TWO STRANDS MODEL OF THE SOFT SYSTEMS IN ACTION:
THE CASE OF AN SME IN AUTOMOTIVE COMPONENT
AND DEFENSE INDUSTRY

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ABSTRACT

TWO STRANDS MODEL OF THE SOFT SYSTEMS IN ACTION:
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AND DEFENSE INDUSTRY

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Small and Medium Sized Enterprises (SMEs) have significant value for the economy as being a source of employment opportunities and creating a large portion of the total added value. Guiding them to solve their problems or improving their work processes is beneficial for both parties as researchers gain real-world experiences. This thesis aims to improve an SME's work processes by adopting the Two Strands Model of Soft Systems Methodology. This model is a more practical and iterative approach than Mode 1 that it considers social, cultural and political sides of the problem situation. The study was conducted by interviewing the employees, partners and the owner of the SME; observing the SME's daily flux and collecting the necessary documents provided by the SME. As found in the literature, there are only three journal papers that fully apply Two Strands Model on real cases and they all published as original papers. This thesis is the first study that applies the Two Strands Model to the automotive component industry and also the defense industry. Since there is not any paper found in the literature that applies that methodology to an SME, another significance of this thesis is that it collaborates with an SME. Therefore, it is believed that this thesis provides valuable insight by filling a gap about SMEs that operates in important sectors. The findings of the thesis ensured beneficial suggestions to the SMEs and some of the suggestions already applied and developments in the work processes achieved.

Keywords: Automotive Component Industry, Defense Industry, SME, Two Strands Model of Soft Systems Methodology

ÖZ

İKİ PARÇALI YUMUŞAK SİSTEMLER METODOLOJİSİNİN OTOMOTİV PARÇA VE SAVUNMA SANAYİİ SEKTÖRÜNDE FAALİYET GÖSTEREN BİR KOBİYE UYGULANMASI

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Küçük ve Orta Büyüklükteki İşletmeler (KOBİ) yarattıkları istihdam ve toplam katma değere olan katkıları nedeniyle ekonomi açısından oldukça önemli bir yere sahiptirler. KOBİ'lerin problemlerinin çözümünde yardımcı olmak ve iş süreçlerini daha verimli bir hale getirmek hem gerçek vakaları inceleme şansı bulan araştırmacılar açısından hem de daha başarılı hale gelen KOBİ'ler açısından fayda sağlamaktadır. Bu tez, İki Parçalı Yumuşak Sistemler Metodolojisi'ni uygulayarak otomotiv parça ve savunma sanayii sektöründe faaliyet gösteren bir KOBİ'nin iş süreçlerini iyileştirmeyi amaçlamaktadır. Bu metot, Mod 1'e göre daha pratik ve tekrarlanan bir yaklaşım olarak kabul edilmekte ve problem durumun kurum içerisinde sosyal, kültürel ve politik açılardan değerlendirilmesine olanak sağlamaktadır. Çalışma verileri şirket çalışanlarıyla, partnerleriyle ve sahibiyle yapılan görüşmelerle; şirketin günlük iş akışının gözlemlenmesiyle ve gerek görülen belgelerin şirket tarafından sağlanması ile elde edilmiştir. Literatürde bulunabildiği kadarıyla, bu yöntemi tamamen uygulayan ve orijinal çalışmalar olarak yayınlanmış 3 adet makale bulunmaktadır. Bu çalışma bulunabildiği kadarıyla belirtilen sektörlerde İki Parçalı YSM'nin ilk uygulamasıdır. Aynı zamanda literatürde bulunabildiği kadarıyla metodu bir KOBİ'ye uygulayan çalışmaya da rastlanmaması dolayısıyla bu alanda da ilk çalışma olmuştur. Uygulandığı sektör ve firma açısından doldurduğu bu boşluklar göz önüne alındığında çalışmanın literatüre önemli bir katkısı olacağına inanılmaktadır. Çalışmanın bulguları şirketin iyileşmesi için önemli öneriler içermektedir ve bazı öneriler şirket tarafından hayata geçirilerek daha başarılı iş süreçleri elde edilmiştir.

Anahtar Sözcükler: KOBİ, Otomotiv Parça Sektörü, Savunma Sanayii Sektörü, İki Parçalı Yumuşak Sistemler Metodolojisi

To My Family

ACKNOWLEDGEMENTS

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LIST OF ABBREVIATIONS

3E'S	Efficacy, Efficiency, Effectiveness
CWM	Chief Workshop Manager
EPM	Electronics and Project Manager
FCM	Final Control Manager
GM	General Manager
HAS	Human Activity System
HRD	Human Resources Department
IQM	Incoming Quality Manager
OHB	Organization Hand Book
PM	Purchasing Manager
PPM	Production and Planning Manager
QCM	Quality Control Manager
QMS	Quality Management System
QSM	Quality System Manager
SME	Small and Medium Sized Enterprise
SSM	Soft Systems Management

CHAPTER 1

INTRODUCTION

1.1   Introduction

Small and Medium Sized Enterprises (SMEs) have significant value for the economy as being a source of employment opportunities and creating a large portion of the total added value. Guiding them to solve their problems or improving their work processes is beneficial for both parties as researchers gain real-world experiences. This thesis aims to improve an SME's work processes by adopting the Two Strands Model of Soft Systems Methodology.

In real life, problems are not as simple and well-structured as in mathematical questions. Most of the time, it is not even possible to clearly define the problems. Especially in profit-making organizations, there are many variables such as relationships between employees, government rules or the qualifications of top managers that might affect the problem or even become a problem itself. While the problems are getting more complicated and detailed in business life, Soft System Methodology (SSM) is an alternative way to define the problem situations and offer a solution to those intricate and multidimensional problems.

SSM emerged in the 1960s and its founder Checkland has continued to refine it in time. First, he introduced the methodology as a nine-stage process (Checkland, 1972) and then convert it to a seven-stage approach (Checkland, 1981). This seven-step learning process is considered as Mode 1 SSM. In continuous years, Two Strands Model of SSM has developed and first appeared in *Soft Systems Methodology in Action* (Checkland & Scholes, 1990).

Soft Systems Methodology is an applied methodology based on a holistic approach. Holistic means the whole is bigger than the combination of parts. Holistic view claims that the characteristics of the whole are different than its separate parts. In a similar way, Human Activity Systems (HAS) states that a person has different roles and reactions when he/she investigated alone or in a group. It claims that when the whole is broken

down into pieces, there are always some missing points about the whole (Kurbanoğlu, 1993, p. 90).

The use of SSM has become widespread in 1988. However, the application of SSM in different context revealed the limitations of Checkland's methodology. Checkland always emphasized the importance of learning in his methodology, but following the certain steps of SSM Mode 1 was limiting the learning process. The seven-step process was intervening in the system instead of interacting with it. Rather than internalizing the methodology in everyday tasks, applying it has become a separate task for the organizations.

To overcome those issues, a new version of SSM called "two strands model" has been developed and published in *Systems in Action* book that written by Checkland and Scholes (1990). This version of the SSM includes a cultural stream analysis different than the Mode 1.

Every SSM application aims to be an organized process of learning. With this learning aim, each SSM use becomes a research. Checkland has conducted many different projects and benefits from those real-world cases to develop SSM. SSM has developed in time by Checkland' work and mature now. However, each use of SSM differs and never follows the exact same way. Each new application entails learning and can be considered as a research. (Checkland & Poulter, 2006, p.175)

1.2 Purpose Statement and Research Questions

The purpose of this study is to determine the necessary changes to improve work processes in an SME that operates in defense and automotive sector. Suggested changes are identified by applying Two Strands Model of SSM. Those steps include the stream of cultural analysis of the SME which consists of three analyses named intervention (role) analysis, social analysis, and political analysis; the stream of logic-based enquiry; determining, listing and selection of relevant systems; naming and modeling relevant systems; comparing models with real world and finally giving suggestions to the SME in order to improve its work processes.

The study was mainly conducted by interviewing the employees, partners and the owner of the SME. Open-ended questions have been used in order to spark conversations with the interviewees. Besides, SME's daily flux has observed by spending time in the company and the necessary documents are provided by the SME. In order to ensure that the study runs smoothly, the collaboration and the willingness of the employees and the owner of the SME were essential. From the actual words of the employees, this analysis made employees think what they are doing in the organization and how they are doing their duties. This thinking provided them a deeper understanding of the real situation of the organization and shows the real causes of problematic situations. The study

identified the required changes to improve the work processes of the organization. However, achievement of these changes is not included in the scope of this study.

1.3 The Significance of the Study

There are different aspects of this study that assign importance to it. Firstly, as found in the literature there are only three journal papers that fully apply Two Strands Model of SSM for real-life cases and they are all published as original papers. This thesis is the first study that applies the Two Strands Model of SSM to the automotive component industry and also the defense industry. Since there is not any paper found in the literature that applies that methodology to an SME, another significance of this thesis is that it collaborates with an SME. Therefore, it is believed that this thesis provides valuable insight by filling a gap about SMEs that operate in important sectors. The findings of the thesis ensured beneficial suggestions to the SMEs and some of the suggestions already applied and developments in the work processes are achieved.

