *R*-squared		0.412	0.409	0.579
Composite reliability	0.880	0.948	0.858	0.942
Cronbach's alpha	0.829	0.939	0.751	0.931
AVE	0.597	0.645	0.668	0.643
VIF	2.138	2.103	1.969	2.360
Q-squared (Q^2)		0.418	0.412	0.583

indices. Therefore, every latent variable has enough predictive validity from parametric and nonparametric perspectives.

Also, both the Cronbach's alpha and the composite reliability index demonstrate that all latent variables have enough internal validity, since all their values are above 0.7 (the minimum value accepted). In addition, AVE results provide latent variables with enough convergent validity, as its value is higher than 0.5 in all cases. Finally, considering that VIF values are below 3.3, we can assume that latent variables have no collinearity problems inside of them.

13.2.1.2 Model Efficiency Indices—Model 2 (Kaizen Control Phase)

Once latent variables have been tested and validated, the model as a construct must be evaluated to determine its reliability. In such an evaluation, results represent the average values of latent variables integrated in the model. The efficiency indicators employed to test the model are:

- Average path coefficient (APC) = 0.372, $P < 0.001$
- Average *R*-squared (ARS) = 0.469, $P < 0.001$
- Average adjusted *R*-squared (AARS) = 0.467, $P < 0.001$
- Average block VIF (AVIF) = 1.790, acceptable if ≤ 5, ideally ≤ 3.3
- Average full collinearity VIF (AFVIF) = 2.143, acceptable if ≤ 5, ideally ≤ 3.3
- Tenenhaus GoF (GoF) = 0.547, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36
- Sympson's paradox ratio (SPR) = 1.000, acceptable if ≥ 0.7, ideally = 1
- *R*-squared contribution ratio (RSCR) = 1.000, acceptable if ≥ 0.9, ideally = 1
- Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7
- Nonlinear bivariate causality direction ratio (NLBCDR) = 1.000, acceptable if ≥ 0.7.

Results from the evaluation indicate that the model is appropriate and effectively represents relationships between latent variables. On one hand, APC shows that the average β value in every hypothesis or relationship is 0.372. Also, since the p value is below 0.001. There is enough evidence to declare with 99.9 % of confidence that indices associating latent variables among them are statistically significant. On the other hand, since p values in ARS and AARS are also below 0.001, that the model has enough predictive validity.

Likewise, AVIF and AFVIF values free the model from collinearity and multicollinearity problems, since they are both below 3.3. Also, the Tenenhaus index, used to assess the model goodness of fit, shows a value higher than 0.36, the minimum value accepted. Therefore, we can conclude that the model is appropriate. Finally, SPR, RSCR, SSR, and NLBCDR values equal 1, and they thus free the model from problems related to such indices.

13.2.1.3 Direct Effects—Model 2 (Kaizen Control Phase)

Direct effects shown in Fig. 13.4 help validate the hypotheses stated between latent variables. To do this, we interpret the β value and the p value in each hypothesis. Conclusions regarding hypotheses stated for model 2 of the Kaizen control stage are the following:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, *Organizational culture* has a direct and positive impact on *Human resources benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.353 units.

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, *Organizational culture* has a direct and positive impact on *Economic benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.326 units.

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, *Organizational culture* has a direct and positive impact on the *Communication process*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.641 units.

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* has a direct and positive impact on *Human resources benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.358 units.

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, the *Communication process* has a direct and positive impact on *Economic* *benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.152 units.

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources benefits* have a direct and positive impact on *Economic benefits*, since when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.404 units.

13.2.1.4 Effects Size—Model 2 (Kaizen Control Phase)

Three latent variables in Fig. 13.4 show an R^2 value, as they depend on others to be explained. Thus, when two or more independent latent variables are responsible for the variance of a dependent variable, the R^2 value must be decomposed into the number of explicative variables. Table 13.6 introduces the effects size contributing to the variance of each dependent latent variable.

Information provided by Table 13.6 makes it possible to conclude the following regarding the explained variance of dependent latent variables:

- Three latent variables have an R^2 indicating their amount of explained variance.
- *Communication process* is 41.1 % ($R^2 = 0.411$) explained by only one latent variable: *Organizational culture*. In this case, the R^2 value is not decomposed.
- Latent variable *Human resources benefits* is 41.5 % explained by *Organizational culture* and *Communication process*, since in this case $R^2 = 0.415$. The former explains 0.206 units, while the latter is responsible for 209 units. As can be seen, both effect sizes are similar.
- Latent variable *Economic benefits* is 58.1 % explained by three latent variables, being R^2 equal to 0.581 units. First, *Organizational culture* explains 0.214 units, while *Human resources benefits* is responsible for 0.276 units. On the other hand, *Communication process* contributes to the variance in 0.091 units. This demonstrates that *Human resources benefits* are the most important variable for obtaining *Economic benefits* in a Kaizen environment.

Table 13.6 Decomposition of effects—Model 2 (Kaizen control phase)

To	From			R^2
	Organizational culture	Human resources benefits	Communication process	
Human resources benefits	0.206		0.209	0.415
Communication process	0.411			0.411
Economic benefits	0.214	0.276	0.091	0.581

Table 13.7 Sum of indirect effects—Model 2 (Kaizen control phase)

To	From	
	Organizational culture	Communication process
Human resources benefits	0.229 (*P* < 0.001) ES = 0.134	
Economic benefits	0.333 (*P* < 0.001) ES = 0.219	0.145 (*P* < 0.001) ES = 0.087

13.2.1.5 Sum of Indirect Effects—Model 2 (Kaizen Control Phase)

As can be observed in Figs. 13.3 and 13.4, latent variables can be indirectly related through a third latent variable (mediator), thus using more than two segments of the model. Table 13.7 presents the sum of these indirect effects. Each one of them is measured with the β parameter and includes the p value between brackets for the statistical hypothesis test. Likewise, the effect size indicates the amount of explained variance.

According to information contained in Table 13.7, we can conclude the following as regards indirect effects between latent variables in Model 2.

- Three relationships show indirect effects, and they are all statistically significant, since the p values for the hypothesis test are lower than 0.001. This indicates that there is enough statistical evidence to declare with 99.9 % of confidence that such indirect effects are different from 0.
- In terms of magnitude, the largest indirect effect is given by *Organizational culture* on *Economic benefits*. It has a value equal to 0.333 units, and the former latent variable explains up to 21.9 % of the variability of the latter latent variable, since the effect size is 0.219. This indirect relationship occurs through latent variables *Communication process* and *Human resources benefits*.
- Latent variable *Organizational culture* has an indirect effect on *Human resources benefits* through *Communication process*. The effect value equals 0.229 units, and the first latent variable can explain up to 13.4 % of the variability of the second latent variable (ES = 0.134).
- Latent variable *Communication process* has an indirect effect on *Economic benefits* through *Human resources benefits*. The effect value equals 0.145 units, and the independent latent variable explains up to 8.7 % of the variability of the dependent latent variable (ES = 0.087).

13.2.1.6 Sum of Total Effects—Model 2 (Kaizen Control Phase)

Total effects are the sum of direct and indirect effects between latent variables. Table 13.8 introduces the total effects for every relationship. As in previous cases, the β parameter indicates the effect value in terms of magnitude, while the p value associated to each β value is used to determine statistical significance of effects.

Table 13.8 Total effects—Model 2 (Kaizen control phase)

To	From		
	Organizational culture	Human resources benefits	Communication process
Human resources benefits	0.582 ($P < 0.001$) ES = 0.339		0.358 ($P < 0.001$) ES = 0.209
Communication process	0.641 ($P < 0.001$) ES = 0.411		
Economic benefits	0.659 ($P < 0.001$) ES = 0.434	0.404 ($P < 0.001$) ES = 0.276	0.297 ($P < 0.001$) ES = 0.178

Finally, the effect size represents the amount of explained variance of dependent latent variables.

As can be observed from Table 13.8:

- There are six total effects between the studied latent variables. All these effects are statistically significant, since the p value related to each β parameter is below 0.001.
- In three relationships, total effects equal direct effects, since no indirect effects are found. These relationships will not be discussed here, as they are presented in the direct effects subsection. However, they involve latent variables:
  - *Organizational culture* and *Communication process*
  - *Human resources benefits* and *Economic benefits*
  - *Communication process* and *Human resources benefits*.
- The largest total effect occurs between *Organizational culture* and *Economic benefits*. The effect value equals 0.659, and the first latent variable can explain up to 43.4 % of the variability of the second latent variable (ES = 0.434). This relationship is particularly important, since the direct effect value (0.326) equals the value of the indirect effect, which is given through *Communication process* and *Human resources benefits*. This demonstrates that both appropriate communication and Kaizen advantages for human resources are key to obtain *Economic benefits* from Kaizen implementation. In other words, *Organizational culture* is not enough to cause an important impact on the economic performance. Other variables also play a role.
- The second largest total effect involves *Organizational culture* on *Human resources benefits*. The effect value is 0.582, and the former latent variable explains up to 33.9 % of the variability of the latter, since the effect size equals 0.339 units. In this relationship, the indirect effect—which occurs through latent variable *Communication process*—is as important as the direct effect.
- Note that latent variable *Communication process* has the third largest total effect on *Economic benefits* (0.297). Moreover, the former explains up to 17.8 % of the variability of the latter (ES = 0.178). In this case, the indirect effect is very similar to the direct effect (0.152 units). Thus, they are equally important to explain *Economic benefits*.

