

Thesis



ROTTERDAM SCHOOL OF MANAGEMENT
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Continuous improvement methods

The influence of a company's life cycle stage on successful continuous improvement method implementation



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Preface

After many months of preparations, thorough research, rigorous data gathering and writing I am proud to hereby present my master thesis.

I have researched the subject "*How does the life cycle stage a production organization is in influence the rate of success of continuous improvement method implementations?*" to show that I have gained insight, experience and ability to perform scientific business administration research. This thesis is the conclusion of the study Part-time Master Business Administration at the Rotterdam School of Management, Erasmus University in Rotterdam.

The main reason for choosing this research subject in particular was my personal interest as a professional in the area of business analysis. That motivated me to gain extensive knowledge of continuous improvement and the methods organisations use for successful implementations in different life cycle stages. What started as an interest developed into knowledge of continuous improvement and how organisations have successfully implemented a single or mix of methods combined with the life cycle stage organisations are in. The study is based on the experience of different production companies, spread over six provinces in The Netherlands.

I have gained a tremendous amount of knowledge from this master program and from writing my thesis. Acquired knowledge will definitely expand my professional experience and will be a significant base to further professional development and personal improvement. I look forward to future possibilities to apply my knowledge into practise and share it with anyone who is open to it.

Special thanks go out to Henk de Vries, who kept pushing me forward despite many delays and struggles. He is an excellent coach and great supervisor. Thank you for helping me to write clearly, to understand and apply the correct methodology and your endless patience.

I am grateful to those who took their time from often quite busy schedules to share their stories and would like to thank all of them. Without these people this research would not be possible. This research would not have been possible without those who were kind enough to open their network for me and helped me with finding cases and experts that were interviewed for my research.

I want to thank my fiancé for kicking me when I felt lazy. Thank you for your patience and thank you for improving my grammar and odd sentence constructions.

My family and friends all deserve a thank you, they kept me motivated to complete my study and had unlimited patience and understanding for my busy schedule over the last three years. I apologise for not being around very often and giving you all the attention you deserve and require.

Finally, I would like to thank all of those from the RSM, my co-reader, classmates, those who taught classes or helped with all sorts of tasks and communications. It has been a great time and I have truly enjoyed this great study!

Haarlem, June 2017


Paul Jones

Management summary

“Standing still is the fastest way of moving backwards in a rapidly changing world.”

Lauren Bacall

Continuous improvement within various organisations can be found in all different shapes and sizes. From simple tasks like cleaning up and organising a workplace to month long interdepartmental projects that reshape internal processes. Having continuous improvement in the DNA of an organisation is not an easy challenge though.

Organisations have various methodologies and tools to choose from to implement continuous improvement in their organisation. But does one choose the best individual solution for their specific organisation? In this thesis, the main research question is:

“How does the life cycle stage a production organization is in influence the rate of success of continuous improvement method implementations?”

This thesis focusses on five different continuous improvement methods, ISO 9000, lean, six sigma, theory of constraints and business process reengineering. In the literature review a study is done on the specific details of each method. The conclusion of this literature research is that all methods have in common that they are focussed on improving processes.

The life cycle stages are from research by Lester *et al.* (2003). The research combines research from others that developed types of life stages that organisations move through. The research by Lester *et al.* lead to a questionnaire that this thesis used to measure in which life cycle stage the cases are in.

For the cases eight organisations with production facilities in the Netherlands were interviewed. Besides measuring the life cycle stage the organisations were in questions were asked about the CI-method that they implemented, why the specific method was selected and whether the implementation was successful.

Six out of the eight cases implemented lean. Only one organisation only applied lean as their CI-method, the other five combined lean with six sigma. The organisations that implemented lean and are ISO 9001 certified stated that the lean/six sigma program was used to meet the requirement of ISO 9004, the part of the ISO 9000 family of standards that focussed on continuous improvement.

Theory of constraints found limited application while business process reengineering was not applied by any of the cases. According to an expert business process reengineering is found to be complex for organisations.

Four out of the five CI-methods were successfully implemented in LCS where the expectation was that the benefits would not outweigh the costs for the implementation. Seven out of the nine hypothesis that expected successful implementations were confirmed. The research concludes that the LCS an organisation is in does not have a negative influence on the rate of success, but can have a positive influence to successfully implement the chosen CI-method.

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1. Introduction and research design

In order to remain present within the market and ensure successful future existence companies must use competitive advantages. The goal of each enterprise is to develop and maintain sustainable competitive advantages in such a manner that the competitors would find it difficult to neutralize such advantages. For that reason, enterprises in all segments use continuous improvement (CI) methods. CI-methods are the ways in which organizations work to improve processes, services or products in incrementally or breakthrough steps (ASQ, sd).

Abdolshah and Jahan (2006) link CI-methods to the organisation's current life cycle stage. The paper investigates the best methods applicable to different stages of the life cycle of an organisation. So far the Abdolshah study remains a unique guidance for CI-methods, and yet no follow up research or disclaimer has been made.

The objective of this thesis is to make a detailed research of the interrelation between CI-methods and the organization life cycle.

1.1. Problem identification

The terms Lean and Six Sigma are familiar to many people around the world. These CI-methods are just two of many. These methods have been researched thoroughly over the last decades. And yet to choose the best solution for an enterprise in a continuously changeable environment, it is necessary to answer the following questions. How do you figure the best method for your organization? How do you make sure that the previously chosen method is still relevant, up to date and as effective?

During the process of expansion, organizations move through different life cycle stages. Each stage has its own characteristics and challenges. Depending on the life cycle stage an organization is in, the question is whether a chosen CI-method is optimal at the given period?

1.2. Problem definition

The main research question for this paper is posed as:

"How does the life cycle stage a production organization is in influence the rate of success of continuous improvement method implementations?"

1.3. Objective

The objective of this research is to contribute to the knowledge of continuous improvement methods by specifying the relationship between life cycle stages of organizations and CI-methods.

The research in this field that was done by Abdolshah and Jahan (2006) does not show how the research was conducted or how the researchers came to their conclusion(s). I decided to dedicate my thesis to further research the connection between life cycle stages of organizations and CI-methods due to a personal interest in CI-methods and the impact they have on organisations' operation and management processes.

2. Literature review

The exploration of the theory is focused on two major areas. The first part goes into different types of CI-methods and their definitions. Subsection 2.1.6 contains a characteristics comparison matrix for each CI-method. The second part discusses the organization life cycle stages.

2.1. Continuous improvement methods

Continuous improvement does not have a single definition and many definitions are not correct as they contain the word continuous or improvement to define the meaning. Below some of these can be found, after which my own definition of continuous improvement is given.

“Continuous improvement, sometimes called continual improvement, is the ongoing improvement of products, services or processes through incremental and breakthrough improvements.” (American Society for Quality, 2016)

“Continuous improvement is a method for identifying opportunities for streamlining work and reducing waste.” (LeanKit, 2016)

“CI is where all members of the organisation work together on an ongoing basis improving processes and reducing errors to overall performance for the customer. Put simply, it means ‘getting better all the time’.” (Fryer, Antony, & Douglas, 2007)

From the various references the following definition has been formed of continuous improvement that is used for this thesis :

“Continuous improvement is an ongoing systematic approach to enhance products, services or processes through incremental and breakthrough changes are enhanced”

Section 3.1 contains the different CI-methods that are analysed in this thesis. These methods are not the only CI-methods, but were specifically chosen. When discussing the concept of quality in the Netherlands, two models come to mind, the EFQM Excellence Model and the INK-management model, which is a Dutch variant of EFQM. These models were deliberately not chosen. The EFQM model is designed to be used as an assessment tool for an organisation's capabilities. Through this it's possible for organizations to deliver strategic objectives. In a user guide EFQM describes how to use Lean and Six Sigma to deliver continuous improvement and EFQM is used to provide direction and vision, not being used as a continuous improvement method itself (EFQM, 2013). The INK-management model has the same issue, but has seemingly also lost most of its popularity in recent years.

2.1.1. ISO 9000

In 1987 the International Organization for Standardization (ISO) published the first version of ISO 9000 (ISO, 2016). ISO 9000 represents a family of standards about quality management systems (QMS). ISO has published variants of ISO 9000 that are industry specific, but ISO 9000 itself is generic in its application. ISO 9000:2015 is the latest version and contains the basics concepts of a QMS. Organizations that implemented a quality management system based on the ISO 9000 family can choose to be audited and receive ISO 9001 certification (ISO, 2016). While no longer as popular in The Netherlands as it was in 2006/2007, for the last years ISO 9001 certifications have remained steady in Netherlands and Europe (ISO, 2016). ISO 9004:2009 is focused on improvement of the QMS by making it more efficient and effective (ISO, 2016), this is the continuous improvement part of ISO 9000.

Definition of ISO 9000:

“Provide guidance and tools for companies and organizations who want to ensure that their products and services consistently meet customer's requirements, and that quality is consistently improved.” (ISO, 2016).

2.1.2. Lean

The Lean approach focuses on reducing “seven wastes” within an organization, which are:

- Overproduction;
- Inventory;
- Extra processing steps;
- Movement, defects;
- Waiting;
- Transport.

These wastes can be reduced in the production process, but also within the entire organization (Chiarini, 2011).

Definition of Lean:

“it adopts a holistic view of the networked enterprise spanning the end-to end enterprise value stream, stresses long-term thinking, encompasses all enterprise operations (e.g., strategic, tactical, operational), and embodies a tightly-interwoven set of mutually supportive and highly complementary principles and practices fostering continuous improvement, organizational learning, and building of dynamic organizational capabilities throughout the value stream that enable creation of value for multiple enterprise stakeholders.” (Bozdogan, 2010, p. 4)

2.1.3. Six Sigma

The Six Sigma approach is a methodology to systematically reduce variation in the quality of products by eliminating defects. It is highly data-driven and follows a disciplined approach using DMAIC (define, measure, analyse, improve and control) as its primary tool. DMAIC focuses on improving customer satisfaction and operational performance (Chiarini, 2011) and is a variant to the Deming Cycle (plan, do, check, act).

The approach was developed by Motorola in the 1980's. Six Sigma grew enormously in popularity when it was implemented within General Electric by Jack Welch (PQA, 2016).

Definition of Six Sigma:

“Six Sigma is an organized, parallel-meso structure to reduce variation in organizational processes by using improvement specialists, a structured method, and performance metrics with the aim of achieving strategic objectives.” (Schroeder, Linderman, Liedtke, & Choo, 2008)

2.1.4. Business Process Reengineering (BPR)

The Business Process Reengineering approach is often used as a radical improvement program. Using BPR in an organization is often a complex task that requires multiple disciplines and different fields of expertise. BPR projects may have multiple sources of risk involved. (Borgianni, Cascini, & Rotini, 2015, p. 133). The scope of BPR projects often require substantial changes, which as a result leads to long project durations (larger projects may take up to a year and a half from starting point to the finish line (Kettinger, Teng, & Subashish, 1997).