Small and Medium Sized Enterprises (SMEs) have significant value for the economy as being a source of employment opportunities and creating a large portion of the total added value. Guiding them to solve their problems or improving their work processes is beneficial for both parties as researchers gain real-world experiences. The study also gives the company a chance to get a deeper knowledge of itself and make the employees realize their duties and place in the organization. Since most of the SME's do not have the institutionalized environment and keep the paperwork at a minimum, this documented study provides a useful guide to improve themselves.

1.4 Structure of the Thesis

This thesis consists of five main chapters as shown in Figure 1. Chapter 1, called introduction, indicates the aim and the significance of the study, explains the research question and shows the structure of the thesis. Chapter 2, called research methodology, explains the SSM Mode 1 and then Two Strands version of SSM as the method of the study. Besides, this chapter explains why Two Strands Model is preferred rather than Mode 1. Chapter 3, called literature review, presents the literature review on the Two Strands Model of SSM applications and SSM Mode 1 applications and summarizes some of the papers. Chapter 4, called empirical findings: two strands model of SSM for work processes, constitutes the empirical part of the study and explains step by step how the Two Strands Model of SSM is applied to the SME. Finally, Chapter 5, called conclusion, includes the discussion of the findings, contribution to learning, limitations and constraints, practical implications and future research.

Chapter 2 • Research Methodology

Chapter 4 • Empirical Findings - Case Study

• Introduction

Chapter 1

• Literature Review

Chapter 3

• Conclusion
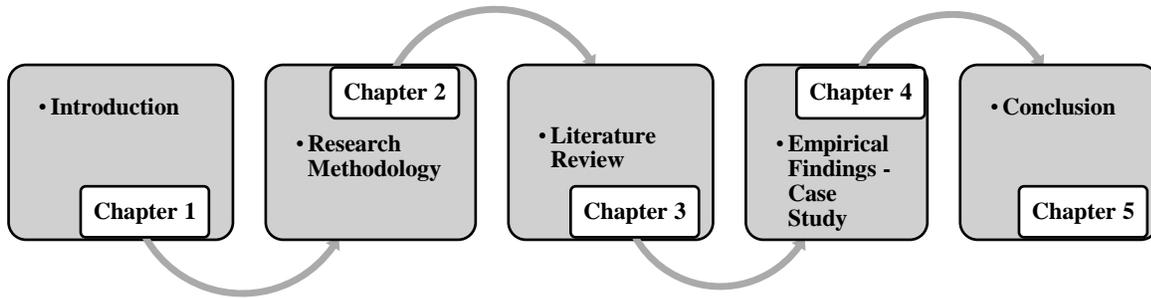
Chapter 5

Figure 1: Structure of the Thesis

CHAPTER 2

RESEARCH METHODOLOGY

In real life, problems are not as simple and well-structured as in mathematical questions. Most of the time, it is not even possible to clearly define the problems. Especially in profit-making organizations, there are many variables such as relationships between employees, government rules or the qualifications of top managers that might affect the problem or even become a problem itself. While the problems are getting more complicated and detailed in business life, Soft System Methodology is an alternative way to define the problem situations and offer a solution to those intricate and multidimensional problems. In this thesis, the Two Strand Model of SSM is applied to a Small and Medium Sized Enterprise (SME) in order to define its problem situations and suggest possible solutions to them.

2.1   System Definition

A systems can be defined as a "*recognizable whole which consists of a number of parts (components, elements) that are connected up in an organized way (the systems structure)*" (Waring, 2005, p. 21). These components of the system interact with each other. There are some certain characteristics of a system in order to be accepted as a complete system definition. Some of these characteristics are: a system processes inputs to create outputs, means a system does something. A system is owned by someone and has a boundary. Outside of this boundary creates the system environment and system is affected by that environment. Inclusion or extraction of a component changes the system.

Determining the system environment is significant because it sets the boundary between the inside of the system and the outside of the system. There is not a certain method of setting this boundary. It might change according to the analyst's view. However, it can be said that if something is affecting the system and the system cannot control it, this thing belongs to the system environment.

Hierarchy of the components in the system should also be determined. This helps the analyst to understand which components subordinate the others. To understand how a system works, authority, time order or sequence between the components is required.

Having full knowledge of the system components'' hierarchy, how these components interact with other and the system environment gives the ability to predict and control of the system. Prediction and control affect the survival of the system when the things go wrong. If the structure of the system is known, the circumstances of the adverse conditions can be predicted.

Another important concept of the system is world-view (Weltanschauung). World-view represents the perceptions, attitudes, beliefs, values, assumptions and motivations of people either as an individual or in a group. Finding out the systems' key element's world-view is essential as they directly affect how the system behaves. Before striving for a change in the system, world-views must be understood. Besides, the analyst should be aware of his/her own world-view and how it affects the analysis.

2.2   System Approach

Seeking solutions for current (modern) complex problems highlights the system approach due to its advantage of investigating the problems with various aspects. That ended up with a need for a methodology based on system approach. System approach is not a methodology; it is a way of approaching the problem. A methodology is conducting a research not randomly; doing it in a certain and step by step way (Kurbanoğlu, 1993, p. 90).

System approach sees the organizations as a whole that consists of different components such as employees, machines, and resources etc. that come together for a specific purpose. These components are tied with each other with communication and decision making processes to achieve organizational goals. System approach provides flexibility to the organizations to investigate and manage its processes inclusively.

Problems in today's world are so complicated that even finding the starting point to solve them is an issue itself. It has become very hard to detect cause and effect relations in the systems. System thinking offers a wide view on this complex environment with a focus on problem's different parts. Elements of the system are related to each other. Importance or the ranking of these relationships depends on the working process of the system. These relationships gather the small parts and form a whole. At that point, the system represents a whole that consists of inseparable parts (Tecim, 2004, p. 79).

2.3 Soft and Hard Systems

During the system methodologies development phase, the first step was determined as the formulation of the problem or the aim. However, if a problem or methodology's aim or starting point can be identified clearly, they called as "hard" problems or methodologies. According to Checkland (1972), this is the main difference between hard and soft problems. Defining the aim or the result of the problems is part of the soft problems. Soft word is used for the problems that cannot be defined clearly or perceived differently by different people.

Wilson (1990) explains the different aspects of hard and soft systems with two examples. The first one is a flat tire example, which has a very obvious solution to solve it. Both the problem and its solution are clear and can be solved easily. That's why it is an example of hard problems. The second example is England's solution to North Ireland problem. In this problem, the problem-solving steps are not clear and it is very hard to please both parties. Wilson emphasizes that hard system methodologies fit with the solution of flat tire example and not sufficient for the solution of soft problems.
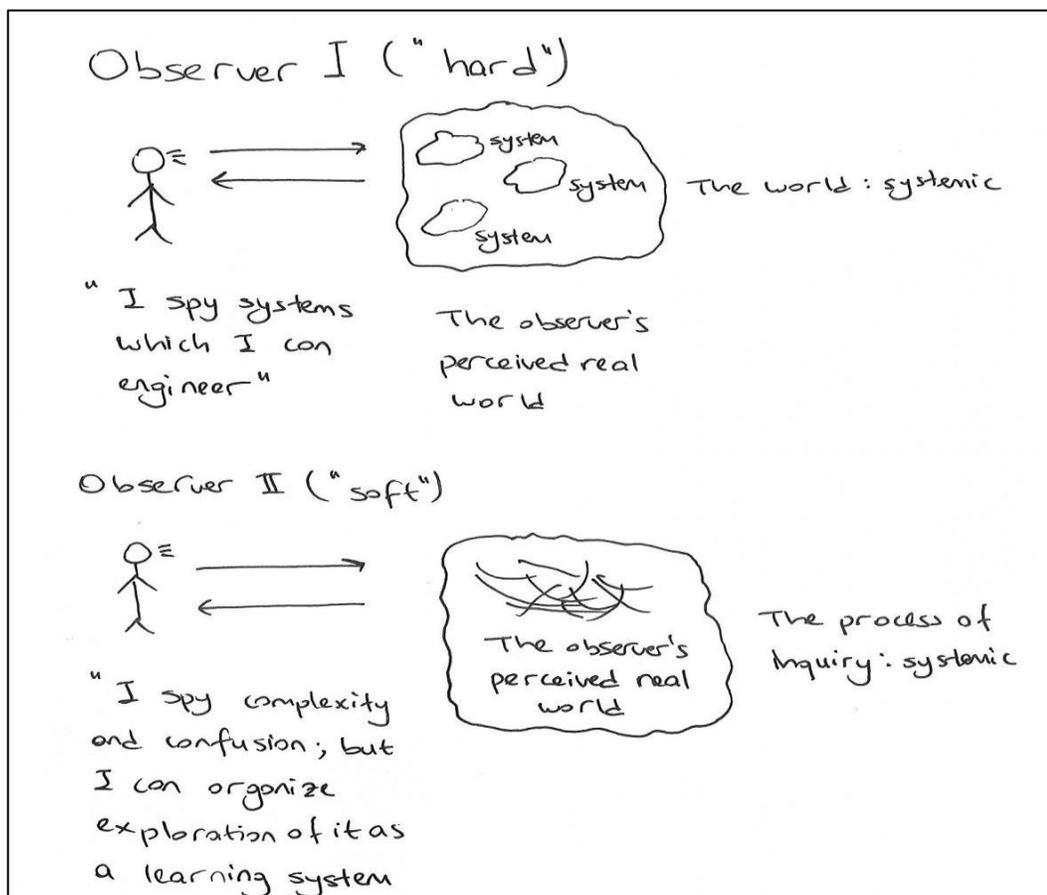
Figure 2: Difference between Hard and Soft Perception (Checkland, 2000, p. 18)

Figure 2, visualizes the distinction between hard and soft perceptions. Hard system observer observes a systemic world that he can clearly understand its real-world and break it into different systems. Then, he can engineer the system. However, the soft observer is in a much more complex environment which he can't even clearly define the real world. He can organize the exploration of it as a learning system.