13.2.1.7 Conclusions and Industrial Implications—Model 2 (Kaizen Control Phase)

Considering the analysis of direct, indirect, and total effects, as well the R^2 valued estimated in this model, we propose the following conclusions and discuss the industrial implications that the model results may have on the Mexican manufacturing industry:

- Mexican manufacturing companies must ensure a suitable *Organizational culture* that promotes continuous improvement in the production lines. This model statistically demonstrates that the benefits obtained from an appropriate work culture are large.
- It is important to establish an effective *Communication process* as a means to create, transfer, and share knowledge. This variable has a direct and positive impact on the benefits that can be obtained from Kaizen implementation, especially for human resources.
- In order to gain *Economic benefits*, manufacturing companies can strengthen the power of their *Organizational culture* through a suitable *Communication process* and by ensuring *Human resources benefits.*
- It is important to consider *Human resources benefits* as an essential element for making improvements and maximizing profits. In this model, *Human resources benefits* have the largest explanatory power on *Economic benefits*. Therefore, companies must work on different programs or systems to disseminate performance results obtained and progress achieved. Similarly, bonus schemes and rewards can be effective approaches to show production operators some of the advantages of participating in improvement events.
- In order to ensure *Human resources benefits*, companies must promote an appropriate *Organizational culture* and *Communication process*, since both variables have a similar impact on employees' benefits.

13.3 Model 3—Kaizen Control Phase

In this section, we present the integrative model in which the three latent variables representing Kaizen control activities are combined into a single latent variable named *Kaizen control* through a second-order factor analysis. By proposing six hypotheses to be tested, the model thus associates four latent variables: three related to Kaizen benefits and one associated with Kaizen execution. More specifically, latent variables under study are:

- *Kaizen control*
  - Organizational culture
  - Communication process
  - Documentation and evaluation

- *Benefits*
  - Competitive benefits
  - Human resources benefits
  - Economic benefits

13.3.1 Hypotheses of the Integrative Model—Kaizen Control Phase

This model is grounded on the assumption that *Kaizen control* is the independent latent variable having an impact on the remaining three (i.e., Kaizen benefits). On the other hand, *Economic benefits* are still considered the dependent latent variable, as in the previous models. This means that the other three variables have an effect on it. As for the proposed hypotheses, Fig. 13.5 illustrates the preliminary model. Hypotheses are discussed and supported below:

What would happen if Kaizen activities were not controlled? Undoubtedly, people would do what they think is best for the company—and for themselves—without actually reaching a consensus. It is thus important to establish certain rules from the moment continuous improvement groups start working. Such rules should aim at supervising communication with managers, meetings, and the use of formats employed to keep record of activities performed, among others (Maarof and Mahmud 2016).

Also, companies must document and save results obtained from surveys administered to human resources. Such information would allow for the planning of training sessions, courses, and workshops according to the actual needs of employees (Yokozawa and Steenhuis 2013b). In fact, when companies provide

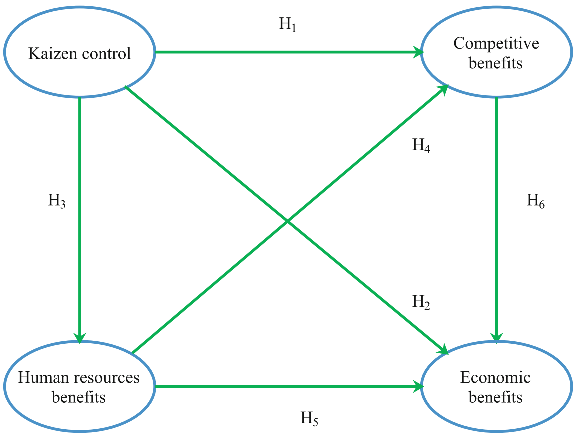


Fig. 13.5 Integrative model—Kaizen control phase

opportunities for professional development and knowledge generation, they are more likely to reach the product quality that customers demand (Saleem et al. 2012).

The manufacturing industry must understand that every improvement program starts with employee education and training, as both allow human resources to develop and increase their work abilities. When employees are more prepared, product quality increases, product designs and prototypes are more quickly introduced into the production lines, and improvement changes are more easily embraced, while many production obstacles are removed (Higuchi et al. 2015a).

Finally, note that education and training do not depend only on employees. Commitment from managers and improvement group leaders, as well as the effectiveness of communication and the amount of bureaucracy, determine—to a great extent—the success of such programs. In fact, improvement groups may be effectively doing their job, while administrative processes keep slowing down the improvement processes (Midiala et al. 2015; Mano et al. 2014).

Considering the fact that *Kaizen Control* programs and activities have an impact on *Competitive benefits* obtained from Kaizen implementation, we propose the first working hypothesis for Model 3:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, *Kaizen control* has a direct and positive impact on *Competitive benefits*.

If Kaizen is implemented as a means to gain or increase *Economic benefits*, *Kaizen control* activities should thus have the same aim: to increase availability of resources. For instance, when errors in the production lines are quickly communicated, waste, and reprocessing are reduced; and this immediately reflects on the company's income (García et al. 2013a; García et al. 2014a). Likewise, if activities are properly documented, many situations are solved faster, and this generates savings. In other words, when a similar problem to the one recorded is being tackled, documentation can be useful for learning how to solve it. Consequently, companies prevent production stoppages or the need for hiring external support (Olsen et al. 2014; Dave and Sohani 2015).

Another key element when companies seek to improve their economic situation is *Organizational culture*. First, *Organizational culture* is important for establishing norms and standards and should aim at standardizing administrative processes, since this would support their certification (Medinilla 2014d; Klefsjö et al. 2014). Furthermore, safety and hygiene aspects must be emphasized, although many improvement programs cover such issues from the beginning as a means to identify work risks. In fact, safe and clean processes and workplaces decrease the number of accidents, which in turn reduces costs incurred from employee absenteeism, health insurance, and incapacities (Vieira et al. 2012a; Kumashiro 2011; Ikuma et al. 2011).

Therefore, by arguing that *Kaizen control* has a strong impact on the *Economic benefits* gained by companies from Kaizen implementation, we propose the second hypothesis for Model 3 as follows:

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, *Kaizen control* has a direct and positive impact on *Economic benefits*.

It is very common to believe that Kaizen is only customer focused. However, we have demonstrated that this philosophy also supports the development and work conditions of human resources. If employees do not see benefits in any project that is being implemented, they may feel used and not taken into account. This can cause many problems.

A company must strive to show employees that if the organization improves, they improve as well, and that benefits are for both the company and workers, as the company success is also the success of employees. There is nothing more challenging in the business industry than working with an unmotivated workforce. Hence, two ways to integrate human resources with the company goals and improvement projects are spreading performance results and the achieved objectives and acknowledging people who make such an outstanding work. Both strategies are sources of motivation and increased self-esteem.

Finally, another important issue that must be communicated is the amount of work accidents happening in each department. This strategy often demonstrates the organization's commitment to promoting and ensuring a safe work environment.

In order to contribute to the discussion regarding the effects of Kaizen control activities on human resources benefits, the third working hypothesis for Model 3 is proposed as follows:

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, *Kaizen control* has a direct and positive impact on *Human resources benefits*.

Hypotheses H_4, H_5, and H_6 relate the three different Kaizen benefits among them. Since such hypotheses have been approached in previous models, they are not discussed in this section. Still, they must remain in the model because their behavior may change under a different model structure. This means that the direct, indirect, and total effects previously identified in these relationships may be different in this model. As a reminder, hypotheses H_4, H_5, and H_6 state as follows and appears in Fig. 13.5:

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources benefits* have a direct and positive impact on *Competitive benefits*.

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, *Human resources benefits* have a direct and positive impact on *Economic benefits.*

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, *Competitive benefits* gained have a direct and positive impact on *Economic benefits*.