BPR does not have a single methodology project implementation. The methodologies that are available have a lot in common with the PDSA cycle used in TQM projects (for example: Mobilization, Diagnosis, Redesign, Transition) or the DMAIC cycle used in Six Sigma projects (for example: Analyse, Redesign, Evaluate, Implement, Improve).

Definition of Business Process Reengineering:

“The fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed” (Hammer & Champy 1993: 32).

2.1.5. Theory of Constraints (TOC)

The Theory of Constraints (TOC) approach was developed by Eliyahu Goldratt and first came to light in his book named *The Goal*. This CI-method views processes in an organization in the form of a chain. A chain is only as strong as its weakest link and the weakest link is seen as a constraint in the processes. The TOC method focuses on the efforts of strengthening the weakest link, making the whole chain stronger. Once the weakest link is improved, a different link may become the weakest and thus the process starts all over again (William Dettmer, 1997).

One of the tools developed by Goldratt are the Five Focusing Steps (5FS). Step one is to find the constraint. The next four steps try to eliminate the constraint, with capital expenditure being the last step (Zeynep Tuğçe Şimşit et al., 2014).

The goal of TOC is to improve the lead time of processes. For a manufacturing plant this could be defined as the time it takes from receiving a customer order until the finished product is shipped. In *Standing on the Shoulders of Giants* (Goldratt, 2006) a comparison is made between TOC and how Ford created the flow line or how Toyota created Total Quality Management. Ford's flowline minimized the time that workers used to look for parts or adjust incorrect parts and focused on assembling the vehicles in a minimum required amount of time.

At Toyota Taiichi Ohno used the concepts from Ford, but applied them in a different way to suit Toyota's manufacturing environment. Toyota did not have enough space or money nor the amount of orders to create production lines that were dedicated to continuously produce a single product. The system developed by Ohno made it possible to create different vehicles on the same production line without creating large amounts of inventory (Womack, Jones, & Roos, 1990).

Goldratt took the concept from Ford and Ohno and described these in such a way that they could be used to optimise the flow within a very different application. Goldratt described the concepts as the Five Focussing Steps:

1. Identify the system's constraint;
2. Decide how to exploit the system's constraint;
3. Subordinate everything else to the above decisions;
4. Elevate the system's constraint;
5. If in the previous steps a constraint has been broken go back to step 1, but do not allow inertia to cause a system constraint.

Theory of Constraints definition:

"A systematic method for the identification and removal of bottlenecks impeding throughput in interdependent production systems, where the constraints are thought to flag critical bottlenecks representing the weakest links in the interdependent production chain. The bottlenecks (e.g., physical, logistical, behavioural, managerial) are perceived as critical leverage points for introducing changes affecting the operation and performance of the entire system" (Bozdogan, 2010, p. 7)

2.1.6. Comparison of CI-methods characteristics

In 2010 Bozdogan researched integrating the lean method with other CI-methods. In his study he made a comparison between the five CI-methods used in this thesis. He correlated the extent to which a method is implemented throughout the different levels of an organization (see Table 1) and the scope within (and even outside) the company (Table 2).

Table 1: Intensity of focus at different enterprise scales (adapted from Bozdogan, 2010, p. 14)

Enterprise level	Total Quality Management	Lean	Six Sigma	Business Process Reengineering	Theory of Constraints
Strategic	Partial	Full	Very little or none	Full	Very little or none
Tactical	Moderate	Full	Full	Partial	Partial
Operational	Full	Full	Full	Full	Full

Table 2: Extent of enterprise scope and intensity of focus (adapted from Bozdogan, 2010, p. 14)

Enterprise scope	Total Quality Management	Lean	Six Sigma	Business Process Reengineering	Theory of Constraints
Networked enterprise	Partial	Full	Partial	Very little or none	Very little or none
Core enterprise	Moderate	Full	Partial	Partial	Partial
Business unit	Full	Full	Moderate	Full	Moderate
Factory floor	Full	Full	Full	Full	Full

Bozdogan chose to compare Total Quality Management to the other CI-methods. In this research the decision was made to replace TQM with ISO 9000, which is built on the foundation of TQM, but is more widely implemented in the Netherlands (Kirchner, 1995) (ISO, 2016).

Based on the works of Bozdogan, Chiarini and Andersson, Eriksson, & Torstensson a CI-method comparison matrix has been made (see Table 3). The matrix shows in detail the characteristics of each method.

2.1.7. Continuous improvement methods conclusion

The different continuous improvement methods are unique in their own way, but they also overlap with other methods. The ability to be able to improve all processes is the foundation that all methods share. Lean and theory of constraints focus on processes flow improvement while Six Sigma focusses on processes variation reduction. BPR separates it from the group as it aims for large scale projects that redesign the enterprise and is more autocratic.

2.1.8. CI-method comparison matrix

Table 3: CI-method comparison matrix

Implementation factors	ISO 9000	Lean	Six Sigma	Business Process Reengineering	Theory of Constraints
History	Since 1987	Since late 1940s (emphasis on developments since mid-1990s)	Since mid-1980s	Since early 1990s	Since mid-1980s
Goal	<ul style="list-style-type: none"> • Ensure that products and services consistently meet customer's requirements • Ensure that quality is consistently improved 	<ul style="list-style-type: none"> • Remove waste • Build long-term dynamic network-wide capability for sustained competitive advantage 	<ul style="list-style-type: none"> • Customer satisfaction • Reduce variation • Create economic wealth 	<ul style="list-style-type: none"> • Cost reduction system • Customer satisfaction • Streamline and downsize oriented • Enhance performance 	<ul style="list-style-type: none"> • Maximize throughput • Manage constraints • Improve net profits
Defining feature	International standard to ensure the quality of products and services and improves the environment. Helps to reassure that products, systems and organizations are safe, reliable and good for the environment.	Mutually supportive and reinforcing set of principles, practices and methods for evolving efficient and flexible enterprises as networked systems creating value for multiple stakeholders	Structured methods, practices and tools for reducing all sources of variation in order to improve quality, satisfy customer needs, and improve the bottom-line	Manifesto for turning the prevailing industrial system on its head; a manifesto for fundamental rethinking and radical redesign of core enterprise processes	Set of ordered practices, methods and tools for improving throughput in production systems in order to maximize financial performance, by viewing the production system as "chains of interdependencies"
Implementation	<ul style="list-style-type: none"> • Top-down directive process involving heavy multi-level management participation • Continual improvement of operations through the QMS • Use of outside experts or internally managed process 	<ul style="list-style-type: none"> • Top-down to involve strong leadership support & engagement, bottom-up driven. • Using structured process for enterprise-level CI & planned systemic change • Use of outside experts or internally managed process 	<ul style="list-style-type: none"> • Top-down directive process involving structured management engagement (project champions, sponsors) • Largely internally managed process with support/facilitation by outside experts 	<ul style="list-style-type: none"> • Top-down directive process involving management participation (e.g., as process owners) • Generally pursuing a structured multi-step implementation process • Facilitation by outside experts or internally managed process 	<ul style="list-style-type: none"> • Top-down directive process involving management participation • Using structured process to remove constraints, ten-step Decalogue for system-wide management, and "drum-buffer-rope" scheduling method for managing production line • Mostly internally managed process with support/facilitation by outside experts
Project methodology	PDSA: <ol style="list-style-type: none"> 1. Plan 2. Do 3. Study 4. Act 	Five steps of lean thinking: <ol style="list-style-type: none"> 1. Specify Value from the Perspective of the Customer 2. Identify the Value Streams 3. Flow 4. Pull 5. Perfection 	DMAIC: <ol style="list-style-type: none"> 1. Define 2. Measure 3. Analyse 4. Improve 5. Control 	Multiple four and five step methodologies are available that are similar to PDSA and DMAIC (Mobilization, Diagnosis, Redesign, Transition or Analyse, Redesign, Evaluate, Implement, Improve)	Five focussing steps: <ol style="list-style-type: none"> 1. Identify the System Constraint 2. The part of a system that constitutes its weakest link can be either physical or a policy. 3. Decide How to Exploit the Constraint 4. Elevate the Constraint. 5. Return to Step One, But Beware of "Inertia"

Table continues next page

Implementation factors	ISO 9000	Lean	Six Sigma	Business Process Reengineering	Theory of Constraints
Management style	<ul style="list-style-type: none"> • Long-term oriented • Risk-based thinking 	<ul style="list-style-type: none"> • Long-term oriented • Management by fact • Capacity to involve all the staff • Participatory management • Respect for humanity 	<ul style="list-style-type: none"> • Short-term oriented • Management by fact • Capacity to involve all the staff • Participatory management 	<ul style="list-style-type: none"> • Radical and autocratic top management • Long- and short-term oriented 	<ul style="list-style-type: none"> • Top management, with minimum participation from the work floor
Mode of improvement and change	<ul style="list-style-type: none"> • Process-specific continuous improvement • Planned systemic enterprise change & realignment 	<ul style="list-style-type: none"> • Continuous process improvement • Gradual incremental change • Planned systemic enterprise change & realignment 	<ul style="list-style-type: none"> • Continuous process- specific improvement • Incremental change (in discrete small or large steps) 	<ul style="list-style-type: none"> • Process-specific continuous improvement • Change in large steps 	<ul style="list-style-type: none"> • Continuous operational improvement • Incremental change
Focus	<ul style="list-style-type: none"> • Meet customer requirements • Strive to exceed customer expectations 	<ul style="list-style-type: none"> • Focusing on all enterprise operations, processes and functions • Emphasis on creating robust value propositions and value exchanges among stakeholders • Managing complex interdependencies throughout the networked enterprise (information flows, knowledge sharing, network-wide learning & capability-building) 	<ul style="list-style-type: none"> • Concentration on specific prioritized business processes • Focus on reducing all sources of variation to improve quality, increase efficiency & shorten cycle time 	<ul style="list-style-type: none"> • Concentration on enterprise processes, not on organizational structures, tasks, jobs or people • Focus on “clean sheet” redesign of specific processes • Concentration on enterprise processes, not on organizational structures, tasks, jobs or people 	<ul style="list-style-type: none"> • Concentration on production processes • Focus on the weakest point (constraint) impeding workflow and causing both delays & inefficiency
Core concepts	<ul style="list-style-type: none"> Seven quality management principles • Customer focus • Leadership • Engagement of people • Process approach • Improvement • Evidence-based decision making • Relationship management 	<ul style="list-style-type: none"> • Adopt a holistic view of the networked enterprise • Stress long-term thinking • Deliver customer- pulled best lifecycle value • Eliminate waste towards the goal of creating value • Ensure stability and synchronized flow • Develop collaborative relationships and mutually-beneficial network-wide governance mechanisms • Foster a culture of continuous learning • Evolve an efficient, flexible & adaptive enterprise 	<ul style="list-style-type: none"> • Adopt customer- focused culture • Reduce all sources of variation • Pursue disciplined, structured, approach to process improvement • Practice proactive, data-driven, management • Emphasize teamwork 	<ul style="list-style-type: none"> • Reinvent enterprise through fundamental rethinking of enterprise processes • Pursue radical (“clean sheet”) redesign of existing business processes • Seek breakthrough process solutions 	<ul style="list-style-type: none"> • Improve workflow (throughput) in the production system • Concentrate on key leverage points (constraints) offering greatest performance improvements • Protect production line against interruptions • Ensure people learn better and faster

Table contains research from: (Bozdogan, 2010) (Chiarini, 2011) (Andersson, Eriksson, & Torstensson, 2006) (Nave, 2002) (ISO, 2016)

2.2. Organization Life Cycle Stage

In 2003 Lester *et al.* introduced the five-stage organization life cycle. The study references to multiple other researchers that suggested organizations move through multiple stages of life as they expand and continue to develop. In their research, they proposed a model (Lester, Parnell, & Carraher, 2003) consisting of the following stages:

1. Existence

The birth stage of an organization. The focus is on having a viable proposal and identifying possible customers. A company is owned and run by one or few people.