Table 1: Difference between Hard and Soft System Approaches (partially taken from Pan, Valerdi, & Kang, 2013, p. 1029)

	Hard system approaches	Soft system approach
Objective system	Hard/well defined problem	Soft/ill-structured problem
Assumption of observed system	Systematic world	Metaphor/systemic mind
Problem solving style	End-means	Participation/debate/reform
Process goal	Optimization/satisfaction	Learning/satisfying
Acting focus	Goal-oriented	Process-oriented

Table 1 summarizes the differences between hard and soft system approaches. As explained previously hard systems deal with well-defined problems while soft system deal with ill-structured problems. Their problem definition and solution methods are shaped by that main difference.

2.4 Soft System Methodology

SSM emerged in the 1960s and its developer Checkland (1972,1981, 1982, 1983, 1987, 2000, 2001) has continued to refine it in time. First, he introduced the methodology as a nine-stage process (Checkland, 1972) and then convert it to a seven-stage approach (Checkland, 1981). This seven-step learning process is considered as Mode 1 SSM. In continuous years, Two Strands Model of SSM has developed and first appeared in *Soft Systems Methodology in Action* (Checkland & Scholes, 1990).

2.4.1 The Theory Behind SSM

Checkland believes that there are always 'sensible' ideas behind any intentional action and those ideas lead the action taker to constitute a theory which justifies his/her action. According to him, whenever we take a deliberate action, we are all theoreticians even though we do not clearly voice the ideas in question. Keynes, one of the most influential economists in the 20th century, remarks that, when he talks with business people, they mostly introduce themselves as down to earth people who have no time for airy-fairy economic theories. He replies those people by saying they usually turn out to be the prisoners of some out of date theory from many years ago. This little example shows that practice and theory are always linked; all theories are provisional and might be replaced as new experiences accumulate. Similarly, improving any real-world situations

by an intervention require some ideas - theory - about the nature of social reality. This intervention must stand a theory in order to make it 'sensible'. (Checkland & Poulter, 2006, p. 171) Since SSM is basically an intervention method to the real world problem, it is important to understand the theory behind it.

The Second World War gave the operational scientists a chance to practice and gain helpful experiences about their field. After the war, this accumulation of knowledge led to a rapid development in management science. Just before the 1970s, some approaches to deal with real-world problem situations had matured. Those approaches such as system engineering, classic Operational Research, RAND Corporation systems analysis, computer systems analysis, System Dynamics, the Viable Systems Model, have a common point that assuming the same theory of social reality. (Checkland & Poulter, 2006, p. 172) Today those systems are called 'hard' systems as explained above. In time, the applications of those systems have proved that their social theory is not broad enough to deal with complex human situations. As a result, new approaches that considered as 'soft' approaches had emerged. Those approaches do not claim that the hard approaches are wrong. They only see the hard and soft approaches as a different case that is suitable for different kinds of problem situations.

The 1960's hard approaches consider the ability of human being while defining the objectives and how to achieve these objectives at an optimum level. They define human activity as goal seeking and optimizing. Even though these aspects are a significant part of human activities when the System Engineering approach tried to be applied on a management problem situation; the application is failed and it has realized that there are plenty of important characteristics of human activities. This failure showed that the SSM needs a broader language to explain SSM experiences. This need ended up making the goal seeking as a subset of 'sustaining relationships'. For instance, if a company aims to increase its market share, the company needs to create and sustain a new relationship between itself and the market. In the same way, optimizing evolved as a subset of 'learning'. (Checkland & Poulter, 2006, p.173) This shift from goal seeking/optimizing to sustaining relationships/learning underlies the SSM.

Another important point on understanding the SSM is that the SSM uses a dynamic view contrary to hard systems' static view (ignoring worldviews). In static view, the observer can objectively observe anything at any time in the outside world. However, in the real world, people's ideas evolve and change in time with interaction with other people. Figure 3 visualizes and explains the dynamic social process that SSM relies on.

As explained above, every SSM application aims to be an organized process of learning. With this learning aim, each SSM use becomes a research. Checkland has conducted many different projects and benefits from those real-world cases to develop SSM. SSM has developed in time by Checkland' work and mature now. However, each use of SSM differs and never follows the exact same way. Each new application entails learning and can be considered as a research. (Checkland & Poulter, 2006, p.175)
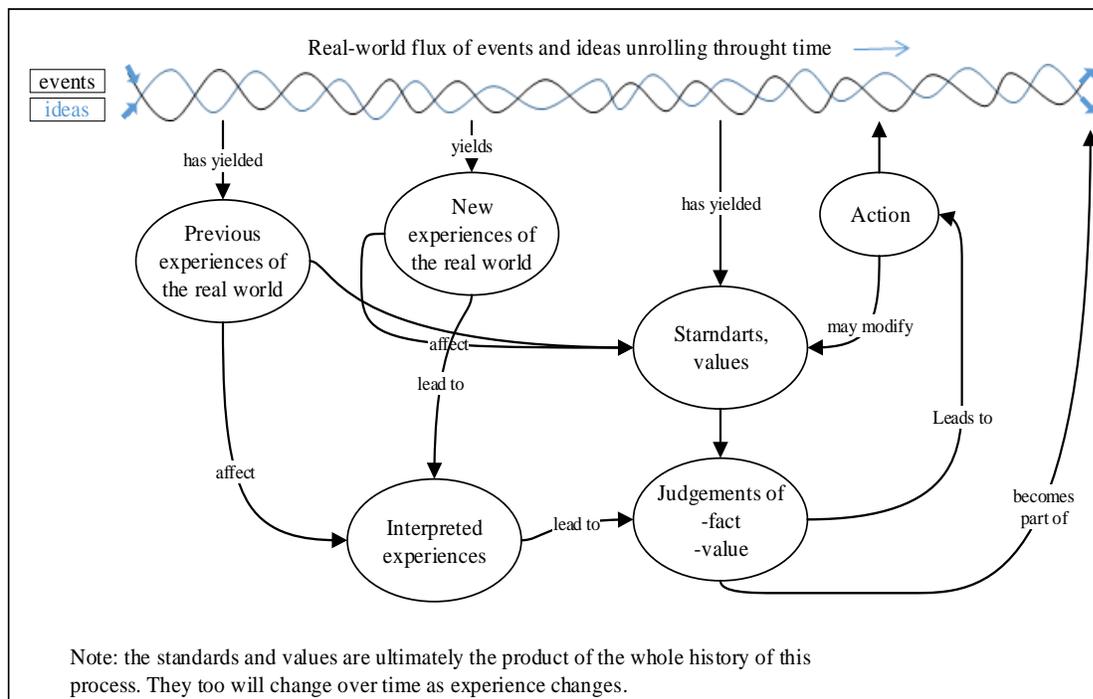
Figure 3: The Dynamic Social Process: A Model Which Makes Sense of SSM Use (Checkland & Poulter, 2006, p.174)

The theory of research which comprises a basis for this progressive methodology is not same as the conventional theory which widely used in academia. Hypothesis testing now dominates the academic discussion and practice. Checkland and Poulter (2006, p. 176) explain this with these words: "*this domination is understandable, since hypothesis testing is the research method in the natural sciences, and these embody the most successful way of finding things out that the world has ever seen. If the results are repeatable by other scientists in other locations at other times, then the results count as part of scientific knowledge*". However, in social phenomena, the cases are more complex and how to do a research is not clear-cut. They are open to various changing interpretations. The changes in the interpretations affect the phenomena. Social knowledge is not comparable to the accumulated knowledge of the natural sciences.