13.3.2 *Evaluation of the Integrative Model—Kaizen Control Phase*

Figure 13.5 depicts the model with the six hypotheses discussed above. Readers are welcome to refer to Chap. 4 to know the research methodology followed to validate the model, which is run under WarpPLS 5 software.

In this chapter, Fig. 13.6 shows results from the validation process. As in all the preceding models, each hypothesis includes a beta (β) value, and a P (p) value for the statistical hypothesis test. Likewise, dependent latent variables show an R^2 value indicating the amount of explained variance.

13.3.2.1 Validation of Latent Variables—Integrative Model (Kaizen Control Phase)

In Chap. 10 we validated latent variables based on the Cronbach's alpha index. However, in addition to considering internal validity, six more indices must be employed to increase reliability of latent variables. Such indices are described in the methodology section (see Chap. 4). They are of extreme importance for this model, since the integrative latent variable *Kaizen control* has not been validated before. Table 13.9 hence shows results from the validation of the four latent variables included in Model 3.

Information from Table 13.9 demonstrates that all latent variables in the model are valid and do not need any modifications to remain in the model. First, note that R^2, adjusted R^2, and Q^2 values are similar and above 0.2, which means that latent variables have enough predictive validity from both parametric and nonparametric perspectives.

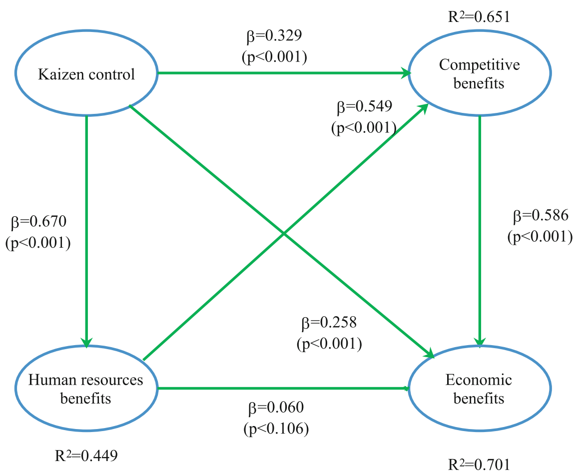


Fig. 13.6 Integrative model evaluated—Kaizen control phase

Table 13.9 Validation of latent variables—Integrative model (Kaizen control phase)

	Competitive benefits	Human resources benefits	Economic benefits	Kaizen control
R-squared (R^2)	0.651	0.449	0.701	
Adjusted *R*-squared	0.649	0.448	0.699	
Composite reliability	0.925	0.948	0.942	0.928
Cronbach's alpha	0.908	0.939	0.931	0.884
AVE	0.608	0.645	0.643	0.812
VIF	3.995	2.687	3.336	2.346
Q-squared (Q^2)	0.651	0.450	0.702	

Also, both the Cronbach's alpha and the composite reliability index show values higher than 0.90, while 0.70 is the minimum value allowed. Thus, there is enough internal validity in every latent variable. Likewise, convergent validity is validated through AVE, whose values are all higher than 0.5. Finally, VIF values free latent variables from collinearity problems, since they are all lower than 5. However, note that *Competitive benefits* show an AVE value higher than 3.3, which is the ideal value. Still, it is lower than 5 and, thus, valid.

13.3.2.2 Efficiency Indices—Integrative Model (Kaizen Control Phase)

Once latent variables have been individually tested, we proceed to evaluate the model's efficiency. To perform this evaluation, ten efficiency indices are estimated, and they express average values of each hypothesis. The indices considered are listed below:

- Average path coefficient (APC) = 0.409, $P < 0.001$
- Average *R*-squared (ARS) = 0.600, $P < 0.001$
- Average adjusted *R*-squared (AARS) = 0.599, $P < 0.001$
- Average block VIF (AVIF) = 2.265, acceptable if ≤ 5, ideally ≤ 3.3
- Average full collinearity VIF (AFVIF) = 3.091, acceptable if ≤ 5, ideally ≤ 3.3
- Tenenhaus GoF (GoF) = 0.638, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36
- Sympson's paradox ratio (SPR) = 1.000, acceptable if ≥ 0.7, ideally = 1
- *R*-squared contribution ratio (RSCR) = 1.000, acceptable if ≥ 0.9, ideally = 1
- Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7
- Nonlinear bivariate causality direction ratio (NLBCDR) = 1.000, acceptable if ≥ 0.7.

As can be observed, the model is efficient and the relationships between latent variables can be eventually interpreted without problem. First, consider APC results, which demonstrate that the average value of the β parameter in every hypothesis equals 0.409 units. Moreover, since the p value is lower than 0.001, such an inference is statistically significant at a 99.9 % confidence level.

ARS and AARS values equal 0.600 and 0.599, respectively, and their p values indicate that the model has enough predictive validity, since they are lower than 0.001. Likewise, note that AVIF and AFVIF coefficients are below 3.3, the ideal value. Thus, the model is free from collinearity and multicollinearity problems among latent variables.

Also, the Tenenhaus index, used to assess the model goodness of fit, shows a value higher than 0.36, the minimum value accepted. Therefore, we can conclude that the model is appropriate. Finally, SPR, RSCR, SSR, and NLBCDR values equal 1, and they thus free the model from problems related to such indices.

13.3.2.3 Direct Effects—Integrative Model (Kaizen Control Phase)

The β and p values estimated, as well as the effects size, help statistically validate the hypotheses initially proposed. These values can be observed in the evaluated model shown in Fig. 13.6, on which the following conclusions are provided regarding the direct effects between latent variables:

H_1 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Kaizen control* has a direct and positive effect on *Competitive benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases 0.329 units.

H_2 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Kaizen control* has a direct and positive effect on *Economic benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases 0.258 units.

H_3 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Kaizen control* has a direct and positive effect on *Human resources benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases 0.670 units.

H_4 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Human resources benefits* have a direct and positive effect on *Competitive benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases 0.549 units.

H_5 In the environment of Mexican manufacturing companies implementing Kaizen, there is not enough statistical evidence to declare that *Human resources* *benefits* have a direct and positive effect on *Economic benefits*, since the *p* value is below 0.05 ($p = 0.106$), the maximum value allowed.

H_6 In the environment of Mexican manufacturing companies implementing Kaizen, there is enough statistical evidence to declare that *Competitive benefits* have a direct and positive effect on *Economic benefits*, since when the former increases its standard deviation by one unit, the standard deviation of the latter increases 0.586 units.

13.3.2.4 Effects Size—Integrative Mode (Kaizen Control Phase)

Figure 13.6 shows dependent latent variables including an R^2 value, which indicates their amount of variance explained by independent latent variables. The explained variance indicates how much an independent latent variable affects a dependent variable, and it is also called the effect size. However, when two or more independent latent variables are responsible for the variance of a dependent latent variable, R^2 must be decomposed. Table 13.10 thus introduces the effects size of every dependent latent variable.

Information provided by Table 13.10 help us conclude the following as regards the size of the effects between latent variables in Model 3.

- There are three dependent latent variables, all of them associated with an R^2 value, as variability measurement.
- Latent variable *Human resources benefits* is affected only by *Kaizen control*, which explains 44.9 % of the variability. In this case, the R^2 value is not decomposed, since only one independent latent variable is involved.
- Latent variable *Competitive benefits* is 65.1 % ($R^2 = 0.651$) explained by *Human resources benefits* and *Kaizen control*. While the former explains 0.422 of the variability, the latter is responsible for 0.229 units. This indicates that *Human resources benefits* are more important when explaining *Competitive benefits*, since it has the highest explanatory power.
- Latent variable *Economic benefits* is 70.1 % explained by three latent variables, since $R^2 = 0.701$. First, *Competitive benefits* explain up to 0.477 of the variability. Second, latent variable *Human resources* is responsible for 0.041 units.

Table 13.10 Decomposed effects size—Integrative model (Kaizen control phase)

To	From			R^2
	Competitive benefits	Human resources benefits	Kaizen control	
Competitive benefits		0.422	0.229	0.651
Human resources benefits			0.449	0.449
Economic benefits	0.477	0.041	0.183	0.701

Finally, *Kaizen control* affects in 0.183 units. Such results emphasize on the importance of reaching *Competitive benefits* in order to obtain *Economic benefits*, since the former shows the greatest explanatory power on the latter.

13.3.2.5 Sum of Indirect Effects—Integrative Model (Kaizen Control Phase)

As can be observed in Fig. 13.6, certain latent variables are indirectly related through a mediator latent variable. Such relationships can be perceived by using two or more segments from the model. Indirect effects are as important as direct effects. In fact, some variables may not be significantly related in a direct way, but their indirect effects are more relevant. Table 13.11 introduces the sum of indirect effects for every relationship between two latent variables. As in all preceding models, the β parameter stands as dependency measure, while the p value serves to test the statistical significance of each effect. Finally, the effect size indicates the amount of explained variance in dependent latent variables.