2. Survival

In this stage formal structures are beginning to form and distinctive competencies are being established. The focus of the company is to generate enough business to have a continuous operation that has enough profits to survive.

3. Success

This stage is also known as the maturity stage. Formal structures and control are in place within the company. An organization grows to the point at which it finds it crucial to protect its achievements and position(s) in the market instead of expanding to new areas.

4. Renewal

In the renewal stage organizations want to go back to a more flexible organization. By teamwork and collaboration, the bureaucracy in an organization is not removed but members learn to work with it. The focus is to put the customer in the first place.

5. Decline

Mintzberg (1984) described this stage as an organization where its members are more focused on personal goals rather than the organizational goals. Profits would drop and market shares are lost. This results in power moving to a select group of people.

Lester *et al.* points out that organizations do not necessarily follow the stages. In any given stage a company can exit the life cycle due to many different reasons.

Table 4 shows the characteristics of each stage:

Table 4: Life Cycle Stage characteristics (Lester, Parnell, & Carraher, 2003)

Life Cycle Stage	Growth/age	Situation	Structure	Decision Making Style	Strategy
Existence	< 10 yrs. Old	<ul style="list-style-type: none"> • Small • Young • Homogeneous 	<ul style="list-style-type: none"> • Informal • Simple • Owner dominated 	<ul style="list-style-type: none"> • Centralized • Trial and error 	<ul style="list-style-type: none"> • Prospector • First mover
Survival	> 15% growth	<ul style="list-style-type: none"> • Medium-sized organization • More competitive 	<ul style="list-style-type: none"> • Functional • Some formality 	<ul style="list-style-type: none"> • Some delegation • Begin formal information processing 	<ul style="list-style-type: none"> • Analyzer • Second mover • Differentiation
Success	< 15% Growth	<ul style="list-style-type: none"> • Heterogeneous environment • Larger size 	<ul style="list-style-type: none"> • Formal • Bureaucratic • Functional 	<ul style="list-style-type: none"> • Reliance on internal information processing 	<ul style="list-style-type: none"> • Defender • Segment control
Renewal	>15% growth	<ul style="list-style-type: none"> • Very heterogeneous environment • Very large 	<ul style="list-style-type: none"> • Divisional • Matrix structured 	<ul style="list-style-type: none"> • Sophisticated controls • Formal analysis in decision making 	<ul style="list-style-type: none"> • Analyzer/combination • Formal analysis in decision making • Low cost
Decline	No Growth	<ul style="list-style-type: none"> • Homogeneous and competitive environment 	<ul style="list-style-type: none"> • Formal • Bureaucratic • Mostly functional 	<ul style="list-style-type: none"> • Moderate centralization • Less sophisticated information processing 	<ul style="list-style-type: none"> • Reactor • Product • Service • Breadth • Low cost

Lester *et al.* developed a 53-item scale that can be used to measure the phase an organization is in. This scale was based on the work of Miller and Friesen (1984) and can be found in Appendix A. From this scale, the information processing statement is critical to determining a particular life cycle stage. As organizations grow larger, more sophisticated information processing is needed.

2.3. Four-phase model

In 1995 Hardjono published his PhD dissertation about the four-phase model. This model was designed to be used by managers and organizational consultants to analyse organizations and develop a strategy to further improve an organization (Hardjono, 1995, p. 15). Figure 1 shows the four-phase model in its most basic form.

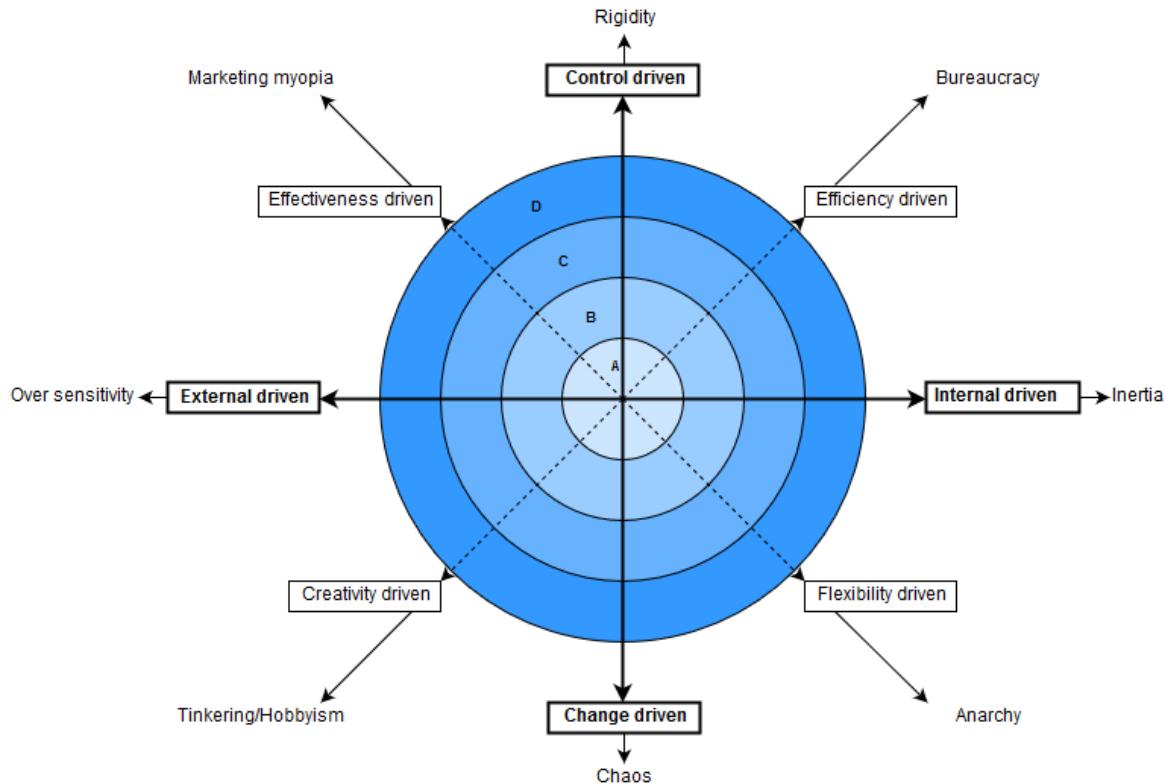


Figure 1: Four-phase model (Hardjono, 1995)

The premise of the four-phase model is that organizations try to improve their competencies. The four basic competencies in the model are:

- A. Material;
- B. Commercial;
- C. Social;
- D. Intellectual/spiritual.

Each of these are represented by a circle in the model. To improve competencies, the corporate focus is oriented on two dichotomies, namely external/internal (horizontal axis) and control/change (vertical axis), creating four quadrants. Each quadrant has a strategic orientation (effectiveness, efficiency, flexibility or creativity). According to Hardjono, the model shows that corporate strategy has a specific rhythm, moving from one strategic orientation to the next (in a clockwise direction, but when necessary the model allows for counter-clockwise movement). If an organization stays in a quadrant too long the effect can be opposite, leading to marketing myopia, bureaucracy, anarchy or tinkering / hobbyism (Hardjono, 1995).

Organisations can be in multiple quadrants at the same time, but the focus is not on all quadrants at all times. Focus should regularly shift from one quadrant to the next. Working on all quadrants protects organisations from falling into traps of anarchy, tinkering / hobbyism, marketing myopia or bureaucracy.

2.3.1. Relationship to CI-methods

The goal of most CI-methods is to have a high customer satisfaction (see 2.1.8). In the external-control quadrant this is done by focussing on being effective in adapting to customer needs. To do so, internal processes must be in order. This situation fits well with CI-methods such as ISO 9000, Lean and Six Sigma.

The internal-control quadrant has a focus on efficiency. Efficient processes lead to shorter cycle times, lower inventory, less costs, etc. This also helps to improve customer satisfaction as prices can be lower, or lead times shorter. ISO 9000, Lean, Six Sigma and theory of constraints are ideal CI-methods for this.

The quadrant internal-change quadrant fits very well with business process reengineering. With BPR the existing is no longer adequate and is radically changed. The quadrant focusses on being flexible. Lean is also a match through the focus on continuously improving in small steps it can lead to the development and introduction of new ideas.

New organizations start in the external-change quadrant. The focus on creativity creates innovations, but also means that everything is changing rapidly, making it very difficult to manage. Hardjono describes it as a “chaotic organization” and that it is best for managers to let it follow its own course. This situation doesn't fit well with any of the CI-methods as they require some minimal form of structure.

Table 5 shows the possible combinations of CI-methods and four-phase model quadrants.

Table 5: CI-methods and four-phase model quadrants

CI-methods	External-Control	Internal-Control	Internal-Change	External-Change
ISO 9000	X	X		
Lean	X	X	X	
Six Sigma	X	X		
BPR			X	
TOC		X		

3. Conceptualization

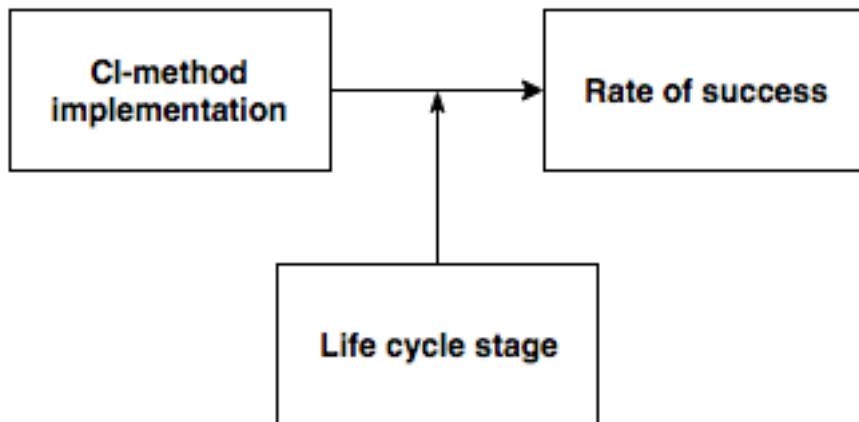


Figure 2: Conceptual model

Independent variable: CI method implementation

Dependant variable: Rate of success of the CI-method(s) implementation

Moderation variable: The life cycle stage an organization is in.