A famous psychologist Kurt Lewin suggested a radical approach called 'action research' in order to conduct research in social situations. He suggests that a social situation can be done by entering the situation by taking part in it and using that involvement as a research experience focused on the change process. This method adopted in the development of SSM. Since repeatability in natural sciences cannot be applied in social issues, - the human situation can not exactly repeat in another same situation - action research offers recoverability to fulfill that need in social problems. Recoverability is not as strong as repeatability but stronger than the plausibility. Checkland and Poulter (2006,

p. 177) explain the recoverability as follows: "Recoverability; that is to say, make the whole activity of the researcher (here the SSM user) absolutely explicit (including the thinking as well as the activity), so that an outside observer can follow the whole process and understand exactly how the outcomes came about. If the observer then wishes to disagree with the actions taken or interpretations made, the coherent discussion can take place."

In order to achieve recoverability, the SSM user must state the framework of language to make it understandable for observers. For instance, Analysis One, Analysis Two, Analysis Three, Root Definition, CATWOE, 3E's, Conceptual Model etc.

2.4.2   What SSM Is

The first appearance of SSM is in Journal of Systems Engineering: Peter Checkland's 'Towards a systems-based methodology for real-world problem solving' (Vol.3, No.2). In this paper, Checkland introduces the basic shape of SSM and the shift from hard to soft systems thinking has not been fully achieved.

Soft Systems Methodology is an applied methodology based on a holistic approach. Holistic means the whole is bigger than the combination of parts. Holistic view claims that the characteristics of the whole are different than its separate parts. In a similar way, Human Activity Systems (HAS) states that a person has different roles and reactions when he/she investigated alone or in a group. It claims that when the whole is broken down into pieces, there are always some missing points about the whole (Kurbanoğlu, 1993, p. 90).

In order to understand how the organizations work in the real world, human behaviors must be investigated. Since all humans differ from each other and even differs according to their current social environment, it is not easy to clearly identify their relations and behaviors in an organization. SSM is a suitable method to investigate all these changing variables by looking at the big picture with a holistic view. HAS emphasizes the significance of the human within the organizations.

SSM claims that the defining the problem is the most important part of problem-solving. That's why it mainly focuses on how to describe and find out the problem by using a different point of views.

SSM is the application of system approach on undefined and complicated problems. In SSM there is not a single well-defined problem. Therefore, 'problem' word is not a proper word to describe the problem; "Problem situation" is used instead.

Checkland conducted many projects that include both theoretical and applied researches in order to develop his soft systems methodology. His methodology is based on finding out problem owners' viewpoints. In the next step, according to these viewpoints, conceptual models have developed. Then, those conceptual models are compared with

the real world or current situation to see the differences between the desired situation and the current situation. Those differences might be the indicators of the problem situations.

2.4.3   Steps of the Basic SSM (SSM Mode 1)

Checkland's SSM includes 7 steps. Those steps are summarized by Checkland as shown in Figure 4. These steps are in a logical order to help analyst to apply the methodology. However, Checkland (1981) emphases that the order is just a helper, analysts do not have to strictly follow it. He states that the beginning can be from any step and repeats or returns might happen. It is also possible to work on more than one step at the same time. He includes that an experienced systems analyst is aware of he/she is working on a system methodology and a change in one step causes changes in the whole system.

- ***First Step:***

The first step is the data collection part of the problem situation. Analysist conduct a detailed research about the potential problem situations by using different methods. Interviewing the problem owners is one of the most commonly used methods. In this step defining the problem is not an aim; it only includes getting more information about the current situation of the problem owners' current environment.
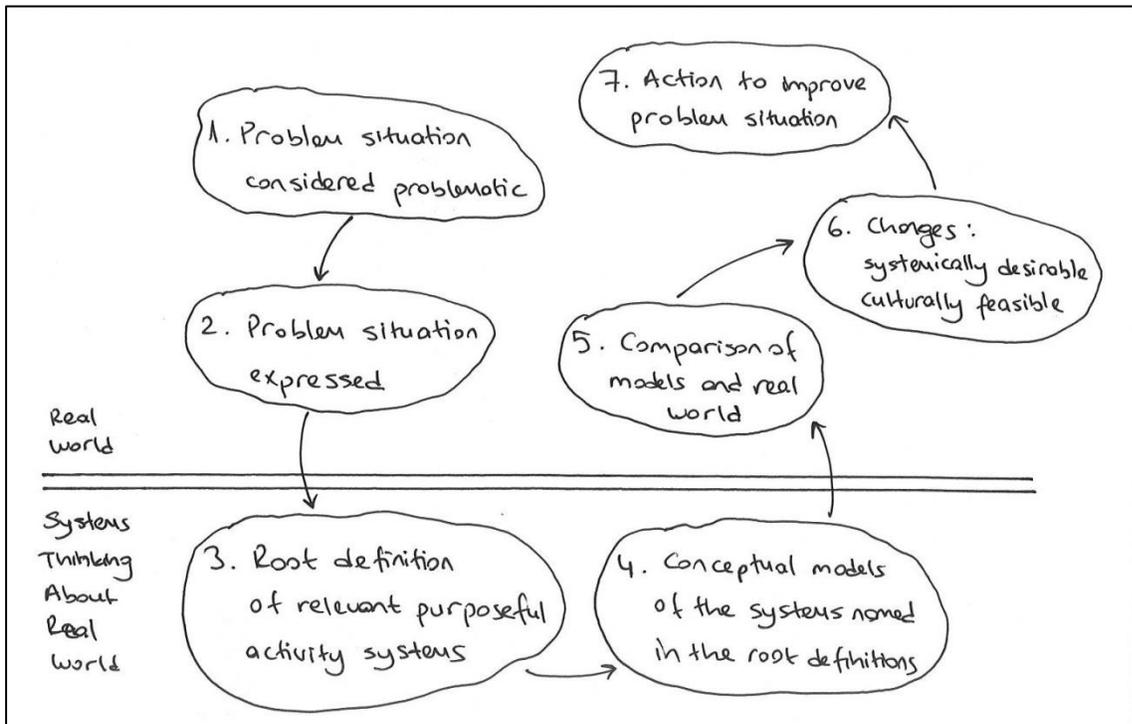
Figure 4: The Conventional 7 Stages of SSM (Checkland, 1993, p.163)

- *Second Step:*

This step includes drawing the 'richest possible picture'. The rich picture is a detailed drawing that visualizes and summarizes the problem situation. Rich picture can be drawn by using various sources such as company reports, interviews and meetings with actors etc. This picture helps the analyst to determine 'relevant systems'. Relevant systems are the systems that are related to the problem situation. These systems are chosen by the analyst. Besides, each of the relevant systems is a HAS that guide the analyst to specify a solution to the problem situation. In addition, relevant systems help the analyst to determine the ideal solution, as each of them represents a desired situation.

Selection of the relevant systems depends on the analyst own choice. Since each person might have different opinions about the same topic, it is a subjective process. However, the analyst considers the significance of the relevant systems in order to solve the problem situation and do the selection based on that.

A relevant system does not have to aim to solve a problem situation. However, it has to include a problem, or at least be related to a problem situation (Naughton, 1977, as cited in Kurbanoğlu, 1993, p. 94). Relevant systems only reveal and show the problem situations, do not offer a solution to them.

- *Third Step:*

In that step, first, the analyst determines and names the relevant systems, then designates their 'root definitions'. Root definition basically describes what a relevant system is doing. It states the relevant system explicitly by using very detailed and clear sentences.

Checkland & Poulter (2006) suggest developing the root definitions by using the equation (PQR): Do P by Q to contribute to achieving R, where PQR answers the questions of what, how and why. Root definition includes six parts that are abbreviated as CATWOE as shown in Figure 5.

C	Customers	beneficiaries or victims of the system; not necessarily customers of the company
A	Actors	those involved in operating the system
T	Transformation	the essential process
W	Weltanschauung	world-view(s) of the actors
O	Owner	power figures who control the existence of the system; not necessarily the owner of the company
E	Environmental Constraints	constraints on the system

Figure 5: CATWOE (Waring, 2005, p. 92)

An Example
A professionally manned system in a manufacturing company which, in the light of market forecast and raw material availability makes detailed production plans for a defined period.

CATWOE analysis:
C: people in the production function
A: professional planners
T: need for production plan -> need met; or,
Information -> plan
W: rational planning of production is desirable and is a possibility: there is the degree of stability needed to make rational planning feasible
O: the company
E: staff and line roles. Information availability

Figure 6: A CATWOE Example (Checkland, 1989, as cited in Checkland & Tsouvalis, 1997, p. 157)

- *Fourth Step*

The fourth step is building the conceptual models. Conceptual models show the minimum number of necessary steps in order to transform the system into the system that defined in root definition. At first, they designed with a limited number of steps, but they can be getting in detailed in time by separating the steps into different conceptual models.

Conceptual models do not reflect the real world and do not explain how the systems work in real life. It is important to abstain from the defining the real world while building the models. Since in next step the analyst compare the conceptual models with real-world situation, if they are mixed each other in this step, the methodology fails. If the analyst explains the real world in conceptual model, it restrain the decision making process to improve the problematic real-world situation.