Based on information provided by Table 13.11, the following conclusions can be proposed regarding the indirect effects between latent variables in the integrative model:

- Three relationships have indirect effects, which are all statistically significant. The p value associated with the β parameter is lower than 0.001. Thus, all effects are statistically significant at a 99.9 % confidence level.
- In terms of magnitude, the largest indirect effect (0.449 units) occurs in the relationship between *Kaizen control* and *Economic benefits*. In this case, the former explains up to 31.8 % of the variability of the latter, since the effect size equals 0.318 units. Such an indirect effect occurs through latent variables *Human resources benefits* and *Competitive benefits*, and it is noticeably higher than the direct effect (0.258); it is almost twice as large. Such results demonstrate that *Kaizen control* activities must first aim at gaining *Human resources benefits* and *Competitive benefits*, as they both eventually improve the economic performance (*Economic benefits*) of companies.
- The second largest effect (0.388 units) can be observed in the relationship between *Kaizen control* and *Competitive benefits* through *Human resources benefits*. Once more, the indirect effect in this relationship is higher than the

Table 13.11 Sum of indirect effects—Integrative model (Kaizen control phase)

To	From	
	Human resources benefits	Kaizen control
Competitive benefits		0.368 ($P < 0.001$) ES = 0.256
Economic benefits	0.322 ($P < 0.001$) ES = 0.220	0.449 ($P < 0.001$) ES = 0.318

direct effect (0.329), which means that in order to improve competitiveness (*Competitive benefits*), *Kaizen control* activities must focus on *Human resources benefits*. Finally, note that, considering the indirect effect, *Kaizen control* explains up to 25.6 % of the variability of *Competitive benefits*.

13.3.2.6 Sum of Total Effects—Integrative Model (Kaizen Control Phase)

In this model, the total effects between latent variables are the sum of the direct effects shown in Fig. 13.6 and the indirect effects provided by Table 13.11. These total effects are presented in Table 13.12 and each effect value incudes a p value to test its statistical significance and the effect size, which indicates the amount of explained variance of dependent latent variables.

Information obtained from Table 13.2 enables to provide the following conclusions regarding total effects between latent variables of the integrative model:

- There are six total effects in the model. All of them are statistically significant at a 99.9 % confidence level, since every p value associated with the β parameters is lower than 0.001.
- In three relationships total effects equal direct effects, since no indirect effects were found. These relationships will not be discussed here, since they are addressed in the directs effects subsection; however, they involve the following latent variables:
  - *Competitive benefits* and *Economic benefits*.
  - *Human resources benefits* and *Competitive benefits*
  - *Kaizen control* and *Human resources benefits*.
- The largest total effect (0.706 units) involves latent variables *Kaizen control* and *Economic benefits*. The independent latent variable can explain up to 50.1 % of the variability of the dependent latent variable, since the effect size equals 0.501.

Table 13.12 Total effects—Integrative model (Kaizen control phase)

To	From		
	Competitive benefits	Human resources benefits	Kaizen control
Competitive benefits		0.549 ($P < 0.001$) ES = 0.422	0.696 ($P < 0.001$) ES = 0.485
Human resources benefits			0.670 ($P < 0.001$) ES = 0.449
Economic benefits	0.586 ($P < 0.001$) ES = 0.477	0.382 ($P < 0.001$) ES = 0.261	0.706 ($P < 0.001$) ES = 0.501

Moreover, in this relationship the indirect effect caused by *Human resources benefits* and *Competitive benefits* is higher than the direct effect.

- The second largest total effect (0.696 units) can be perceived in the relationship between *Kaizen control* and *Competitive benefits.* In this case, the first latent variable explains up to 48.5 % of the variability of the second latent variable (ES = 0.485). Moreover, the indirect effect given through *Human resources benefits* is larger than the direct effect.
- Note that the total effects shown in the relationship between *Human resources benefits* and *Economic benefits* is particularly attractive, since only the indirect effect is significant. In other words, the direct rapport between these two variables seems to be statistically worthless, but the influence of *Competitive benefits* is the one that makes the relationship significant. In this case, *Human resources benefits* explains up to 26.1 % of the variability of *Economic benefits* (ES = 0.261), with a total effect that is equivalent to the indirect effect (0.382 units). Such phenomenon demonstrates that in order to obtain *Economic benefits, Human resources benefits* should first aim at gaining *Competitive benefits*.

13.3.2.7 Conclusions and Industrial Implications—Integrative Model (Kaizen Control Phase)

From the model evaluation, we can conclude the following:

- Mexican manufacturing companies should strive to maintain proper control of improvement plans and projects, since monitoring, and controlling Kaizen events have the strong impact on human resources benefits.
- *Kaizen control* activities must aim at gaining appropriate *Human resources benefits.* It is the only way of guaranteeing *Economic benefits*, since the direct relationship between *Kaizen control* and *Economic benefits* is weak.
- When *Competitive benefits* influence on the relationship between *Human resources benefits* and *Economic benefits*, such a relationship becomes significant. This implies that in order to obtain *Economic benefits*, *Human resources benefits* should bring *Competitive benefits.*
- Considering the effects magnitude, the critical path to follow in the model *is Kaizen* control—*Human resources benefits*—*Competitive benefits*—*Economic benefits*.

Appendix A
Critical Success Factors (CSFs) Identified in the Literature

CSF1. The management department plans the acquisition of the resources (economic, physical space, and time).
(Treece 1993; Tanner and Roncarti 1994; Wittenberg 1994; Creswell 2001; Salgueiro 1999; Richardson and Gurtner 1999; Berger 1997; García et al. 2013c; Suárez Barraza 2009; Hashimoto et al. 2010; Aken et al. 2010; Marin-Garcia et al. 2009; Bashkite and Karaulova 2012; Lanigan 2004; Laraia et al. 1999; Mika 2006; Brunet 2000; Burch 2008; Holden 2011; Jayaram et al. 2010; Minton 1998; Melnyk et al. 1998; Rapp and Eklund 2002)

CSF 2. Kaizen policies, objectives, and structure are established.
(Caswell 1998; Cox et al. 2006; Pomlett 1994; Lillrank 1995; Gondhalekar et al. 1995; Lu 1987; Cooney and Sohal 2004; Bateman 2005; Prajogo and Sohal 2004b; Adamson and Kwolek 2007; Kosandal and Farris 2004; Bhuiyan and Lucas 2007; Bisgaard 2007; Fodness and Murray 2007; Bicheno and Holweg 2009; Demers 2002; Sridharan 2008; Francisco 2007; Tozawa and Bodek 2002; Modarress et al. 2005b; Ortiz 2009; Atehortua Tapias 2010; Savolainen 1999).

CSF 3. The company considers customers' opinions when making modifications.
(Caswell 1998; Lillrank 1995; Suárez-Barraza et al. 2011a; Cooney and Sohal 2004; Bateman 2005; Prajogo and Sohal 2004b; Kotha and Swamidass 2000; Jaca Garcia et al. 2010; Cua et al. 2001; Jin et al. 2006; Romero Hernandez and Nieto Lara 2011; Krajewski et al. 2013; Wilkinson et al. 2001; Marksberry et al. 2010; Barraza et al. 2009; Alukal and Manos 2006; Imai 2012; Glover et al. 2014; Mika 2006; Ortiz 2009; Palmer 2001; Marin-Garcia et al. 2009; Landa 2009; García et al. 2013c; Arya and Choudhary 2015; Schroeder et al. 2007).