The rate of success of continuous improvement methods implementations is moderated by the life cycle stage an organization is in. The result is that the relationship between the variables can be positive or negative depending on the combination of the life cycle stage and the selected CI-method set. These combinations are further elaborated and hypotheses are formed below.

Existence stage

This is the stage where organizations start. In the four-phase model it corresponds with the external-change quadrant. As this quadrant is chaotic it would be very difficult to implement any kind of CI-method. This leads to the first hypothesis:

H1. Organisations in the existence stage do not benefit from implementing any CI-method

Survival stage

In the survival stage structures begin to form. As the focus is on generating enough profit to sustain operations it is necessary to reduce waste. This corresponds with the external-control quadrant. The lean approach also fits well into the stage and quadrant.

H2A. For organisations in the survival stage the benefits of implementing lean outweigh the costs.

Organizations that experience rapid growth need to be sure to keep meeting customer requirements to be able to continue to survive. ISO9000 has the goal to exceed customer requirements and continually improve quality.

H2B. For organisations in the survival stage the benefits of implementing ISO 9000 outweigh the costs.

With the other CI-methods it is expected that the positive results of implementing them are outweighed by the cost of implementation.

H2C. For organisations in the survival stage the benefits of implementing Six Sigma do not outweigh the costs.

H2D. For organisations in the survival stage the benefits of implementing business process reengineering do not outweigh the costs.

H2E. For organisations in the survival stage the benefits of implementing theory of constraints do not outweigh the costs.

Success stage

In the success stage organizations become more bureaucratic, similar to the internal-control quadrant. Lean can be applied through all levels and departments and focuses on managing complex interdependencies within and outside of organizations.

H3A. Organisations in the success stage benefit from implementing lean.

The statistical tools that are at the heart of Six Sigma require data. Organizations in the success stage rely on their data processing and are capable of supplying the required data for Six Sigma.

H3B. Organisations in the success stage benefit from implementing Six Sigma.

Quality management systems must be in place to remain successful and continue to satisfy customer requirements. ISO 9000 meets these requirements.

H3C. Organisations in the success stage benefit from implementing ISO 9000.

With the implementation Theory of Constraints, the flow at an operational level can be optimized and lead to lower lead times and inventories.

H3D. Organisations in the success stage benefit from implementing theory of constraints.

BPR is the remaining method, here it is expected that the positive results of implementing BPR is outweighed by the cost of implementation.

H3E. For organisations in the success stage the benefits of implementing business process reengineering do not outweigh the costs.

Renewal stage

Organizations in the renewal stage are experienced. Using lean, it is capable to manage the networked enterprise and to reduce waste while improving performance.

H4A. Organisations in the renewal stage benefit from implementing lean.

Organizations in the renewal phase have the necessary sophisticated controls and use formal analysis for decision making. This combines well with the Six Sigma tools set and requirement for data analysis.

H4B. Organisations in the renewal stage benefit from implementing Six Sigma.

With the other CI-methods it is expected that the positive results of implementing them are outweighed by the cost of implementation.

H4C. For organisations in the renewal stage the benefits of implementing ISO 9000 do not outweigh the costs.

H4D. For organisations in the renewal stage the benefits of implementing business process reengineering do not outweigh the costs.

H4E. For organisations in the renewal stage the benefits of implementing theory of constraints do not outweigh the costs.

Decline stage

In the decline stage organizations become more centralized. This leads to a more top-down management style where power is with a select group of people. With business process reengineering a top-down approach is used to redesign the organization. To redesign an aggressive and autocratic management style is used, which fits well with the decline stage. As change is required this fits well with the fourth quadrant of the four-phase model, internal-change. This leads to the final positive hypothesis:

H5A. Organisations in the decline stage benefit from implementing business process reengineering.

With the other CI-methods it is expected that the positive results of implementing them are outweighed by the cost of implementation.

H5B. For organisations in the decline stage the benefits of implementing ISO 9000 do not outweigh the costs.

H5C. For organisations in the decline stage the benefits of implementing lean do not outweigh the costs.

H5D. For organisations in the decline stage the benefits of implementing six sigma do not outweigh the costs.

H5E. For organisations in the decline stage the benefits of implementing theory of constraints do not outweigh the costs.

3.1. Summary of hypothesis

Table 6 shows a summary of the hypothesis. Each CI-method is matched to the different life cycle stages. The green colour shows a. expected positive outcome when specific CI-methods are matched to a stage. Red shows negative outcome.

Table 6: Hypothesis summary

	1. Existence	2. Survival	3. Success	4. Renewal	5. Decline
ISO 9000	Red	Green	Green	Red	Red
Lean	Red	Green	Green	Green	Red
Six Sigma	Red	Red	Green	Green	Red
Theory of Constraints	Red	Red	Green	Red	Red
Business process reengineering	Red	Red	Red	Red	Red

Hypothesis - Implementation not successful

Hypothesis - Implementation successful

4. Methodology

The following chapter will go deeper into the methodological aspects and research design of the thesis.

4.1. Empirical setting

The concepts from chapter four are made measurable in the following parts.

4.1.1. Moderating variable: Life cycle stage

To measure which life cycle stage an organization was in when implementing the CI-method (set) the interviewees are asked to fill in the questionnaire that was developed by Lester, Parnell and Carraher (Appendix A). See section 0 for exact details on the questionnaire.

4.1.2. Independent variable: CI-method set

Measured by quantifying results gained through semi-structured interviews with quality manager from organizations that have implemented a specific set of CI-methods. The interviewees will be asked in-depth questions on the decision to implement the specific methods, such as:

- Which method has been implemented or attempted to implement?
- What were the goals of implementing?
- Have these goals have been met?
- Why was this specific method or set of methods chosen?
- Have other methods been considered?
- Does the organization regard the implementation successful?
- How was success quantified?

4.1.3. Dependant variable: Rate of success of CI-method implementation

The rate of success is very difficult to measure as there are many different variables that can lead to better financial or production results. Therefor the rate of success is de facto the perceived rate of success by the organization members.

The rate of success is measured by quantifying results gained through semi-structured interviews with quality manager from organizations that have implemented a specific set of CI-methods. The interviewees will be asked in-depth questions on the successes of the specific methods, such as:

- Does the organization consider the implementation successful?
- Is the CI-method still being applied at the moment of interview?
- Is the organization planning on continuing to use the method in the future?
- Would the respondent recommend others to use the method?

4.2. Research type and strategy

To answer the research question of this thesis the following steps will be taken:

1. Research subject;
2. Research design;
3. Conduct interviews with quality managers/consultants for cases;
4. Conduct interviews with CI-method experts;
5. Conduct interview with overall expert of continuous improvement;
6. Prepare data for analysis;
7. Analysis of data;
8. Report on results.

4.2.1. Research approach

This structured research moves from a general level to a more specific level. The theory has resulted in hypotheses and these will be tested (Blackstone, 2016). This means the research approach is deductive.

Data are gathered through multiple case studies using a multi-method approach. Each case will represent an organization that implemented a specific set of CI-methods.

After conducting case studies, preliminary findings are discussed with experts on each specific CI-method to gain more insight into when a method should or should not be used and whether the preliminary findings meet the expert's expectations.

The overall findings of cases and method experts will be discussed with an overall expert in quality management with great knowledge on continuous improvement methods to reduce bias.

4.2.2. Research type

Research is conducted in a multiple case study form. Case study is defined as following:

"A case study is an empirical inquiry that investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident" (Yin, 2014).

Case studies can be applied for many different types of research, however most fitting with "how" and "why" questions, and in research where there is no requirement to control behavioural events and that is focused on contemporary events (Yin, 2014). This research has a how question. There is no need to control behavioural events and people that were directly involved with the subject can be interviewed. This makes the case study a fitting form of research.

The research tries to look at the relationship between life cycle stages and CI-method through multiple lenses. First of all, by interviewing those that have implemented a single or set of CI-methods, but also through interviews with experts on CI-methods and their view on this subject.

4.2.3. Research area

The research is conducted with production companies in The Netherlands that have implemented one or multiple CI-methods. Each company will be used as a single case to test the hypotheses.

Production companies in The Netherlands have been selected specifically. It is to limit the scope of the research, making it possible to conduct the research within a limited time frame. Another goal is to limit other variables that could have influence on the possible outcome.

4.3. Case study and expert's selection

Data is gathered through cases, CI-method expert interviews and an overall expert interview.

4.3.1. Case study and expert selection

The cases are not selected randomly but found through a personal network. Companies are contacted that fit within the research area that is described in 4.2.3.

For each life cycle stage, at least one case is required. Before conducting the questionnaire, it is not possible to know the LCS of the organisation. This can lead to having multiple cases in one stage and only one case for another LCS. Finding relevant organisations in the existence and decline phase is expected to be most difficult. Organisations in the existence phase are expected to be focussed on finding their market and might not have any production facilities yet. Organisations in the decline phase have sales drops and lower market shares, this could result in organisations not wanting to share any data for this research.

For each case an interview is held with an employee with a relevant function. This could be, but is not excluded to, plant managers, quality managers, operational managers or external continuous improvement consultants. Each case will consist of one interview and a filled in LCS questionnaire to determine the life cycle stage for each case.

The experts are selected by using the same personal network to approach people that have implemented or have researched one or more of the CI-methods, for example lean six sigma black belt consultants, professors in the field of operational management or continuous improvement consultants.

4.4. Data collection methods

4.4.1. Data collection for case studies

Data for case studies is gathered from organizations at a single-point in time to match the life cycle stage to the implemented CI-method. The following techniques to gather data are used:

1. Case survey

A case survey is held with developed scales to measure which life cycle stage an organization was in when implementing the continuous improvement method(s). The case survey is held by questionnaire that was developed by Lester *et al.* (2003) and can be found in Appendix A.

The questionnaire has five sets of four questions with a 5-point Likert scale (1 - strongly disagree, 2 - disagree, 3 - neutral, 4 - agree, 5 - strongly agree). Each set of questions represents a specific life cycle stage. The highest scoring set of questions determines the life cycle stage. When two or more sets of questions are equal, the question on data-processing determines the outcome. Table 7 shows which questions belong to a specific set of questions and the corresponding Life Cycle Stage

The preference is to have the questionnaire filled in before the semi-structured interview takes place. This will help to prepare the interview.