Even though the conceptual model is successfully built by a root definition if the conceptual model fails to provide a useful comparison with the real world, that means the root definition is not radical enough. In the next step, the root definition should be the basis of offering radical changes to the system. If it does not, root definition should be redefined (Naughton, 1977).

Figure 8, shows the model building process in SSM. PQR means, to achieve R use Q to do P. This method is suggested by Checkland to form a proper root definition. This method answers the questions of what will be done in the system, how is it going to happen and why they are doing this.

Three E's in the Figure 9 is used to check whether the suggested possible changes have created the required improvements in the each HAS. To figure out whether the conceptual models have successfully reflected the transformation process these three E's suggested by Checkland. Efficacy questions whether the resources that used in the transformation process provided the necessary effect. Efficiency questions whether the transformation process was performed by using minimum amount of resources. Effectiveness questions, whether the transformation was effective on helping the organization achieve its long term goals.

- *Fifth Step*

In this step, conceptual models are compared with the real world visualized in the rich picture. This comparison reveals the missing or incorrect processes in the system. By detecting those, necessary improvement can be suggested to the organization. Possible solutions that are going to be presented to the problem owners are defined in this step. If there are some points that cannot be compared properly, steps from 2 to 5 should be repeated. SSM is a cyclic process that encourages the users repeatedly performs the previous steps until get useful results.

- *Sixth Step*

This step contains the discussion of detected differences between the real world and rich picture with the problem owners. Suggested possible solutions are being shared with the problem owners and they are discussed with the analyst in order to determine if they are applicable or not. Future plans can be made and some concerns of the problem owners might limit the implementation of possible solutions.

- *Seventh Step:*

If the sixth step can be conducted properly, the necessary changes approved by the problem owners can be applied in this step. These changes might lean new problems and SSM might be reapplied.

2.4.4   Two Strands Model of SSM

The use of SSM has become widespread in 1988. However, the application of SSM in different context revealed the limitations of Checkland's methodology. Checkland always emphasized the importance of learning in his methodology, but following the certain steps of SSM Mode 1 was limiting the learning process. The seven-step process was intervening in the system instead of interacting with it. Rather than internalizing the

methodology in everyday tasks, applying it has become a separate task for the organizations.
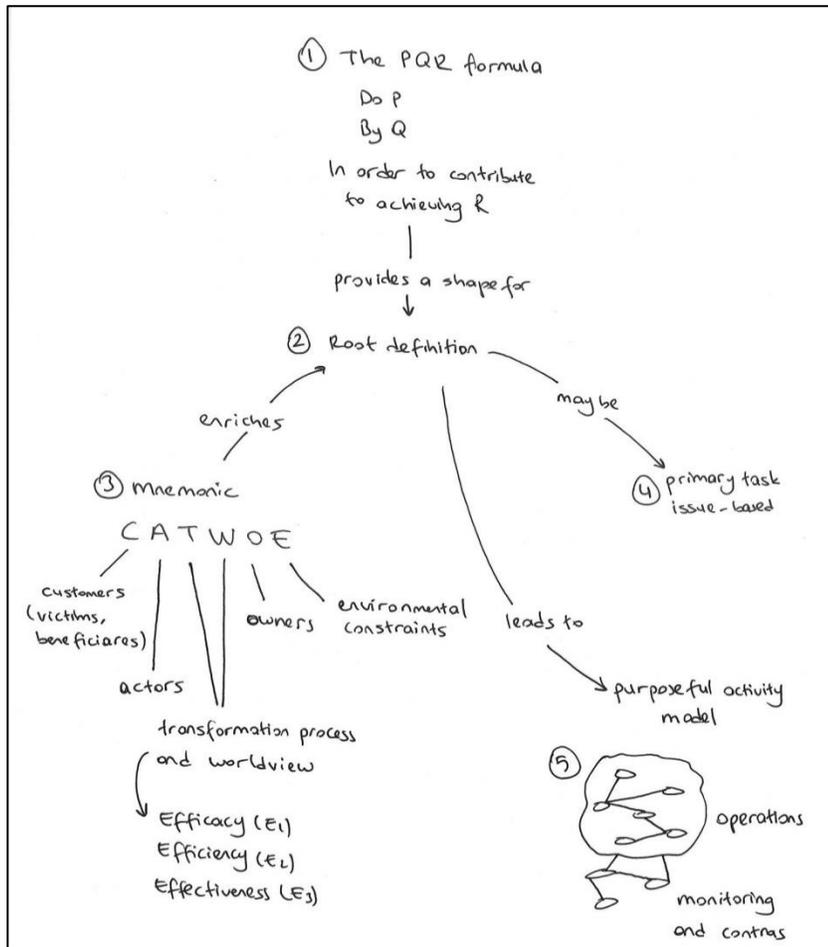
Figure 7: Guideline for Building Models

Scholes and Checkland find outs the need of such a new version while conducting a study in the company that Scholes work as Business Planning and Control Manager. Instead of seeing it like a separate project, Scholes starts using the SSM in his day-to day works. After working a while, Checkland and Scholes realized there is a difference between "*using SSM to do a study*" and "*doing a study using SSM*" (Checkland & Scholes, 2010, p 281). This difference started the authors to think what is missing in the current seven-stage model of SSM and what they can change.

To overcome those issues, a new version of SSM called "two strands model" has been developed and published in *Systems in Action* book that written by Checkland and Scholes. This version of the SSM includes a cultural stream analysis different than the Mode 1.

SSM Mode 1 neglects the cultural structure of the organizations. However, cultural aspects such as social roles, norms, beliefs, and power distribution etc. affect the success and the daily flux of the organizations. Organizations become a whole with its cultural and structural aspects. Problem situations might be causing due to cultural conflicts in the organization. While inspecting the problem situations, ignoring the cultural aspects might mislead the analyst.

As it can be seen from Table 2 Two Strand Model of SSM consists of two main analyses: stream of cultural analysis and logic based stream of analysis.

Firstly, cultural stream of analysis consists of two main parts. First, based on the interviews, research, and analysis the rich picture will be drawn and in the second part Analysis one, Analysis two and Analysis three will be held.

Analysis one investigates the roles of the employees in the firm to be able to analyze the intervention itself. There are three important roles in this analysis which are "client", "the problem owner" and "the problem owner".

Table 2: Contents of Two Strand Model of SSM

Two Strand Model of SSM
1. Stream of Cultural Analysis
-Analysis One: Intervention or Role Analysis
-Analysis Two: Social Systems Analysis
-Analysis Three: Political Analysis
-Rich Picture Building
2. Logic Based Stream of Analysis
-Name, list , select relevant HAS
-Root definitions
-PQR, CATWOE, 3E's
-Design conceptual models
-Compare conceptual models with real world
-Determine suggested changes

Analysis two, the social system analysis, consists of roles, norms and values of the company. The roles are the job positions in the organization chart. The norms are expected behaviors of employees due to their roles. And the values are the standards that decide whether a behavior is good or bad.

Analysis three, the political analysis, deals with the power distribution within the organization. It requires asking questions such as how the power is obtained, used, how it is defended, to whom it can be passed on and how it can relinquish etc.

Secondly, logic based stream of analysis includes the same steps of SSM Mode 1 which explained in detail in previous sections. In this part of the analysis, the relevant systems were determined, named, listed, selected and modeled. After that, the conceptual models are compared with the problem situation within the rich picture. Lastly, according to the comparison results, some suitable and possible changes are recommended. Figure 8 and 9 visualizes the process of SSM. These two figures summarize all the explanation in this chapter.

2.4.5   Why Two Strands Model Of SSM

In this study, instead of Checkland's seven-stage cyclic learning process model that appears in Systems Thinking Systems Practice (Checkland, 1981), Two Strands Model of SSM that first appeared in *Soft Systems Methodology in Action* (Checkland & Scholes, 1990) is applied. Application of SSM in different research areas revealed the limitations of SSM Mode1. Checkland always emphasized the importance of learning in his methodology, but following the certain steps of SSM Mode 1 was limiting the learning process. SSM Mode 1 neglects the cultural structure of the organizations. However, cultural aspects such as social roles, norms, beliefs and power distribution etc. affect the success and the daily flux of the organizations. Organizations become a whole with its cultural and structural aspects.

Table 3: Comparison of SSM Mode 1 and Mode 2 (Checkland, 2000, p. 39)

Mode 1		Mode 2
Methodology-driven	vs	situation driven
Intervention	vs	interaction
Sometimes sequential	vs	always iterative
SSM an external recipe	vs	SSM an internalized model

Mode 1 and Mode 2 are different version of Checkland's SSM. Mode 2 does not aim to replace the Mode 1. While Mode 2 explains the relationships in the organization to help managers understand what is going on in the organizations, Mode 1 detects the required steps to solve the problem situation.