CSF 4. The company adopts a continuous improvement culture.
(Miller 2004; Forman and Vargas 1999; Creswell 2001; Suárez-Barraza and Ramis-Pujol 2008; Worley and Mitchell 2008; Womack and Jones 1996; Pritchard 2002; Lee and Dale 1998; Cunningham 2007; Glover et al. 2013b; Salgueiro 1999; Richardson and Gurtner 1999; Berger 1997; Kaye and Anderson 1999; Farris et al. 2009a; García et al. 2013c; Farley 1999; Filippini et al. 2012; Rico and Cohen 2005; Suárez Barraza 2009; Farris 2006)

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CSF 5. The company develops an organizational structure to detect failures.
(Imai 1986; Bicheno 2001; Ortiz 2009; Ortiz 2014; Audenino 2012; Elsey and Fujiwara 2000; Sheridan 1997; Laraia et al. 1999; Cuscela 1998; Modarress et al. 2005b; Mika 2006; Martin and Osterling 2007; Doolen et al. 2008; Glover et al. 2014; Brunet and New 2003; Paul Brunet and New 2003; Cheser 1994; Tanner and Roncarti 1994; Lareau 2003)

CSF 6. Suggestion groups (e.g. quality circles) are organized to propose improvement in products and processes, or to solve problems.
(Arya and Jain 2014; Suárez-Barraza and Miguel-Dávila 2011; Suárez-Barraza and Ramis-Pujol 2010; Chera et al. 2012; Treece 1993; Yokozawa and Steenhuis 2013a; Ramadani and Gerguri 2011; Hino 2006a, b; Bashkite and Karaulova 2012; Palmer 2001; Machuca 2002; Lanigan 2004; Jørgensen et al. 2003; Juran et al. 1990)

CSF 7. Improvement groups are committed and motivated.
(Tozawa and Bodek 2002; Colenso 2000; Suárez-Barraza1 and Lingham 2008; León Lefcovich 2003; Garza 2005; Macpherson et al. 2015b; Brunet 2000; Imai 2012; Francisco 2007; Imai 2004; Tapias and Correa 2010; Wittenberg 1994; Larson 1998; Suárez Barraza 2008; Sridharan 2008; Alukal and Manos 2006)

CSF 8. Improvement groups set goals to comply with improvement programs.
(Burch 2008; Valencia Patiño 2014; Demers 2002; Werkema 2006; Holden 2011; Bicheno and Holweg 2009; Barraza et al. 2009; Mor et al.; Jasti and Kodali 2014; Jayaram et al. 2010; Minton 1998; Marksberry et al. 2010)

CSF 9. The company has groups to support Kaizen implementation.
(Dean and Bowen 1994; Dale et al. 2007; Kamsu-Foguem et al. 2013; Wilkinson et al. 2001; Becker 1960; Goldacker 2005; Krajewski et al. 2013; Delbridge and Barton 2002; Deming 1986; Fodness and Murray 2007; Long and Shields 2005; J 2005)

CSF 10. Improvement groups are heterogeneous.
(Romero Hernandez and Nieto Lara 2011; Nunnally 1978; Watson and Sallot 2001; Crosby 1979; Bisgaard 2007; Jin et al. 2006; Heard 1999; Bhuiyan and Lucas 2007; Upton 1996; Cua et al. 2001; Gondhalekar and Karamchandani 1994; Bond 1999)

CSF 11. Production operators and administrative staff are trained.
(Melnyk et al. 1998; Jaca Garcia et al. 2010; Pardo and Ruiz 2002; Herreras 2005; Basu and Miroshnik 1999; Kosandal and Farris 2004; Kotha and Swamidass 2000; Adamson and Kwolek 2007; Proctor 1997; Prajogo and Sohal 2004b; Bateman 2005; Rapp and Eklund 2002; Broadbent 1994)

CSF 12. The management department is trained in teamwork and problem-solving skills.
(Cooney and Sohal 2004; Eisenhardt and Graebner 2007; Anderson et al. 1994; Suárez-Barraza et al. 2011a; Lu 1987; Gondhalekar et al. 1995; Liker 2005; Chen et al. 2004a; Lillrank 1995; Aoki 2008; Yuan and Shen 2011; Sabatini 2000; Patton 1997; Pomlett 1994; Liu et al. 2015a)

CSF 13. The company is customer-focused.
(Shang and Pheng 2013; Cox et al. 2006; Montabon 2005; Tabachnick and Fidell 2001; Caswell 1998; Readman and Bessant 2007; Imai 2006; Ishikawa and Lu 1985; Gaboury 2007)

CSF 14. Members of improvement groups are skilled and experienced.
(Creswell 2001; Lee and Dale 1998; Laraia et al. 1999; Holden 2011; Minton 1998; Kamsu-Foguem et al. 2013; Gondhalekar et al. 1995)

CSF 15. Managerial and interdepartmental leadership.
(Creswell 2001; Salgueiro 1999; Richardson and Gurtner 1999; García et al. 2013c; Suárez Barraza 2009; Marin-Garcia et al. 2009; Treece 1993; Bashkite and Karaulova 2012; Lanigan 2004; Laraia et al. 1999; Mika 2006; Tanner and Roncarti 1994; Brunet 2000; Burch 2008; Minton 1998; Melnyk et al. 1998; Rapp and Eklund 2002)

CSF 16. 5s is implemented as a Kaizen strategy.
(Howell 2011; Kumiega and Van Vliet 2008a; Forman and Vargas 1999; Kotabe et al. 2007; Suárez-Barraza and Ramis-Pujol 2008; Suárez-Barraza et al. 2012; Womack and Jones 1996; Webb and Bryant 1993; Glover et al. 2013b; Jin and Doolen 2014; Berger 1997; Farris et al. 2009a; Savolainen 1999)

CSF 18. Restrictions to implement the proposed improvement changes.
(Howell 2011; Kumiega and Van Vliet 2008a; Forman and Vargas 1999; Kotabe et al. 2007; Suárez-Barraza and Ramis-Pujol 2008; Suárez-Barraza et al. 2012; Womack and Jones 1996; Webb and Bryant 1993; Glover et al. 2013b; Jin and Doolen 2014; Berger 1997; Farris et al. 2009a; Savolainen 1999)

CSF 19. Collaborators eagerly contribute to continuous improvement changes.
(Nissen 1996; Arya and Jain 2014; Yokozawa and Steenhuis 2013a; Hino 2006b; Jørgensen et al. 2003; Juran et al. 1990; Ortiz 2009; Elsey and Fujiwara 2000)

CSF 20. An external or internal facilitator helps effectively coordinate the continuous improvement program.
(J 2005; Crosby 1979; Gondhalekar and Karamchandani 1994; Jaca Garcia et al. 2010; Pardo and Ruiz 2002; Adamson and Kwolek 2007; Bateman 2005; Anderson et al. 1994)

CSF 21. Improvement groups include representatives of different disciplines.
(Imai 1997; Chera et al. 2012; Machuca 2002; Yuan and Shen 2011; Pomlett 1994; Montabon 2005; Caswell 1998; Gaboury 2007)

CSF 22. The PDCA (Plan-Do-Check-Act) cycle is followed as a Kaizen strategy.
(Kumiega and Van Vliet 2008a; Rodríguez 2002; Schroeder et al. 2007; Pritchard 2002; Instone and Dale 1989; Suárez-Barraza et al. 2013; Berger 1997; García et al. 2013c; Atehortua Tapias 2010; Park et al. 2012; Marin-Garcia et al. 2009; Suárez-Barraza and Miguel-Dávila 2011)

CSF 23. Employees are committed and motivated.
(Alukal and Manos 2006; Atehortua Tapias 2010; Bateman 2005; Tanner and Roncarti 1994)

CSF 24. Kaizen group members are acknowledged for their achievements and efforts in Kaizen events.
(Womack and Jones 1996; Whitehead 2007; Valencia Patiño 2014)

CSF 25. There is communication across departments.
(Tapias and Correa 2010; Suárez-Barraza et al. 2013; Suárez Barraza 2008)

CSF 26. The improvement approach is consistent with the organizational culture.
(Suárez-Barraza and Ramis-Pujol 2008; Savolainen 1999; Proctor 1997)

CSF 27. Employees are skilled and experienced.
(Shang and Pheng 2013; Salgueiro 1999; Readman and Bessant 2007; Rapp and Eklund 2002)

CSF 28. Internal processes are efficient in checking the effectiveness of proposed solutions.
(Miller 2004; Lévy and Varela 2003; Suárez-Barraza and Miguel-Dávila 2014; Kobayashi et al. 2008; Cunningham 2007)

CSF 29. The company follows a specific methodology to understand customers.
(Salgueiro 1999; Kerrin 2002; Laraia et al. 1999; Mika 2006; Doolen et al. 2008)

CSF 30. The company is customer-focused.
(Gattoufi et al. 2004a; Hashimoto et al. 2010; Sandoval-Arzaga and Suárez-Barraza 2010; Park et al. 2012; Aken et al. 2010; Kaiser 2010)

CSF 31. The company focuses on critical processes that definitely influence Kaizen sustainability.
(Jørgensen et al. 2003; León Lefcovich 2003; Garza 2005; Macpherson et al. 2015b; Larson 1998)

CSF 32. Quality management systems are developed to achieve customer satisfaction.
(Crosby 1979; Jin et al. 2006; Liker 2005; Aoki 2008; Ishikawa and Lu 1985; Gaboury 2007)

CSF 33. Human resources are integrated.
(Filippini et al. 2012; Farris 2006; Langer et al. 2007; Park et al. 2012; Aken et al. 2010)

CSF 34. The company has a defined organizational culture.
(Worley and Mitchell 2008; Lee and Dale 1998; Rapp and Eklund 2002; Anderson et al. 1994; Yuan and Shen 2011)