Table 7: Lifecycle Stage question sets (Lester, Parnell, & Carraher, 2003)

Life Cycle Stage	Set of question
Existence	1, 4, 7, 12
Survival	5, 11, 13, 18
Success	2, 6, 8, 14
Renewal	3, 9, 15, 19
Decline	10, 16, 17, 20

2. Semi-structured interviews

Semi-structured interviews are held with quality managers and/or external consultants that were closely involved with the implementation of CI-methods within the organization. Semi-structured interviews are chosen so that there is flexibility to go deeper into interesting subjects or areas that need more explanation and to skip parts that are not relevant. An interview participation information sheet has been developed (see Appendix B for details).

4.4.2. Data collection for specific CI-method expert

Data for each specific CI-method expert are gathered through semi-structured interviews, such as in the case studies. The interviews are held after the case study interviews to discuss preliminary findings. The discussion will go into the applicability of the specific method within companies at different life stages.

4.4.3. Data collection overall CI-methods expert

Data for the overall CI-method expert are gathered through a semi-structured interview, such as in the case studies. The interview is held after the case study and the specific CI-method

expert interviews to discuss preliminary findings. The discussion will go into the applicability of the methods within companies at different life stages.

4.5. Data analysis

The life cycle stage questionnaire has been built in Excel and when fully filled in immediately shows results.

The semi-structured interviews will be fully transcribed and analysed.

4.6. Reliability and validity

When conducting a study, the results should be reliable and valid. Reliability is about how concepts are measured. If you repeat the same measurement on the same subject the result must be the same.

To have a valid research the instrument must measure what you want to measure. Reliability is a precondition for validity. Something can be reliable without being valid, as your instrument can measure very reliably, without measuring what you intended to (van der Velde, Jansen, & Anderson, 2004).

Achieving a high level of reliability and validity can be difficult with qualitative research, but is not impossible with the correct preparation.

For this research, the following steps were taken to achieve a high level of validity:

- Participants are explained in a briefly matter and with clear terms that the purpose of the research is, which data are required and what will happen with these data. This will be done with a participant information sheet that is prepared before engaging potential participants;
- Ask open and probing questions;
- Avoid asking leading or proposing questions;
- Summarise to validate understanding of answers.

5. Results and analysis

This chapter reveals the findings of a research based on multiple case studies and expert interviews.

5.1. Case results

The following subchapters shows the description of all the examined cases and the results thereof.

5.1.1. Case descriptions

The study was conducted through semi-structured interviews within eight different companies. That factor that all the examined companies have in common is their production locations within the Netherlands. Table 8 shows an overview of the different cases:

Table 8: Cases from research

Case	Industry	Role	FTE local	FTE global
Company 1	Recycling	ISO 9001 consultant	150	250
Company 2	Machine	Project Leader, Process Improvement	8.500	16.000
Company 3	Food	Continuous improvement consultant	250	500
Company 4	Electronics	Plant Lean Manager	350	138.000
Company 5	Packaging	Plant Manager	275	43.000
Company 6	Raw materials	Senior Consultant	10.000	26.000
Company 7	Industrial	Quality Manager	1.000	3.500
Company 8	Agriculture	Manager Operations	45	100

The cases with the largest amounts of FTE are a part of larger global companies that have operations or their headquarters in the Netherlands. These cases focussed on the local plant.

All interviews were held between October 2016 and May 2017. Finding a case for each life cycle stage was difficult, as organisations were not always willing to participate or had time for an interview. The writer of this thesis works at the first company. Other organisations were found by having an intermediate with connections in relevant organisations ask their contact if they were willing to participate in this research. Case interviews were all held at the local plants in The Netherlands. The interviews took approximately 45 to 60 minutes and sometimes were followed by a tour through the plant. The LCS questionnaire was sent before the interview. In 50% of the cases this questionnaire was filled in prior to the interview. In two cases the questionnaire was filled in at the end of the interview and in two cases the questionnaire was provided within a few days after the interview. Time constrictions with the interviewees did not always permit them to answer the questionnaire prior or during the interview. In multiple cases the result of the LCS questionnaire was discussed to confirm the outcome.

All interviews were transcribed and sent to the interviewees for feedback. A selected few interviewees provided feedback, which was to clarify their statements. The case interviews are summarized in the following sections. The summaries of the expert interviews are in sub-chapter 5.2.

5.1.2. Case 1

Implemented method: ISO 9000

Successful implementation: No

Lifecycle stage: Decline stage

Company 1 uses ISO 9000 as their continuous improvement method. The organisation was first certified in 2008 while it was part of a larger group company. The interview was held with the consultant that helps the organisation with its ISO 9000 certification. The interviewee is an external consultant specializing in management systems.

The organisation struggles to successfully implement continuous improvement within their organization. They are ISO 9001 certified, but the organization's structure is constantly changing and administration is directed from the top. The organisation has multiple systems in place that can be used for continuous improvement, but they are not always structured properly by upper management. Many employees have a lot of knowledge about specific subjects that are valuable for the organisation, but there are no structures in place to share any of this knowledge, this leads to a difference in what plant managers want/can do and what management allows them to do. In the opinion of the interviewee the company has not successfully implemented ISO 9000. The organisation is certified and yet does not use the system in the intended way.

This company scored highest in the decline phase. This matches with the criteria of the management maintaining a top-down structure and giving limited powers to plant managers or operators. The information processing is limited, but badly needed, which is one of the leading signs in determining the LCS. The second highest scoring phase is survival. This corresponds with the substantial growth that the organisation experienced over the last five years. The survival and decline phase 'clash' with each other as long as management tries to keep power. In this case, mid-level managers have full responsibility but do not receive any authority.

Table 9: Life cycle stage questionnaire results company 1

LCS	Score
1. Existence	6
2. Survival	14
3. Success	8
4. Renewal	12
5. Decline	15

5.1.3. Case 2

Implemented method: Lean

Successful implementation: Yes

Lifecycle stage: Success and renewal stage

The second company is a large organisation in the machine industry. It has recently started to implement the lean method in one of its two factories. The examined factory is the largest and most mature of the two. It does not have a traditional production line due to the size of their products. As the factory has been struggling to produce products with a constant quality, they decided to implement lean to improve the situation.

The interviewee works as project leader in the implementation of lean within the factory. The organization has set goals that must be reached by 2020 and are focused on improving product quality, reducing lead-times and lowering production costs. These goals were set by the top management, which also made the decision to implement lean in the factory. The implementation of lean is still in process, but current metrics show positive results.

While lean is used on the factory floor, the organization also uses other CI-methods, such as Six Sigma, for projects of variable sizes. Continuous improvement in the organisation was always more focussed on technology development rather than on production process, but with the implementation of lean this has started to change.

The LCS scores are equal for the success and renewal stage with survival following behind it closely. This result fits with the description of the company, which is mostly focused on innovation and partly works like a start-up company with the introduction of a radical new technology. The organisation size is approximately 15.000 employees and it has a very mature product.

Table 10: Life cycle stage questionnaire results company 2

LCS / Case	Score
1. Existence	5
2. Survival	13
3. Success	15
4. Renewal	15
5. Decline	8

5.1.4. Case 3

Implemented method: Lean, six sigma

Successful implementation: Yes

Lifecycle stage: Existence stage

The third company is an organisation with multiple retail formulas in the food industry. It has two production facilities with each around 250 employees. The organisation used 5S from lean for a while, but without any structure or clear goals. In 2015, the organisation hired an external firm to implement continuous improvement systematically, starting with the logistics department at one of the plants. The external firm is specialised in implementing lean and six sigma methods within the food industry. The interviewee for the case is the owner of the external consulting firm.

The implementation started by determining a clear goal for the organisation. To reach the goal, KPI's were created and set from the highest level to the operators in the plant in a cascade model. Operators and team leaders meet every day to discuss briefly why targets were not met and what needs to be changed to reach their goals. The results from these daily meetings are discussed weekly by upper management. In these meetings decisions are made on issues that cannot be solved by operators and/or require financial investments.

Operators and team leaders went through a training course on applying lean and six sigma methods. The external firm uncovered various types of waste that can be reduced in the full value chain.

The goal of the continuous improvement implementation was to reduce costs and improve operational efficiency. This is not as a onetime project, but through the trainings and counselling by the continuous improvement coaches from the consulting firm, continuous improvement is secured in the organisation as uninterrupted and overall involving process.

Currently the external firm has completed most of the tasks and has monthly visits to give advice on any issues or answer emerging questions from their client. The full spectrum of continuous improvement is the responsibility of the organisations itself and does not depend on the external consultants. The organisation considers the implementation to be successful as goals to reduce costs and measurable efficiency improvement have been met.

In the LCS questionnaire the organisation scored the highest in the existence phase. The organisation is nearly forty years old, but with a new and young management team it has started to rediscover the possibilities with the organisation. The new management is trying to reposition the company in the market. Even with new management, the organisation has a very limited number of shareholders and its structure is described as simple. All described above are clear signs of the existence phase.

The questionnaire results show high scores for the success and renewal stage, both scoring two point less than the existence phase. The trend of rediscovery set by the new management is pushing the organisation towards the renewal phase. The lean six sigma program fits in these phases. While management is working on new company strategy, the factories keep producing and supplying their traditional business.

Table 11: Life cycle stage questionnaire results company 3

LCS	Score
1. Existence	17
2. Survival	13
3. Success	15
4. Renewal	15
5. Decline	10

5.1.5. Case 4

Implemented method: Lean, sig sigma, ISO 9000

Successful implementation: Yes

Lifecycle stage: Survival and success stage

With nearly 140.000 employees world-wide, the fourth company is the largest one in this research by far. The organisation has one plant in the Netherlands, this is where the interview was held. The local plant was the subject of the research. According to the interviewee the implementation of their continuous improvement program is rolled out globally at all locations, including the headquarters. The organisation invested heavily into their lean six sigma program. For the employees, the highlight of continuous improvement in the organisation is the yearly contest for the best continuous improvement idea. The contest starts at the plant where the winners can then compete for the best continuous improvement idea. The winners go on to present their idea in the sub-regional contest, then the regional contest and ends with presentations of the best ideas to the board of directors in Florida, USA. This shows how continuous improvement has significant management support and is implemented at all locations over the world.

The plant in the Netherlands was purchased by the current organisation in 2011. With the new owners, the organisation almost immediately started to implement the lean six sigma program. The organisation is ISO 9001 certified and uses the lean six sigma program to fulfil the requirements of ISO 9004. The lean six sigma program was developed at the headquarters and is globally monitored. All plants have goals and the performance audit of the lean six sigma program takes place every two years.

The program is applied in every department. The financial department also applied improvement methods such as DMAIC to reduce month-end closing times. Each employee that is not part of management has a personal target number of improvements that need to be achieved yearly. The improvements range from very simple tasks, such as organising your tools, to large projects that take multiple weeks or months to implement. For example, optimising a production line. The employees are encouraged to share their improvements, regardless of the size and significance. All improvements are registered in a global database which can be used to find solutions to similar existing problems.