Table 3 and Figure 10, shows the difference between Mode 1 and Mode 2. Mode 1 has to follow a certain methodology while mode 2 has a more flexibility. As Figure 10 visualize it Mode 1 plays a role as an intervention by staying the out of everyday flux of the organization. However, Mode 2 becomes a part of business processes and stay in the middle of the flux. Ideas and cultural aspects of problem owners matter in Mode 2.

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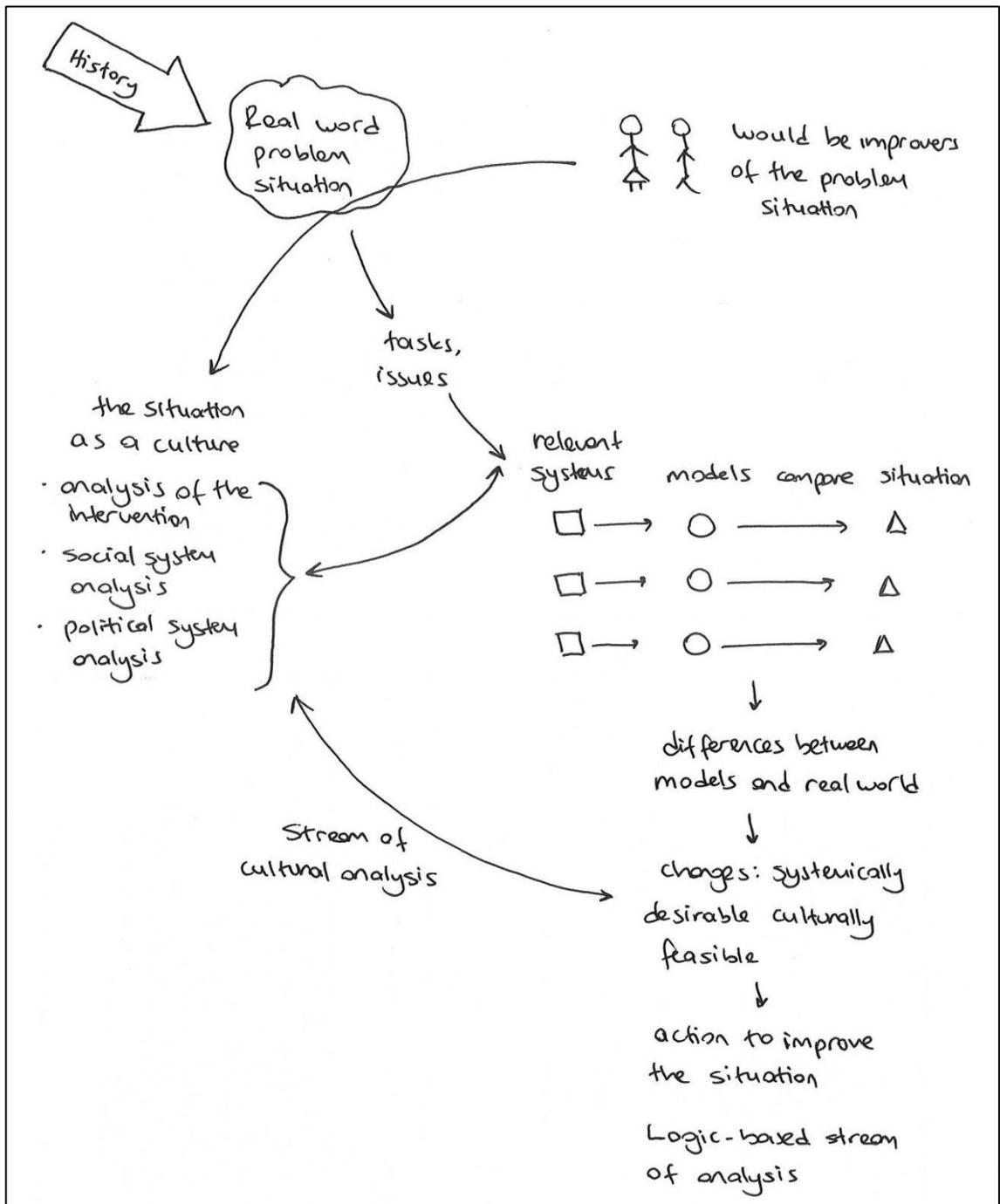
Figure 8: The Process of SSM
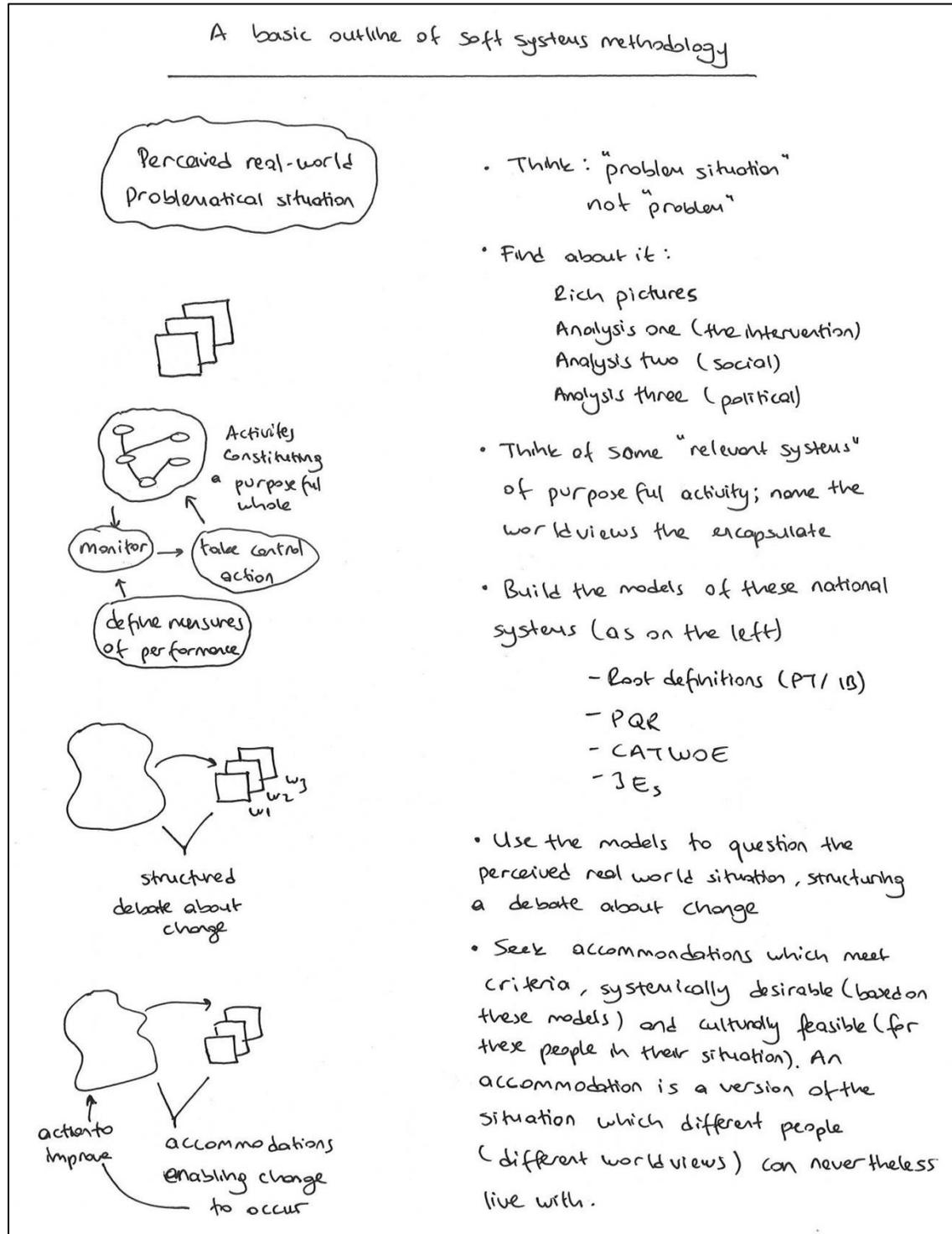
Figure 9: Key Elements in SSM's Learning Cycle (Checkland & Poulter, 2006, p. 170)
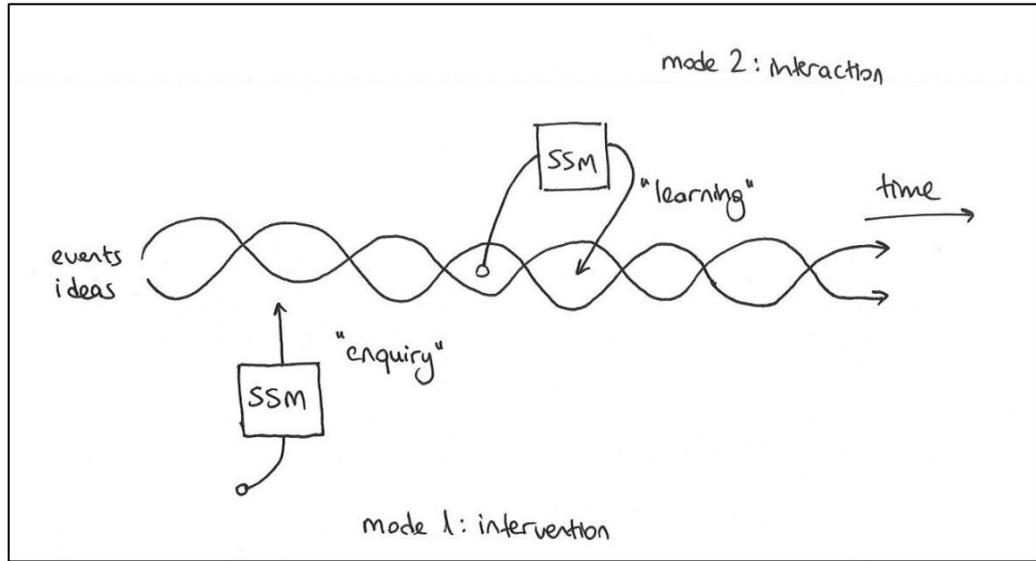
Figure 10: SSM's Position in Mode 1 and Mode 2 (Checkland & Scholes, 2010, p. 282)