CSF 35. Administrative staff and operators are self-disciplined.
(Salgueiro 1999; Bashkite and Karaulova 2012; Bicheno 2001; Sheridan 1997; Martin and Osterling 2007)

CSF 36. The company follows standard operating procedures (SOP).
(Marin-Garcia et al. 2009; Hino 2006a; Bashkite and Karaulova 2012)

CSF 37. Job rotation is promoted
(Instone and Dale 1989; Suárez-Barraza et al. 2013; Sandoval-Arzaga and Suárez-Barraza 2010; J 2005; Aoki 2008)

CSF 38. Intelligence and creativity of workers are used in a productive way.
(Macpherson et al. 2015b; Colenso 2000; Tanner and Roncarti 1994; Modarress et al. 2005b; Elsey and Fujiwara 2000; Ortiz 2009; Machuca 2002)

CSF 39. Activities are periodically assessed through performance evaluation systems.
(Arya and Jain 2014; Bicheno 2001; Brunet 2000; Colenso 2000)

CSF 40. Managers inform operators of their work performance.
(Gondhalekar et al. 1995; Yuan and Shen 2011; Pomlett 1994; Readman and Bessant 2007; Ishikawa and Lu 1985)

CSF 41. Progress towards the objectives is continuously measured.
(Schroeder et al. 2007; Webb and Bryant 1993; Kerrin 2002; Atehortua Tapias 2010; Sandoval-Arzaga and Suárez-Barraza 2010)

CSF 42. Forms and/or control records are used to assess activities performance.
(Atehortua Tapias 2010; Demers 2002; Barraza et al. 2009; Jayaram et al. 2010)

CSF 43. The company has safety programs.
(Ramadani and Gerguri 2011; Hino 2006b; Machuca 2002)

CSF 44. The company applies appropriate control and monitoring techniques.
(Francisco 2007; Larson 1998; Alukal and Manos 2006; Holden 2011; Mor et al.).

CSF 45. There is an organizational structure to detect failures.
(Wilkinson et al. 2001; Krajewski et al. 2013; Heard 1999; Cua et al. 2001; Jaca Garcia et al. 2010; Kosandal and Farris 2004; Bateman 2005; Cooney and Sohal 2004; Lillrank 1995; Pomlett 1994; Cox et al. 2006)

CSF 46. Pending issues are documented and monitored.
(Coimbra 2013; Oropesa-Vento et al. 2015a)

CSF 47. Processes are measured and standardized.
(Arrobo and Lenoren 2015; Arya and Choudhary 2015; Macpherson et al. 2015b; Oropesa-Vento et al. 2015a)

CSF 48. Managers are committed until the end.
(Webb and Bryant 1993; Glover et al. 2013b; Park et al. 2012; Landa 2009; Bashkite et al. 2014; Devaraj et al. 2004; Glover et al. 2014; Coimbra 2013; Imai 2012; Jayaram et al. 2010; Goldacker 2005; Adamson and Kwolek 2007; Suárez-Barraza et al. 2011a; Aoki 2008; Shang and Pheng 2013)

CSF 49. Employees are interviewed to identify their needs.
(Jaramillo Osorio 2013; Oropesa et al. 2016a; Rincón Mármol et al. 2013)

CSF 50. Value streams are mapped.
(Lu 1987; Broadbent 1994; Prajogo and Sohal 2004b; Kotha and Swamidass 2000; Bond 1999; Bhuiyan and Lucas 2007; Long and Shields 2005; Becker 1960; Burch 2008; Larson 1998; Ortiz 2014)

CSF 51. Enhancers take Kaizen philosophy to the level sought.
(Alukal and Manos 2006; Cheser 1994; Brunet and New 2003; Farris et al. 2009a; Berger 1997; Suárez-Barraza and Ramis-Pujol 2008; Forman and Vargas 1999)

Appendix B

Journals and magazines with one* and two** publications on Kaizen CSFs

Journal/magazine	Year
Business Week*	1993
Training and Development*	1993
Annals of the University of Petrogani, Economics*	1993
National Productivity Review*	1994
Assembly Automation*	1994
The Learning Organization	1996
Bizjournals*	1996
Editorial CECSA, Mexico. In Spanish*	1996
Aviation Week and Space Technology*	1997
Proceedings of the American Production and Inventory Control Society, Washington, DC*	1997
Decision Sciences Institute*	1997
Integrated Manufacturing System*	1997
Production and Inventory Management Journal*	1998
International Journal of Organizational Analysis*	1998
Supply Management*	1998
Hospital Material Management Quarterly*	1999
Portland International Conference of Management Engineering and Technology*	1999
XI Congreso de Calidad Total, Monterrey. MX*	1999
The TQM Journal*	2000
International Journal of Quality & Reliability Management*	2000
IET London: Savoy Place*	2000
Sustainability: A Guide to Process Improvement*	2001
Manufacturing Operations and Supply Chain Management*	2001
Fortune*	2001
Proceedings 2nd International Workshop on Engineering Management for Applied Technology*	2001
Journal of Ship Production*	2002
Center for Quality of Management Journal*	2002

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Journal/magazine	Year
Annual Quality Congress Proceedings*	2002
2nd edition, Wake Forest, NC: Kaizen Sensei*	2002
Upholstery Design and Management*	2003
Industrial Engineering Research Conference, Portland, OR	2003
Inside WSU*	2003
Home Vital Enterprises*	2003
ASQ's 57th Annual Quality Congress; Expanding Horizons	2003
Proceedings of the 2003 Industrial Engineering Research Conference, Portland, OR	2003
Electronics Assembly*	2003
Society for Health Systems*	2003
Doctoral Dissertation, University of Houston, Houston, TX	2003
Interfaces*	2004
Proceedings of the 2004 Industrial Engineering and Research Conference, Houston, TX	2004
Air Transport World 41, no.9 (August 2004)*	2004
Symposium AAA: Superconducting Materials From Basic Science to Deployment	2004
Manufacturing Engineering*	2004
The Journal for Quality and Participation (2004)*	2004
Total Quality Management and Business Excellence*	2004
Ciencia UANL. Vol VIII, No. 3 (July- September, 2004)*	2004
Manufactura. Información Estratégica para la Industria*	2004
Spectrum: Journal of State Government. Spring2005*	2005
Technical Report 05D-02 (41 pages), Blacksburg, Virginia: Virginia Polytechnic Institute and State University*	2005
Occupational Hazards*	2005
Management Decision*	2005
Strategic Finance*	2006
Doctoral Dissertation, Virginia Polytechnic Institute and State University, Blacksburg, VA*	2006
Proceedings of the 2006 Industrial Engineering and Research Conference, Orlando, FL*	2006
Proceedings of the 2006 American Society for Engineering Management Conference, Huntsville, AL*	2006
Proceedings of the 2006 American Society for Engineering Management Conference, Huntsville, AL*	2006
Occupational health & safety*	2007
Machine Design*	2007
Air Transport World*	2007
Presented at the 2007 American Society for Engineering Management Conference, Chattanooga, TN*	2007
Management Services *	2007
Working Paper, Department of Industrial and Manufacturing Engineering, Wichita, KS*	2007
Productivity Press*	2007

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Journal/magazine	Year
Ergonomics Conference. Dallas, TX*	2007
Instituto Profesional de Enseñanza Superior *	2007
Healthcare Quarterly*	2008
Assembly Magazine*	2008
Proceedings of the 2008 Flexible Automation and Intelligent Manufacturing Conference*	2008
Doctoral Dissertation, University of Massachusetts*	2008
Public Money & Management*	2008
Gestion de la Produccion. São Carlos, Brazil*	2008
Journal of Nursing Care Quality*	2009
Journal of the Transportation Research Board*	2009
CONCYTEG 2009*	2009
Material Handling Management*	2009
Management Journal*	2010
Pecvnia : Revista de la Facultad de Ciencias Económicas y Empresariales, Universidad de León*	2010
Globalization, Competitiveness & Governability*	2011
Metal Finishing*	2011
International Journal of Lean Six Sigma*	2011
Ceramic Industry*	2011
Intangible Capital*	2011
DYNA Ingenieria e Industria*	2011
Ed. Rio de Janeiro: Qualitymark*	2011
Journal of The Japanese and International Economies*	2011
Applied Ergonomics*	2012
CIRP Journal of Manufacturing Science and Technology*	2012
Academia Journals Tuxtla Gutiérrez*	2012
Journal of Engineering and Applied Sciences	2012
Asian Journal on Quality	2012
Elsevier España*	2012
Work: A Journal of Prevention, Assessment and Rehabilitation*	2012
Communications, Computing and Control Applications (CCCA), 2012 2nd International Conference on (2012)*	2012
Journal of public health management and practice: JPHMP*	2012
Journal of Personality and Social Psychology*	2013
Journal of Enterprise Transformation*	2013
The Mediterranean Journal of Computers and Networks*	2013
Operations Management*	2013
Journal of Cleaner Production*	2013
Computers & Industrial Engineering*	2013
Procedia—Social and Behavioral Sciences*	2014