The goal of the implementation was to grow closer to the customer. This was achieved by eliminating waste, reducing lead-times and ultimately satisfying the customer's needs. The program has a clear focus on the customer and is considered to be successfully implemented. One of the major indicators of positive outcome at the Dutch plant while applying the program zero warehouse storage of finished. All products are shipped directly to the customer worldwide. Now the inventory only consists of only necessary raw materials and limited work-in-process pieces.

The LCS scored equally at the survival and success stage, with the renewal stage scoring one point less. While the head company is very large, it is important to note that the plant in the Netherlands only has 350 employees, most of whom work in operational and logistical departments. Being a part of a bigger organisation has its advantages, like having access to the sophisticated information systems and lean six sigma program provided by the group.

Table 12: Life cycle stage questionnaire results company 4

LCS	Score
1. Existence	11
2. Survival	14
3. Success	14
4. Renewal	13
5. Decline	10

5.1.6. Case 5

Implemented method: Lean, six sigma, theory of constraints

Successful implementation: Yes

Lifecycle stage: Renewal stage

The fifth company is a strong player in the paper industry and a part of a large global organisation. The organisation has multiple plants within the Netherlands, this case study focussed on one of the local plants. In 2010, the plant started with its own continuous improvement program. Their own philosophy is “if you don’t get better, you get worse. Continuous improvement is not seen as an optional thing to do, it is something that should be in the DNA of the organisation.”¹.

The continuous improvement program was developed internally by the plant, with limited use of external consulting. The program is called world class manufacturing and uses lean as a backbone. However, the program also uses parts from six sigma and more recently theory of constraints has been applied to projects as well. The organisation has implemented a continuous improvement board that determines the priorities of possible improvement projects. The improvement projects are done by teams that are led by a greenbelt certified employee. More complex projects that require statistics are run by one of two blackbelt certified employees.

The program started with a basic course educating most operational employees on what continuous improvement is and the basic concepts of lean, 5S and total productive maintenance (TPM). After this course, an internal green-belt training was given to the lead operators. The program did not only focus on training, it was also applied within the factory. The most memorable fact for the interviewee was the beginning of the 5S-tool. Plant management decided to stop the production process, clean the factory, paint machines, removed unnecessary tools, parts, bins, etc. from the factory.

With proper training and waste being reduced theory of constraints is being applied to manage the bottleneck in the plant. Previously the machines were planned individually and the goal was to produce as much as possible per machine. With ToC, the focus is on product flow through the factory. The goal of ToC is to increase the total output of the plant without adding any new machines.

The program has a strong focus on securing each step. New projects are not approved until the current projects are secured properly within the organisation. The disadvantage of this method is the extended timing in completing projects in process. For some of the employees the pace of implementation seems to be too slow, but by securing each step they are trying to ensure that changes that are made become a part of the organisations DNA.

The renewal stage scored highest in the LCS questionnaire. The plant is small, but it can use resources provided by the global organisation. For example, it uses the SAP system from the group, which helps to allow complicated information processing and complex control systems. The way of implementing continuous improvement in the factory shows that the local management has enough freedom to make most decisions, this fits into the renewal stage as well.

¹ Paraphrased from case 5 interview

Table 13: Life cycle stage questionnaire results company 5

LCS	Score
1. Existence	7
2. Survival	13
3. Success	15
4. Renewal	18
5. Decline	8

5.1.7. Case 6

Implemented method: Lean, six sigma

Successful implementation: Yes

Lifecycle stage: Renewal stage

Company six is a large organisation in the raw material industry. It is part of a global conglomerate that has products and services in many different areas. The lean six sigma continuous improvement system was first introduced around 1995, while the organisation was still a part of a different company. The implementation started when lean six sigma was a hype and many production organisation were implementing the method. Employees without a current project or spare time were sent to internal green and black belt courses. The main problem was that they did not put the lessons to practice. Later, the management changed this and sent only motivated employees to the course and supported the lean six sigma programme. This made a big difference.

The business excellence department is responsible for continuous improvement coordination. Here the focus is on three areas: continuous improvement, projects, and auditing internal and external procedures and management systems.

The interviewee stated that to successfully implement the system there were several requirements like: to know the processes, control the processes, know the organisation's capabilities and the customer's requirements. An organisation can only make a good product if it knows what it can produce and what their customer expects.

The goals of the continuous improvement programme were: first time right and removal of waste. This is put into practice by standardising tasks. It is expected that employees follow the standards, but there is space to improve the standards. If employees have good ideas they can discuss these and if approved, they can test their ideas. The organisation has a conformation process in place as well. This process is applied to see if the operators work in accordance with the standards. This process is also applied in cases something goes wrong, to check if standard requirements failed. If standards were duly followed they continue with the deeper investigation of the process to find the error. The conformation process is applied to remove variation from the system.

Failing to follow standards does not result in punishment, but is used as an experience to learn from. The organisation shares the findings on mistakes or safety issues. The information sharing is organised on a global level, so the employees of every branch could learn from what has happened or was found.

The interviewee confirms that the implementation of lean six sigma is successful. He describes management support as the most important factor for this success, 'without management support you can try all you want, but it won't help'².

The lifecycle stage result from the questionnaire shows that case 6 is in the renewal phase, followed very closely by the success stage.

² Paraphrased from case 6 interview

Table 14: Life cycle stage questionnaire results company 6

LCS	Score
1. Existence	10
2. Survival	13
3. Success	14
4. Renewal	15
5. Decline	10

5.1.8. Case 7

Implemented method: Lean

Successful implementation: Yes

Lifecycle stage: Survival stage

Company 7 is an industrial production organization specialized in semi-finished product for different industries. The company has a long history and currently focusses on five different branches. The interviewee is QC manager for one of these branches.

Continuous improvement was not an important aspect in the operational department for a long time. This has changed in the last three years due to a management change. The operational department uses the lean and six sigma method for change projects. Although there is no official continuous improvement program, the organisation is systematically improving operations and is aware of current and future projects. They stick to this way of working because the operational managers accept the fact that they cannot do everything at once. While most internal projects are run by using 5S and/or DMAIC methods, small projects are done by simply applying basic knowledge and 'just doing it'. The organisation has recently hired an external firm that uses fault tree modelling. This method is currently being applied to two areas where the production has high failure cost.

Continuous improvement is driven largely from financial targets that are set in conjecture with upper management. The operations department is then given a large amount of freedom on determining how these goals will be reached. The choice for lean and six sigma methods is due to experience of members of the operational team with these methods, and not from a top management decision.

With the change in management and by applying continuous improvement methods, the organisation is now admitting the added value of well-educated operators. Improvements are made by consulting with the operators. Knowledge of machines and processes is gathered from senior operators. This knowledge is thought to junior operators in training courses. Such training help to understand the processes and the effects that the operators can have on the final product.

The organisation finds their continuous improvement implementation successful. They see it as a requirement to future improvements and competitive advantage.

The LCS questionnaire shows that the organisation is in the survival stage and scored almost as high in the success stage. Criteria that match the organisation are the change in management, where the company has changed from many owners to just a few. The information processing that is mostly focussed on monitoring performance matches the success stage criteria as well.

Table 15: Life cycle stage questionnaire results company 7

LCS	Score
1. Existence	9
2. Survival	15
3. Success	14
4. Renewal	11
5. Decline	5

5.1.9. Case 8

Implemented method: ISO 9000
Successful implementation: Yes
Lifecycle stage: Decline stage

Company eight is a modern company in the agriculture sector. In the last decade, the organisation has grown substantially year-over-year and developed from a local firm with one production location, to a global firm with locations on multiple continents.

The organisation has not implemented ISO 9001, but it used a sector specific method named MPS. MPS resembles ISO 9001, but does not contain any obligation to have a continuous improvement system in the organisation. The organisation does not have a heavily documented continuous improvement system in place, but focusses a lot on continuous improvement of processes and machines and practices a continuous improvement system that resembles lean. Improvement recommendations are free to be introduced by any employee in the firm and are encouraged by management.

Continuous improvement has had a strong focus on process automation and the organisation is considered as a leader in automation in their specific sector. The result of automation process is that the organisation looks rather like a traditional production company than an agricultural firm. The weather seasons will remain, the most important influencing factor for the agricultural production process and limits production in The Netherlands to seven months per year.

There is no structure around continuous improvement but over the last years it has come more naturally, as the interviewee described it. Due to the company growth, part of management does realise that this “natural” way of improving is something that could disappear easily and sees the added value of systematically implementing a CI-method.

In the LCS questionnaire, the decline stage scored the highest. This seems contradictive to the high growth that the organisation has experienced over the last years. The organisation is owned by a single shareholder that does not have a clear vision on the future of the organisation and is not sure if he wants the organisation to grow any further. The reason for growth is described as fully market driven, there ‘happened’ to be a growing demand for the product they produce.

Table 16: Life cycle stage questionnaire results company 8

LCS	Score
1. Existence	15
2. Survival	13
3. Success	12
4. Renewal	12
5. Decline	16

5.2. Expert interviews

Three experts were interviewed on their thoughts of continuous improvement and the ability to successfully implement a specific method in a lifecycle stage. Two of the interviewees have actively implemented lean, six sigma and/or ISO 9000 in production organisations. The third interviewee has researched lean and continuous improvement extensively. The two method experts both work for the same organisation that is active in the graphic industry. Experts in different methods and active in different sectors were contacted, but eventually none were available for this research.

5.2.1. Lean and Six Sigma expert

The interviewee works as a consultant in the graphic industry and helps companies to implement lean and six sigma methods. He also has experience in implementing the ISO 9001 adaptation to the graphic industry.

The interviewee believes that support from a core team is the single most important factor to implement any continuous improvement method. This core team should have a member from the board of directors. The organisation needs a deep intrinsic motivation to successfully apply any continuous improvement method in the way that they were designed to be. The interviewee specifically mentioned that there is a gap between applying the methods in the way they were designed and applying the methods simply to receive certification.

The interviewee thinks that the foundations of any CI-method can be implemented in all life cycle stages. For the expert, the basics of all CI-methods are 80% equal, but differ in the last 20%. For example, ISO is focussed on securing processes and lean is focussed on removing obstacles. Organisations in the existence phase can be limited in applying the administrative side of ISO but an organisation can benefit from the structure that is in the foundation of the method.

5.2.2. ISO 9001 expert

The second expert helped to develop a standard similar to ISO 9001 for the graphic industry. After several years this standard was replaced with the original form ISO 9001, a project in which the interviewee contributed as well.

The graphic industry contains many small business with around 50 to 80 employees. In the Netherlands, there are only a few plants with more than 250 employees. These smaller organisations often do not have enough staff to implement ISO 9001. The expert and his company provide advice and practical solutions to implement ISO programs.