CHAPTER 3

LITERATURE REVIEW

3.1 Systematic Literature Review

This section presents a review of recent literature on SSM usage in SMEs and different sectors. In order to conduct the literature review, Kitchenham systematic review has been implemented. A systematic literature review identifies, evaluates and interprets available research on a specific research question or research area. Its main objective is to conduct an objective evaluation of a research topic by using a "*trustworthy, rigorous, and auditable*" methodology. Systemic reviews are preferred because they summarize the existing evidence of a topic; suggest new areas for further studies by identifying gaps in the research literature. Also provides a framework for new researches (Kitchenham, 2004).

This procedure consists of three main phases of planning the review, conducting the review and reporting the review. Josette (2012) defines a systematic review as the summary of a research literature that is focused on a single question and states it brings all high-quality research evidence together related to this question. According to Tranfield, Denyer, and Smart (2003), a successful systematic review must start with a well formulated, answerable question. The question set the limits of the research area and helps to determine the importance and relevance of the studies. If the research question is insufficient, the review will be insufficient too.

Literature reviews are an essential part of a well-conducted thesis. These reviews are beneficial to detect gaps in the literature. Besides, being aware of the previous studies retain the researcher from duplication or have a chance to compare its results with other studies.
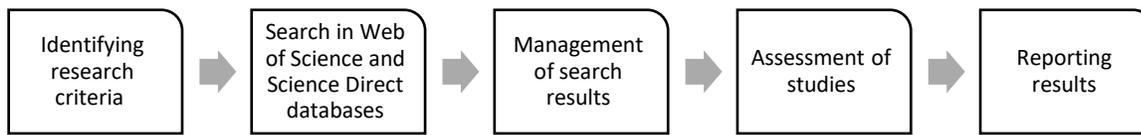
Figure 11: Review Protocol of Kitchenham Systematic Review

The steps of Kitchenham systematic review are presented in Figure 11. Firstly, as the first step of the systematic review procedure, the research criteria are identified. Only the studies in English and published as a journal article were considered in the literature review.

3.2   Two Strands Model of SSM

Firstly, since the methodology of the study is "Two Strands Model of Soft Systems Methodology", "two strands model" keyword is used for the review in Web of science and Science Direct databases. As found in the literature, the research revealed that there are only three studies that have applied this method[1]. Papers of Torlak & Müceldili (2014), Nolan & Crowe (2010) and Ameyaw & Alfen (2018) have been published as "original paper" in Systemic Practice and Action Research Journal. This result imposes a high importance to this thesis as it provides an insight about a topic that has not been studied enough yet. As found in the literature this thesis is the first study that applies Two Strands Model of SSM on defense and automotive components industry, also one of the firsts in applying the methodology on a real-life case.

Torlak & Müceldilli (2013) applies the Two Strands Model of SSM on a private hospital in Turkey. They aim to offer possible solutions to the various problem situations in the hospital such as communication problem between physicians and patient, need of an appointment system etc. Ameyaw & Alfen (2018) uses Two Strands Model of SSM in order to understand the reasons behind the low private sector investment in power generation sector in Gana. They use the method to define and sort out the problem situation. Nolan & Crowe (2010) uses SSM Mode 2 and Critical Systemic Thinking in order to explore how the climate change discourse is conducted in Biofuels policy in New Zeland.

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[1] Access date: 25.07.2018

3.3   SSM Mode 1

Only three studies, mentioned in previous section, are not sufficient to understand the nature of SSM applications in the literature. That's why, to broaden the scope of the review, since the method of the study is Soft Systems Methodology the main keyword for the systemic review is selected as "soft system". Methodology word is removed to reach more studies as it is realized that some studies only use "soft system" in their keywords or titles. Since the Web of Science database is sensitive to a letter change, "soft system" and "soft systems" word combinations are searched differently in order to not to miss a study. This has doubled the review process but new studies have been discovered when the plural suffix "s" added.

One essential point in this literature review is that the articles found in the research are examined before analyzing the number of studies. The abstract of all found articles are read one by one and irrelevant articles are excluded from the review. This basically means that there are more articles that could be found by those keywords. However, not all of them are related to the scope of this study.

Soft System Methodology has been used in a high variety of research areas. According to the Web of Science database[2], "Soft System" keyword has been used in 25 different areas from Medicine to Management until 2018. For that reason, in order to narrow the literature scope and reach more suitable results, some additional keywords are identified. Since the case study in this thesis is applied to an SME that operates in Defense and Automotive Component Industries, firstly these sectors are used as secondary keywords.

Firstly, the review with "defense" and "automotive" keywords presented very few articles in total. This result presents a gap in the literature. More studies that apply SSM on Defense and Automotive sectors are needed. This reveals one of the contributions of this thesis into the literature.

Secondly, since the review should include more study, the need for new keywords has emerged. To extend the scope of the review "industry" and "sector" words added to the keywords. Another aim of this selection was to see in which sectors the SSM has applied the most.

Then, to find out whether the SSM has applied on SMEs, "SME" keyword has been added as a new keyword. As in the previous case, the research showed that there are limited numbers of articles that apply SSM on SMEs. This revealed another contribution of this thesis into the literature. However, the possibility of not using SME abbreviation as a keyword in the articles, "small and medium-sized" keyword should be checked, too. Therefore, "small" keyword has been added to the list and made another research. The result supported that there is a gap in the literature applying SSM on SMEs.

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[2] Access date: 23.04.2018

As a result, the applied keyword combinations in the review are as follows:

- "Soft system" was combined with "defense" by using the Boolean AND operator.
- "Soft system" was combined with "automotive" by using the Boolean AND operator.
- "Soft system" was combined with "industry" by using the Boolean AND operator.
- "Soft system" was combined with "sector" by using the Boolean AND operator.
- "Soft system" was combined with "SME" by using the Boolean AND operator.
- "Soft system" was combined with "small" by using the Boolean AND operator.
- "Soft systems" was combined with "defense" by using the Boolean AND operator.
- "Soft systems" was combined with "automotive" by using the Boolean AND operator.
- "Soft systems" was combined with "industry" by using the Boolean AND operator.
- "Soft systems" was combined with "sector" by using the Boolean AND operator.
- "Soft systems" was combined with "SME" by using the Boolean AND operator.
- "Soft systems" was combined with "small" by using the Boolean AND operator.

Following tables are categorized by using the mentioned keywords above. In order to provide summarized information "small" and "SME" keywords review findings and "industry" and "sector" keywords findings are combined separately. The literature review findings visualized with four tables: SSM journal papers in Automotive Sector, Defense Sector, Other Sectors and papers work on SMEs. Tables created by eliminating the papers in the review according to their relevance with this thesis topic.

3.3.1   SSM in Automotive Component Sector

Table 4: SSM Papers in Automotive Component Sector

	Year	Author	Journal
1	2009	Shankar et al.	Journal of Knowledge Management

As it can be seen from the Table 4 only one article could be found in the review. Shankar, Acharia, & Baveja (2009) aim to propose a suitable knowledge management system that can meet ever-changing organizational needs. They applied SSM to an Indian auto-component supplier to design the framework. They identify knowledge sharing methods and indicate hierarchal nature and bi-directional flow of knowledge within the organization. In addition, they emphasize that competency and infrastructure are significant parts of a knowledge management system.

3.3.2 SSM in Defense Sector

Table 5: SSM Papers in Defense Sector

	Year	Author	Journal
1	2014	Erkoyuncu et al.	Journal of Service Management
2	2013	Erkoyuncu et al.	International Journal of Production Research

Table 5 shows that two articles have been found in the literature. Erkoyuncu, Durugbo, & Roy (2013) have conducted a research with 22 aerospace experts from naval and defense sectors for three years. They applied SSM to find out and categorize the uncertainties that show up especially at the bidding stage of service contracts.