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Journal/magazine	Year
International Journal of Quality and Reliability Management**	1995 2007
Harvard Business Review**	1996 2002
Managing in a Dangerous World**	1997 2004
McGraw-Hill**	1997 2014
Industrial Management**	1998
Journal Business and Management**	1998 2011
European Management Journal**	2004 2011
International Journal of Production Research**	2004 2005
Business Credit**	2005 2014
International Journal of Automotive Technology and Management**	2007 2009
Proceedings of the 2008 American Society for Engineering Management Conference, West Point, NY**	2008
Journal of Policy Development and Research**	2009 2013
Annals of Emergency Medicine**	2009 2011
Lean Construction Journal**	2009 2012
ICFAI Journal of Operations Management**	2009 2010
Biochemical Engineering Journal**	2010 2014
Congreso Internacional de Investigación, Academia Journals Cd. Juárez**	2012 2013
Journal of the Japanese and International Economies**	2013

Appendix C

Countries with one* and two** publications on Kaizen CSFs and benefits

Country	Year
Germany**	2005 2011
Denmark*	2003
Estonia*	2014
Greece*	2013
Holland*	2013
Malaysia*	1997
Nigeria*	2012
Norway*	2013
Romania*	2009
Singapore*	2013
Sweden**	1997 2011
Thailand*	2014

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Appendix D

Universities and institutions with one* and two** publications on Kaizen CSFs and benefits

University/institutions	Year
University of Houston*	2004
New York University*	1993
Johnson & Johnson Medical, Inc., Arlington, Texas*	1994
Kaizen Institute of Europe*	1994
BNY Mellon's new CLO*	1996
University of Louisville*	1996
Business Development & Lean-Kaizen Operations Consultant*	1996
Lean Enterprise Institute, Inc.*	1996
Gettysburg College (USA)*	1997
George Washington University*	1997
Nissan Motor Co. Ltd. in Japan*	1997
Universiti Utara Malaysia*	1997
Lean Enterprise Institute (LEI)*	1997
Dana Holding Institute*	1998
Angelery Engineering Research Company (AERCO)*	1998
TBM Consulting Group*	1998
Michigan State University*	1998
The Universidad of British Columbia*	1998
University of Massachusetts, Medical School*	2008
Sikorsky Aircraft's Institute*	1999
University of Iowa Health Care*	1999
TRW Chassis Systems plant*	2000
The New York Times*	2001
UJI - Universidad Jaume I de Castellón*	2001
Non-Manufacturing Organization*	2002
Portland State University*	2002
Industry and Solution Engineering, SAP Canada*	2002
Wayne State University*	2002

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University/institutions	Year
University of Vigo (España)*	2002
University of Petrosani, Romania*	2008
University of Antioquia, UdeA, Medellin, Antioquia, Colombia*	2011
Instituto de Delphi Electronics & Safety de México*	2008
About SEI US-Stockholm Environment Institute*	2003
Karnatak University*	2003
TBM Consulting Group Inc. Durham, Carolina del Norte*	2003
University of Guelph*	2003
University of Copenhagen*	2003
The S. C. Johnson Graduate School of Management*	2004
Management: UK Manufacturing Management*	2004
University of Quebec at Montreal*	2004
Preco Electronics*	2004
University of Southern California*	2004
The Ohio State University*	2005
Karlsruhe Inst. of Technology, Germany*	2005
Consulting Maurer & Associates*	2005
Consulting and Operations. San Francisco *	2005
Alukal Partners LLC*	2006
University of Southampton*	2006
Concordia University*	2006
Chalmers University of Technology*	1997
Institution of Electrical Engineers London., UK, IEE*	2000
Washington-based World Resources Institute (WRI)*	2000
KAIZEN ASSEMBLY, Bellingham, WA*	2006
Breakthrough Management Group*	2007
Cooper Power Systems Inc. facilities, Waukesha, Wis.*	2007
Case New Holland (Fiat Group, The Netherlands), Racine, WI*	2007
Purdue University, West Lafayette, IN*	2007
Consultora Lefcovich & Asociados*	2007
London Health Sciences Centre*	2008
The University of Warwick, Coventry, UK*	2008
University, Medill School of Journalism*	2008
Manufactured Housing Research Alliance*	2009
Alabama Technology Network, UAH*	2009
University of Central Florida, Orlando, FL*	2009
Freelance writer in Eden Prairie, Minn.*	2009
Japan Cardiff Business School**	2008

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University/institutions	Year
Seattle University, Seattle, WA*	2004
Merck Research Laboratories, Rahway, New Jersey*	2010
Kaizen Assembly, Inc.*	2010
Université de Grenoble 2, UPMF*	2010
University of Newcastle*	2010
École Nationale Supérieure des Mines d'Alès*	2013
Science Applications International Corporation*	2005
Said Business School, Oxford, UK*	2003
School of Business and Management, University of Teesside*	1997
Covenant University, Ota, Ogun, Nigeria*	2012
Universidad Iberoamericana. Mexico*	2010
Promac Engineering Industries Limited*	2011
Warner Lambert Consumer Healthcare*	2014
Louisiana State University*	2014
CemmMex/ Amphenol*	2011
Guru Nanak Dev Engineering College, Ludhiana, India*	2010
Corning Inc., Display Technologies, Corning, NY*	2012
University of Greater Noida, India. *	2012
Werkema Editora LTDA*	2012
Philipps-University Marburg*	2012
Universidad Pontificia Bolivariana Seccional Bucaramanga, Colombia*	2013
Magnagraf*	2013
Bhisham Chera, MD*	2013
Safety and Health, Toyota Argentina SA*	2013
Philip Atkinson Consulting*	2012
Toyota France*	2011
Summa Health System*	2011
University-Industrial Extension Service, Raleigh, NC, USA*	2011
National University of Singapore*	2011
CEO of AlertMD*	2012
University of Salford*	2012
Institute of Technology, Nirma University, Ahmedabad*	2013
Hitotsubashi University, Tokyo*	2013
GKN Driveline Américas, Joaquim Silveira*	2013
Technology Center of the Federal University of Santa Maria*	2013
KIER, Kyoto University, Yoshida-Honmachi, Sakyo, Kyoto*	2013
University of Connecticut*	2010
Gjovik University College, Teknologiveien*	2012

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University/institutions	Year
Vissap Ltd*	2013
Chiarini & Associati*	2013
Institute for Occupational Health & Safety, Athens, Greece*	2013
Tallinn University of Technology, Ehitajate tee 5, Tallinn 19086, Estonia*	2014
University of Technology, North Bangkok*	2014
University of Vigo, EEI Campus das Lagoas, Vigo*	2014
Rowe School of Business, Dalhousie University, Halifax, Nova Scotia, Canada*	2014
University of Portsmouth**	
Cardiff University**	2001 2002
California State University**	1993 2000
University of Monash, Caulfield East, Victoria, Australia**	2000 2004
University of Buckingham**	2001 2011
University of Brighton, UK**	2007 2001
Universidad de Utah, Salt Lake City, Utah**	2002 2005
Loughborough University**	2003 2005
Wichita State University (WSU)**	2003 2007
International Air Transport Association**	2004 2007
University of St. Thomas. Minnesota**	2004 2011
University of Pennsylvania, Philadelphia**	2004 2010
St. Cloud State University**	2005 2006
The Association of Manufacturing Excellence (AME)**	2005 2007
Autonomous University of Nuevo León, Monterrey, Mexico**	2005 1999
United States Surgical Corporation**	1994 1998
Consulting Industry Week**	2007 2009
University of Wisconsin—Oshkosh**	2010 2013

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University/institutions	Year
Polytechnic University of Valencia**	2013 2014
Technological University of Pereira. Colombia**	2011
Nottingham University Business School**	2011 2014
Tecnun–University of Navarra. Spain**	2011
Chuo University, Tokyo, Japan**	2013
University of Twente, The Netherlands**	2013

Appendix E

Departments with one* and two** publications on Kaizen CSFs and benefits

Department	Year
Cellular manufacturing*	1993
Emergency*	1994
Computer support services*	1995
Automotive*	1996
Lean Enterprise Research Centre (LERC)*	1997
Mathematics*	1998
Business organization and marketing*	1999
Electronic engineering and communications*	2000
IW/MPI Census of Manufacturers*	2001
Decision & info science*	2002
Superconducting materials*	2003
Businesses and education	2004
Health, wellness, and fitness*	2005
Agricultural and construction equipment*	2006
Safety and ergonomics*	2007
Strategy and operations consulting*	2008
Centre for Research in Innovation Management (CENTRIM)*	2009
Accounting*	2010
Finance & supply chain*	2011
Construction management*	2012
Centre de Recherches en Innovations Socio Techniques et Organisations Industrielles, PACTE*	2013
Operations and information management*	2014
Laboratory of production engineering (LGP)*	1986
Medicine and public health*	1993
Administration and economics*	1994
Radiation oncology*	1995
Electric*	1999 2000

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Department	Year
Study of manufacturing and management to develop research tools**	2005 2007
Marketing and consulting**	2000 2003
Businesses organization**	2001 1998
Research**	2011
Industrial organization**	2012

Survey

The impact of Kaizen critical success factors (CSFs) on performance indicators

This survey aims at gathering reliable information regarding Kaizen (continuous improvement) sustainment in the manufacturing companies of Ciudad Juárez. The survey analyzes critical success factors (CSFs) contributing to successful Kaizen implementation and evaluates their impact on the benefits that companies obtain.