According to the interviewee organisations need to fulfil three requirements to implement ISO 9000.

1. Motivation - organisations must have the motivation to implement any kind of system, or it will never happen;
2. Time - organisations need to take their time to implement a system. When the economy is in a recession or when a company is too busy to focus on making changes, they will not create time to implement a system;
3. Knowledge - organisations do not always have the knowledge on how to implement a system.

According to the interviewee in the 1990's the graphic sector signed a covenant that required all organisations to be ISO 9001 certified. The interviewee helped to develop an adaptation of ISO 9000 that could be implemented by organisations of all sizes and ages that worked well within sector. With this knowledge, it is possible that ISO 9000 has been successfully implemented within organisations in the graphic sector that are in all different stages of LCS.

5.2.3. Overall expert

The overall expert is a professor in supply chain management and specializes in researches on how lean can be implemented in small and medium-sized enterprises.

According to the interviewee an organisation that is exclusively in the existence phase will not apply or implement any continuous improvement method. The focus of the entrepreneur is on discovering the goal of the organisation. For organisations such as company 3 it is possible to implement CI-methods. This is not a young entrepreneurial organisation, but an existing stable company that is trying to find its entrepreneurial spirit. In doing so the goal of the company would be to not end up in the decline phase.

Implementing CI in the survival stage would also be very difficult according to the expert. With the growth of the company the focus is neither on cost reduction nor efficiency.

The interviewee states that he sees a successful and correct implementation of any method very rarely. Most companies have checks on a financial level, but very few systems are in place outside of the financial departments. DMAIC is a tool from Six sigma that is used, but the statistical side of six sigma is very rarely applied. The interviewee thinks it is too complicated for most organisation, as they struggle to gather the required data. Many organisations that state to use lean alone apply some of the tools, but miss the management philosophy with which it was created. The goals of CI-method implementation should not be a cost reduction. When applying the methods as designed, cost reduction should be a result.

To successfully implement continuous improvement the interviewee suggests to start mapping the processes in the organisation, as ISO 9000 requires. Mapping helps to structure the organisation itself, which is a big improvement. The next step would be securing a control cycle, such as plan-do-check-act of DMAIC and use it to learn.

When discussing business process reengineering the interviewee notes that he has not heard anything about it in a long time. The method was designed to solve a problem, but more than 20 years later this problem still has not been solved. Implementing and applying BPR is simply too complicated. According to the interviewee theory of constraints is also rarely applied. ToC does not have any added value for organisations, especially in combination with lean.

5.3. Analysis of results

To analyse the results from the cases and expert interviews, the cases were entered in to the matrix from section 3.1 which shows which CI-method can be successfully implemented in each life cycle stage according to the hypotheses from this research. The results are set in Table 17.

Table 17: Matrix of results

CI-Method / Lifecycle stage	1. Existence	2. Survival	3. Success	4. Renewal	5. Decline
ISO 9000		C4 ●	C4 ●		C1 ● C8 ●
Lean	C3 ●	C4 ● C7 ●	C2 ● C4 ●	C2 ● C5 ● C6 ●	
Six Sigma	C3 ●	C4 ●	C4 ●	C5 ● C6 ●	
Theory of Constraints				C5 ●	
Business process reengineering					

Hypothesis - Implementation not successful

Hypothesis - Implementation neutral results

Hypothesis - Implementation successful

C# ● - Implementation from case not successful

C# ● - Implementation from case neutral results

C# ● - Implementation from case successful

During this research, not all hypotheses could have been tested, leaving mostly the negative hypotheses without clear result. Of the hypotheses that could be tested the table shows mixed results. Part of the hypotheses is that expected successful implementation results are confirmed. There are also results where an unsuccessful implementation was expected and yet the results seem to be the opposite.

5.3.1. Analysis of existence phase

The matrix shows that the third company was able to successfully implement lean and six sigma while the hypotheses state the opposite for both methods. The results do match the statement of the overall expert where an existing organisation is finding its entrepreneurial spirit again. Case 3 scored high for both success and renewal phase, both phases have positive hypotheses for the successful implementation of lean and six sigma.

5.3.2. Analysis of survival phase

Case 4 and 7 are both in the survival phase. Case 4 has successfully implemented ISO 9000 within its organisation but does not use it for their continuous improvement program. Lean and six sigma tools are used for their CI program which is implemented successfully. Six sigma is implemented successfully while the hypothesis is negative. In this case, it is important to note that case 4 scored equally for the survival and success stage, where the outcome does match the hypothesis. Case 4 also scored very high for the renewal stage where the hypothesis for implementing six sigma is also positive.

The implementation of lean by case 7 matches the hypothesis exactly.

5.3.3. Analysis of success phase

In the success phase, most results match exactly with the hypotheses. Unsuccessful implementation of theory of constraints was found in the success phase. Company 4 was aware of how theory of constraints works, but said that it did not apply it in their organisation as it had no added value compared to lean.

5.3.4. Analysis of renewal phase

In the renewal phase most results match with the successful implementation hypotheses. Company 5 used theory of constraints as well, but it had a very limited scope. This is also the reason why the implementation is marked with neutral results. Company 5 also applies lean and six sigma which both have a much larger impact on the organisation.

5.3.5. Analysis of decline phase

The decline phase shows two cases both of which have implemented ISO 9000. Case 8 has a positive implementation while case 1 has a negative implementation.

The result of case 1 matches with the hypothesis. While the organisation is ISO 9001 certified, they struggle to apply any type of continuous improvement in the organisation.

Company 8 is continuously busy with improving their organisation and production. The organisation does not have a fixed methodology to follow and their adapted version of ISO 9000 does not require this.

No cases were found where companies implemented the business process reengineering method in the organisations. The overall expert said that he has not seen much of this method for a long time.

6. Conclusion

This chapter contains the conclusion of the conducted research that was performed and answers to the research question. The end of the chapter contains the limitations of the research and recommendations for future research.

6.1. Answers to hypotheses

The purpose of this research was to answer the following question:

“How does the life cycle stage a production organization is in influence the rate of success of continuous improvement method implementations?”

The hypotheses below were developed and tested to answer this question.

Existence stage

H1. Organisations in the existence stage do not benefit from implementing any CI-method

This hypothesis was written on the belief that the chaos that is part of the existence phase would not permit to implement any type of CI-method. One of the examined cases represented an organisation which meets the criteria of the existence stage and successfully implemented lean. The organisation also measured strong in other life cycle stages where it is expected that organisations can successfully implement lean. The hypothesis states that no organisations can benefit from any CI-method, as one case was found in the existence phase this hypothesis is rejected.

Survival stage

In the survival stage, it was reasoned that the structure of ISO 9000 would help organisations to continue to meet customer requirements and that the waste reduction focus of lean would help to profit margins.

H2A. For organisations in the survival stage the benefits of implementing lean outweigh the costs.

Two examined cases in the survival stage successfully implemented lean in their organisations. Company four implemented lean in all plants worldwide and applied continuous improvement in all departments of the organisation. Company seven is starting to see the benefits of lean, and will continue to apply the method in the future. This hypothesis is confirmed.

H2B. For organisations in the survival stage the benefits of implementing ISO 9000 outweigh the costs.

Company four implemented ISO 9000 successfully in the survival stage but did not apply it for continuous improvement. Lean and six sigma were used to fulfil the continuous requirement of ISO 9004. As the organisation has implemented ISO 9000 and continues to use it the hypothesis is confirmed.

H2C. For organisations in the survival stage the benefits of implementing Six Sigma do not outweigh the costs.

Company four successfully implemented six sigma in the survival stage. This organisation scored equally for the survival and the success stage and applies lean. The organisation does benefit from the implementation of six sigma. This hypothesis is rejected.

H2D. For organisations in the survival stage the benefits of implementing business process reengineering do not outweigh the costs.

H2E. For organisations in the survival stage the benefits of implementing theory of constraints do not outweigh the costs.

No organisations were found that implemented business process reengineering or theory of constraints in the survival stage. With no data available these hypotheses cannot be confirmed or rejected.

Success stage

H3A. Organisations in the success stage benefit from implementing lean.

Companies two and four successfully implemented lean in the success stage. Company two is in the early stages of applying lean within one of the two factories and is seeing benefits of the method and will continue to apply it within the factory. This hypothesis is confirmed.

H3B. Organisations in the success stage benefit from implementing Six Sigma.

In the success stage organisations become more bureaucratic and have control systems in place. These characteristics were reasoned to be required to successfully implement six sigma. Company four successfully implemented six sigma in the success stage. This hypothesis is confirmed.

H3C. Organisations in the success stage benefit from implementing ISO 9000.

This hypothesis is the same situation as hypothesis H2B where company four has implemented ISO 9000. This hypothesis is confirmed.

H3D. Organisations in the success stage benefit from implementing theory of constraints.

H3E. For organisations in the success stage the benefits of implementing business process reengineering do not outweigh the costs.

No organisations were found that implemented business process reengineering or theory of constraints in the success stage. The reasoning behind the ToC hypothesis was that the method could help organisations to optimise product flow in the factory. Company four stated that theory of constraints would have no benefits within their lean six sigma program. Their program is already focussed on optimising product flow without using ToC. With no data available these hypotheses cannot be confirmed or rejected.

Renewal stage

H4A. Organisations in the renewal stage benefit from implementing lean.

Companies two, five and six are in the renewal stage and have successfully implemented lean as their continuous improvement method. Company five had visible improvements from lean as the factory was fully cleaned and looks as if it is new. The program has made operators eager to improve and take the next steps into further improve factory performance and the quality of their products. This hypothesis is confirmed.

H4B. Organisations in the renewal stage benefit from implementing six sigma.

Company five and six are in the renewal stage and have successfully implemented six sigma. Both organisations have applied the statistical parts of six sigma and measure output and defects extensively. This hypothesis is confirmed.

H4E. For organisations in the renewal stage the benefits of implementing theory of constraints do not outweigh the costs.

Company five applied theory of constraints in the renewal phase. The implementation has neutral results, but the organisation continues to use the method to reduce strain on the bottleneck in the factory. The entire management team has even read the book The Goal from Eli Goldratt on ToC. This hypothesis is rejected.

H4C. For organisations in the renewal stage the benefits of implementing ISO 9000 do not outweigh the costs.

H4D. For organisations in the renewal stage the benefits of implementing business process reengineering do not outweigh the costs.

No organisations were found that implemented ISO 9000 or business process reengineering in the renewal stage. With no data these hypotheses cannot be confirmed or denied.

Decline stage

H5B. For organisations in the decline stage the benefits of implementing ISO 9000 do not outweigh the costs.

Two cases have opposite outcomes for this hypothesis. Company one has not successfully implemented ISO, the organisation struggles to implement proper structures and is continuously changing the structures that are in place. Company eight has an adapted version of ISO 9000 and implements improvements that are suggested from the top and bottom levels in the organisation. As company eight has successfully implemented ISO 9000 and benefits from the method the hypothesis is rejected.

H5A. Organisations in the decline stage benefit from implementing business process reengineering.

H5C. For organisations in the decline stage the benefits of implementing lean do not outweigh the costs.

H5D. For organisations in the decline stage the benefits of implementing six sigma do not outweigh the costs.

H5E. For organisations in the decline stage the benefits of implementing theory of constraints do not outweigh the costs.

No organisations were found that implemented business process reengineering, lean, six sigma or theory of constraints in the decline stage. With no data available these hypotheses cannot be confirmed or rejected.

Table 18 shows a summary of the hypotheses outcomes.

Table 18: Summary of hypotheses results

CI-Method / Lifecycle stage	1. Existence	2. Survival	3. Success	4. Renewal	5. Decline
ISO 9000	N	C	C	N	R
Lean	R	C	C	C	N
Six Sigma	N	R	C	C	N
Theory of Constraints	N	N	N	R	N
Business process reengineering	N	N	N	N	N

Hypothesis "does not benefit"

Hypothesis neutral results

Hypothesis "benefits"

R = Hypothesis Rejected

N = Hypothesis not Confirmed nor Rejected

C = Hypothesis Confirmed

6.2. Answer to research question

Seven out of nine hypothesis reasoning that organisations would benefit from implementing a specific type of CI-method were confirmed. The other two can be neither confirmed nor denied. Four hypothesis were rejected where it was expected that the costs would not outweigh the benefits of implementing.

Despite the chaos being a characteristic feature of the existence stage, it is possible to benefit from CI-methods implementation at this stage, especially for organisations that have returned to the existence stage.

Organisations in the survival stage will benefit from successful implementations of ISO 9000, lean and six sigma. The DMAIC tool from six sigma can be especially beneficial for organisations. Other six sigma tools require organisations to have more complex information processing, which might not be available to organizations in the survival stage.

In the success stage the CI-methods ISO 9000, lean and six sigma will be an advantage if implemented successfully.

Implementing lean, six sigma and theory of constraints in the renewal stage is beneficial to production organisations. The cost of implementation will outweigh the associated costs.

In the decline stage implementing continuous improvement methods is possible, and yet difficult. Management commitment is a must for a successful implementation. The decline stage was the only stage where business process reengineering was reasoned to be beneficial for organisations. The production organisations that applied this method could not be found. The method is too complicated for the organisations to implement.

The main research question remains open.

“How does the life cycle stage a production organization is in influence the rate of success of continuous improvement method implementations?”

Four out of five continuous improvement methods were implemented successfully at life cycle stages in which the literature lead us to believe differently. Implementing any CI-method is a long-term project. One of the interviewees even stated that the implementation will never end, as continuous improvement never stops. So apparently, the life cycle stage an organisation is in will not have a negative influence on the implementation. Implementing lean successfully in the existence phase or ISO 9000 in the decline phase it is not impossible.

Implementing a CI-method in a matching LCS will have a positive influence as it will make it relatively easier to implement. If basic requirements for the implementation are already in place, an organisation will not have to waste any extra time, energy, or money on implementing these. If an organisation has a well implemented ERP system, complex data will automatically be gathered, data that is required for six sigma tools. If an organisation has become more departmental, there is a structure in place, that can be used for ISO 9000. Having these basic requirements in place will have a positive influence on the ability to successfully implement the chosen continuous improvement method. Organisations in the survival, success and renewal stage will have these basic requirements.

Successful implementation of continuous improvement is achievable for every organisation, despite the life cycle stage it is in. For successful implementation, an organisation must have started providing structure and having intrinsic motivation to make the implementation a success. For these organisations, ISO 9000 will achieve improvement by providing structure, the lean method will bring continual process improvements and six sigma will provide the tools for improvement projects.

6.3. Contribution to the theory

With this thesis, research was conducted to see if it is possible to determine which CI-method to implemented by determining in which LCS an organisation is in. Very limited research has been done into the field of how to determine which CI-method to choose. This research can help to find which factors within organisations help to determine whether a CI-method can be successfully implemented or not.

6.4. Limitations and further research

There are limitations to the research that was performed to write this master thesis. In the following paragraphs the most important ones are mentioned and recommendations are made for future research.

The research was conducted within a limited set of production companies within the Netherlands. Due to time restrictions, the sample could not be larger. The interviews were held with people who are personally involved with the implementations of continuous improvement within their organisations. The data that is received from them is biased and focussed on the success gained through the implementation. Each case is made up from data from a single person. Interviewing multiple people from the same organisation might result in a different outcome.

The interviews are a snapshot in time. As continuous improvement is an always ongoing process result over time may differ very much for each case.

The cases were sampled through personal contacts and therefore not fully at random. Finding production companies that said to use any type of continuous improvement methodology was difficult and time consuming. The research had a considerable amount of delay due to this.

The hypotheses that were developed can be further refined. In their current form, finding one case that does not match the hypothesis leads to rejection. My recommendation for future research is to change them to the following:

Organisations in the (insert LCS) can benefit from implementing (insert CI-method).

and

For organisations in the (insert LCS), the benefits of implementing (insert CI-method) will rarely outweigh the costs.

Using the life cycle stages by Lester *et al.* had advantages and disadvantages. The questionnaire that came with the research made it much easier to measure in which stage an organisation was in. The research was not known by any of the interviewees who in multiple cases referred to the stages from Greiner (Evolution and revolution as organizations grow, 1998). The questionnaire also required explanation, as respondents did not always understand the questions correctly.

Measuring if implementations are successful is difficult and based on whether goals of the implementation were met. There is not a simple indicator that can be measured to define success.

The four-phase model by Hardjono had limited value in gathering data. It helped to determine the hypotheses. Measuring in which phase an organisation is required a large investment of time for each case, thorough research into the history of the organisation and multiple interviews. For this research and the amount of cases used there was no time to use the four-phase model. The results from company three do appear to show that the organisation has gone full cycle and is returning to the External-Change phase, which matches with the existence phase from the life cycle stages. Future research can be conducted to discover if it is possible to implement continuous improvement methods in new organisations that are still in the External-Change phase.

The relevance of theory of constraints and business process reengineering in production organisations is up for debate. Much time has been spent to find more cases which applied these methods within production organisations, but such cases simply could not be found. In the business of software implementations, BPR seems to be used in an adapter form named business process modelling.

For future research, I would recommend to research whether continuous improvement methods are used in the way they were originally designed. Frequently methods such as ISO

9000 were mentioned to be used simply to gain certification. The statistic side of six sigma had limited applications in the cases in this research. The DMAIC tool is frequently used, the statistical side of six sigma was rarely applied. The methods show signs of degeneration by using some tools and have a strong focus on cost reduction, which should be a result and not a goal of successfully implementing continuous improvement.

Abbreviations

Abbreviation	Description
5FS	Five Focusing Steps
5S	Japanese workplace organisation method
BPR	Business Process Reengineering
CI	Continuous Improvement
DMAIC	Define, Measure, Analyse, Improve and Control
ISO	the International Organization for Standardization
LCS	Life cycle stage
MDRT	Mobilization, Diagnosis, Redesign, Transition
PDSA	Plan, Do, Study, Act
QMS	Quality management system
TOC	Theory of Constraints
TPM	Total productive maintenance

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Appendix A: Organizational life cycle

Copied from Lester *et al.* 2003

Respondents are asked to rate the following statements based on the scale of 1 to 5. (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree.

1. Our organization is small, both in size and relative to our competitors.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

2. As a firm, we are larger than most of our competitors, but not as large as we could be.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

3. We are a widely dispersed organization, with a board of directors and shareholders.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

4. The seat of power in our firm is primarily in the hands of the founder.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

5. Power in our firm is spread among a group of several owners/investors.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

6. Power in our firm is concentrated in our vast number of shareholders.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

7. Our firm's organizational structure could best be described as simple.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

8. Our structure is department-based and functional, becoming much more formal.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

9. Structure in our firm is divisional or matrix in nature, with highly sophisticated control systems.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

10. Our structure is centralized with few control systems.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

11. In our organization, we have some specialization (accountants and possibly engineers, e.g.) and we are becoming somewhat differentiated.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

12. Information processing could best be described as simple, mostly word-of-mouth.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

13. Information processing is best described as monitoring performance and facilitating communication between departments.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

14. Information processing is sophisticated and necessary for efficient production and earning adequate profits.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

15. Information processing is very complex, used for coordination of diverse activities to better serve markets.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

16. Information processing is not very sophisticated, but badly needed.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

17. Decision-making is centralized at the top of the organization and considered to be not very complex.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

18. Most decisions in our firm are made by a group of managers who utilize some systematic analyses, but who are still fairly bold.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

19. Most decisions in our firm are made by managers, task forces, and project teams who are trying to facilitate growth through participation.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

20. Most decisions in our firm are made by a few managers who take a conservative, internally political approach.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="checkbox"/>				

Appendix B: Interview participation information sheet

Note: To be adapted to each specific interviewee

About me:

This research is conducted by Paul Jones. I am a Part-time Master student at the Rotterdam School of Management, Erasmus University. During the day I work full time as a business analyst for Inashco, a global company that retrieves metals from waste-to-energy ashes. I have a strong interest in processes improvement and continuous improvement methods, such as lean, six sigma and theory of constraints.

Summary or research:

My master thesis idea started with a question from my CFO on how an organization should select a continuous improvement method (set). I am researching if there is a relationship between which life cycle stage an organization is in (from the research of Lester, Parnell and Carraher, 2003) and the organization being able to successfully implement a specific set of CI-methods.

Goal of interview:

The goal of the interview is to gain insight in how successful your organization is in implementing your selected continuous improvement method. I would like to learn why this specific CI-method was selected, about the choices behind the implementation and whether the organization has met the goals of the implementation.

Required data:

I wish to gather the following data:

- Which life cycle stage was your organization in when starting to implement your selected continuous improvement method? These data are gathered by filling in a short 20 question multiple choice questionnaire before the interview is conducted.
- Which continuous improvement methods have been implemented and why?
- What were the goals of the implementation, how this was measured and to which extent have these goals been met?

Required time:

The questionnaire will take approximately 5 minutes to fill in. The interview that follows will take between an hour and an hour and a half. After the interview some follow-up questions could follow by phone or e-mail to clarify specific subjects.

How data are processed:

This interview is used as one case in a multiple case study.

Your name and data will be shared with my supervisor and co-reader from the RSM. In the final thesis, personal data and organizations are made anonymous. It is important to note that the thesis will be made publically available.

While conducting the interview:

If allowed, the interview will be recorded as an audio file. This will allow me to focus on the conversation and later write a full transcript of the interview. You as a participant will receive a copy of the transcript and will be allowed to revise the transcript to leave out sensitive information, if any.