This research is carried out by M.S. Midiala Oropesa Vento, current PhD student in Engineering Sciences at the Autonomous University of Ciudad Juárez. Research findings can be shared with participating companies if desired. Information is gathered, analyzed, and discussed for academic purposes only. Please provide truthful information.

All surveys and answers provided are confidential.
Only findings will be shared if desired.

Would you like to receive a copy of the research findings? Yes ☐ No ☐

Email:
____

Survey questions must be answered by using the following rating scale with values ranging from 1 to 5, where
:

1	**2**	**3**	**4**	**5**
Never	Rarely	Sometimes	Frequently	Always

Directions:

(a) The survey is divided in sections and subsections.
(b) Please carefully read each question.
(c) Rate each question by checking the desired value.
(d) Do not rate the same question twice.

Glossary

Kaizen	Continuous improvement technique developed in Japan and adopted by Western companies. The term derives from two Japanese terms: *kai*, meaning change, and *zen*, meaning "for the better" or improvement
Critical success factors (CSFs)	Limited number of key variables, activities, or conditions which, if well implemented, ensure successful competitiveness for companies
Kaizen benefits	Positive results obtained from Kaizen implementation. They are reflected on increased customer satisfaction

Section I: Kaizen critical success factors (CSFs) (Kaizen planning, execution, and control phases)

IMPORTANT: This section identifies CSFs for Kaizen implementation and sustainment during the planning, execution, and control phases.

I. According to your personal experience, rate the following activities using the rating scale.

Rating scale:

1 = never, 2 = rarely, 3 = sometimes, 4 = frequently, 5 = always

KAIZEN IMPLEMENTATION AT THE PLANNING PHASE

How often does your company carry out the following activities during the planning phase of Kaizen?	1	2	3	4	5
1. The management department plans the acquisition of all the resources needed for improvement programs (financial resources, physical space, time)					
2. The company sets policies, objectives, and the structure of Kaizen events.					
3. Customers' opinions are taken into account when making changes.					
4. The company develops a continuous improvement culture.					
5. The company has a structure to detect failures.					
6. Suggestions groups (e.g. quality circles) are organized to improve products and processes or to solve problems.					
7. Improvement groups are committed and motivated.					
8. Improvement groups set goals to comply with improvement programs.					
9. The company has groups to support Kaizen execution.					
10. Improvement groups are heterogeneous.					
11. Production operators and administrative staff are trained.					
12. The management department is trained in teamwork and problem-solving skills.					
13. The company is customer-focused.					
14. Members of improvement groups are skilled and experienced.					

KAIZEN IMPLEMENTATION AT THE EXECUTION PHASE

How often does your company carry out the following activities during the execution phase of Kaizen?	1	2	3	4	5
15. Managerial and departmental leadership.					
16. 5S is implemented as a Kaizen strategy.					
17. Kanban is implemented as a Kaizen strategy.					
18. Restrictions to implement the proposed improvement changes.					
19. Collaborators eagerly contribute to continuous improvement changes.					
20. An external or internal facilitator helps effectively coordinate the continuous improvement program.					
21. Improvement groups include representatives of different disciplines.					
22. The PDCA cycle (plan-do-check-act) is used as a Kaizen strategy. 23. Employees are committed and motivated.					
24. Kaizen group members are acknowledged for their achievements and efforts in Kaizen events.					
25. There is communication across departments.					
26. The improvement approach is consistent with the organizational culture.					
27. Employees are skilled and experienced.					
28. Internal processes are efficient in checking the effectiveness of proposed solutions.					
29. The company has methodologies to understand customers.					
30. The company is customer-focused.					
31. The company focuses on critical processes that definitely influence Kaizen sustainability.					
32. Quality management systems are developed to achieve customer satisfaction.					
33. Human resources are integrated.					
34. The company has a well-defined organizational culture.					
35. Administrative staff and operators are self-disciplined.					
36. The company follows a standard operating procedure (SOP).					
37. Job rotation is promoted.					
38. The intelligence and creativity of workers are used in a productive way.					

KAIZEN IMPLEMENTATION AT THE CONTROL PHASE

How often does your company carry out the following activities during the control phase of Kaizen?	1	2	3	4	5
39. Activities are periodically assessed through performance evaluation systems.					
40. Managers inform operators of their work performance.					
41. Progress toward the objectives is continuously measured.					
42. Forms and/or control records are used to assess activities performance					
43. The company has safety programs.					
44. The company applies appropriate control and monitoring techniques.					
45. The company has an organizational structure to detect failures.					
46. Pending issues are documented and monitored.					
47. Processes are standardized and measured.					
48. Managers are committed until the end.					
49. Employees are interviewed to identify their needs.					
50. Value streams are mapped.					
51. Enhancers take Kaizen philosophy to the level sought.					

Section II: Kaizen economic benefits

IMPORTANT: This section identified the three types of Kaizen benefits that companies obtain: Economic benefits, competitive benefits, human resources benefits.

Rating scale
1 = never, 2 = rarely, 3 = sometimes, 4 = frequently, 5 = always).

ECONOMIC BENEFITS

To what extent do you think your company obtains the following Kaizen benefits?	1	2	3	4	5
1. Fewer defective products.					
2. Unit manufacturing cost reduction.					
3. Order lead times reduced as close as possible to zero.					
4. Increase work productivity.					
5. Compliance with product delivery times and quantities.					
6. Material handling.					
7. Waste reduction (inventory, waiting times, transport, and operator's movements).					
8. Fewer production process steps.					
9. Maximized profits.					
10. Reduced equipment failure.					
11. Increased general productivity.					
12. Short design and operating cycles.					
13. Improved cash flow.					
14. Increased and improved economic stability.					

COMPETITIVE BENEFITS

To what extent do you think your company obtains the following Kaizen benefits?	1	2	3	4	5
15. The company has the tools to meet customer needs.					
16. New products are more often introduced into the market.					
17. Improved product quality					
18. Customer needs are met					
19. Improved employee skills					
20. Reduction of changeover times					
21. The company adopts a systemic and holistic vision					
22. Process-oriented thinking					
23. Improved product designs					
24. Global competition					
25. Strategic advantage					
26. Experience in and knowledge of organizational processes.					
27. Internal barriers easily removed and authentic, and powerful work teams emerge.					
28. Continuous adaptation to sudden market changes.					

HUMAN RESOURCES BENEFITS

To what extent do you think your company obtains the following Kaizen benefits?	1	2	3	4	5
29. Increased customer satisfaction					
30. Increased employee motivation					
31. Improved attitude and work skills of operators and mangers					
32. Increased employee self-esteem					
33. Fewer cumulative trauma disorders (CTDs) derived from ergonomic problems.					
34. Increased participation					
35. Improved communication among administrative levels					
36. Positive influence on individuals					
37. Decreased customer attrition and employee turnover					
38. Improved attitude and skills of managers and executives to address continuous improvement changes					
39. Participation and collaboration to build a new system					
40. Attention is paid to the most important issues.					
41. Increased employee responsibility and commitment					

Please provide the following personal information:

Please provide the following personal information:

Industrial subsector	Textile Automotive Electrical/Electronics Plastics Medical Others
Number of employees in your company	0-50 □ 51-100 □ 101-200 □ 201-500 □ More than 500 □
Position:	
Gender	□ Male □Female
Work experience (years)	□ Less than 2 □ 2 - 5 □ 5 - 10 □ More than 10

Please provide any additional information that you consider important regarding the Kaizen implementation process in your company.

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Thank you

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