Erkoyuncu, Roy, Shehab, & Kutsch (2014) aim to offer a framework in order to deal with the effect of uncertainty on cost estimates in the defense sector. They applied SSM in collaboration with four major defense sector organizations by sharing documents, applying semi-structured interviews, workshops and case studies. They developed a seven stage framework to plan, identify, prioritize, classify, and manage cost uncertainties.

3.3.3 SSM Applied to SMEs

Table 6: SSM Papers that Applies the Methodology on SMEs

	Year	Author	Journal
1	2012	Tavella & Hjortsø	International Food & Agribusiness Management Review
2	1999	Taylor & DaCosta	Systems Research and Behavioral Science
3	1996	Kennedy	Australian Psychologist

Above table shows the articles that apply SSM to SMEs, as found in the literature. Tavella & Hjortsø (2012) work on the design and management of local organic food supply chains in their paper. The objective of their study is to suggest SSM as a new method to design and manage those supply chains. They examine a case study in German small-scale organic cereal sector partners. They used SSM to reduce uncertainties within local organic food supply chains and define the benefits of SSM, compared with less structured methods.

Taylor & DaCosta, (1999) starts their study by emphasizing the vast majority of case studies that apply SSM are interested in large organizations. In order to fill this gap, they conduct a case study in a small sized warehousing and distribution company. They conclude that the political area in an SME is as complex as a large enterprise. Thereby, SSM is a suitable method for SMEs as well as large organizations. In her paper

Kennedy, (1996) draws attention to SSM application in the psychology area. She applies SSM to a problematic situation in a small sized organization, with the aim of showing the value of SSM for practitioners and researchers in psychology.

3.3.4 *SSM Sector and Journal Information*

Below tables visualize the sectoral distribution of related SSM papers and show their journals and titles.

Table 7: SSM in other Sectors

	Year	Author	Journal
1	2017	Weaver et al.	European Journal of Operational Research
2	2017	Mello et al.	Production Planning & Control
3	2017	Damenu & Beaumont	Information and Computer Security
4	2017	Sepehrirad et al.	Systemic Practice and Action Research
5	2017	Crowe et al.	BMJ Quality and Safety
6	2017	Hildbrand & Bodhanya	Kybernetes
7	2017	Beall & Brocklesby	Journal of Management and Organization
8	2017	Palm & Lilja	International Journal of Quality and Service Sciences
9	2016	Antunes et al.	Energy Procedia
10	2016	Fischbacher-Smith	Security Journal
11	2015	Santiago-Santiago et al.	International Journal of Clothing Science and Technology
12	2015	Behera et al.	Production Planning & Control
13	2015	Proches et al.	International Journal of Qualitative Methods
14	2015	Keeffe & Ormsby	Development in Practice
15	2012	Ngai et al.	International Journal of Production Economics
16	2011	Doloi	International Journal of Project Management
17	2011	Yasui	Systems Engineering
18	2011	Hardman & Paucar-Caceres	Systemic Practice and Action Research
19	2009	Hindle & Franco	Journal of the Operational Research Society
20	2009	Morimoto & Agouridas	Transportation Research Record
21	2009	Ariyatum et al.	Design Journal
22	2009	Clemens	Systemic Practice and Action Research
23	2009	Pollack	Journal of the Operational Research Society
24	2008	Kayaga	Water Policy
25	2007	Petkov et al.	Decision Support Systems
26	2007	Taylor et al.	Systems Research and Behavioral Science
27	2005	Fielden & Malcolm	Systemic Practice and Action Research
28	2003	Crawford et al.	International Journal of Project Management
29	2000	Kirwan	Applied Ergonomics

30	2000	Jagodzinski et al.	Design Studies
31	1999	Jones	Journal of the Operational Research Society
32	1999	Dias	Civil Engineering and Environmental Systems
33	1999	Mobach et al.	Pharmacy World and Science
34	1999	Reid et al.	Systems Research and Behavioral Science
35	1998	Kirk & Pine	International Journal of Hospitality Management
36	1996	Hsu & Yeo	International Journal of Project Management
37	1995	Macadam et al.	Agricultural Systems
38	1995	Lehaney & Hlupic	The Journal of the Royal Society for the Promotion of Health
39	1994	Bin Yusoff & Jenkins	Journal of Information Technology (Routledge, Ltd.)
40	1990	Macadam et al.	Agricultural Systems

When Table 4, 5, 6 and 7 combined, 36 different journals that published SSM papers in different sectors are found. "Systemic Practice and Action Research" journal publishes the highest amount of studies with five papers. Then "International Journal of Project Management", "Journal of the Operational Research Society" and "Systems Research and Behavioral Science" journals follows with three papers each.

The Figure 12 shows that, according to the literature review, the amount of SSM papers have changed through the years. It is hard to mention a regular increase or decrease; however, there is a significant increase in the number of papers in 2017. It can be interpreted that the method is drawing attention and expected to gain more popularity in the future.
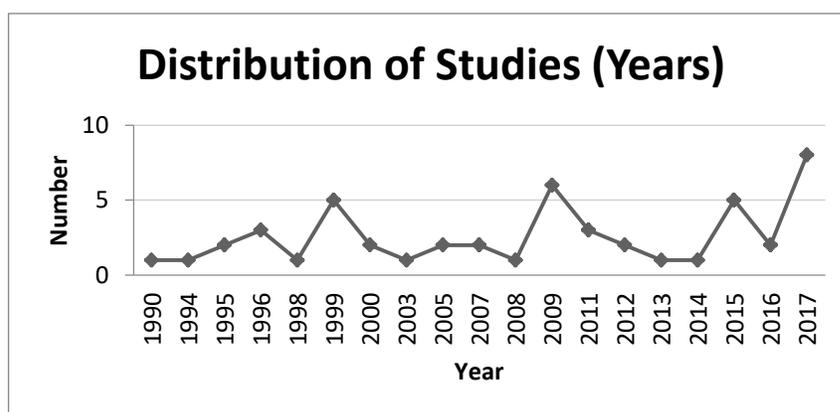
Figure 12: Yearly Distribution of SSM Mode 1 Papers

As it can be seen from Table 8, as found in the literature, SSM has been applied in 37 different sectors. The sector names directly taken from the papers, "public" sector comes first with six papers and "construction" sector is second with three papers.

Table 8: Sectoral Distribution of SSM Papers

	Year	Author	Sector
1	2009	Morimoto & Agouridas	aircraft manufacturing
2	1996	Hsu & Yeo	*all sectors*
3	2009	Shankar et al.	automotive
4	2017	Weaver et al.	business
5	1996	Boardman & Cole	capital goods manufacturing
6	2015	Santiago-Santiago et al.	clothing
7	1999	Dias	construction
8	2011	Doloi	construction
9	2015	Behera et al.	construction
10	1990	Macadam et al.	cotton
11	1999	Reid et al.	dairy
12	2013	Erkoyuncu et al.	defence
13	2014	Erkoyuncu et al.	defence
14	2011	Hardman & Paucar-Caceres	education
15	2005	Fielden & Malcolm	education
16	2016	Antunes et al.	electricity sector
17	2000	Jagodzinski et al.	electronics design
18	2007	Taylor et al.	entertainment
19	1996	Kennedy	*not stated*
20	2017	Crowe et al.	health
21	1995	Lehaney & Hlupic	health
22	1998	Kirk & Pine	hospitality
23	1999	Jones	hospitality
24	2007	Petkov et al.	information and communications technology
25	2017	Damenu & Beaumont	information security
26	2011	Yasui	insurance
27	2017	Beall & Brocklesby	land-based
28	1995	Macadam et al.	livestock
29	2015	Keeffe & Ormsby	logistics
30	2009	Ariyatum et al.	medical device
31	2000	Kirwan	nuclear power and process control
32	2012	Tavella & Hjortsø	organic food
33	2017	Sepehrirad et al.	petroleum
34	1999	Mobach et al.	pharmacy
35	2003	Crawford et al.	public
36	2017	Palm & Lilja	public
37	1994	Bin Yusoff & Jenkins	public
38	2009	Hindle & Franco	public

39	2009	Pollack	public
40	2009	Clemens	public
41	2005	Rodriguez-Ulloa & Paucar-Caceres	seamless steel tubular products
42	2016	Fischbacher-Smith	security sector
43	2017	Mello et al.	shipbuilding
44	2015	Proches et al.	sugar
45	2017	Hildbrand & Bodhanya	sugar
46	2012	Ngai et al.	textile
47	1999	Taylor & DaCosta	warehousing and distribution
48	2008	Kayaga	water

It can be concluded that there is a need of more studies to reach sufficient knowledge about SSMs application to SMEs. Also, lack of studies in defense and automotive component sectors is also constitute a gap in the literature. More importantly, there are very few researches that focus on Two Strands Model of SSM. Therefore, this study is expected to provide significant insight into SMEs that operates in those sectors in Turkey and serve as a model of the methodology in the literature.

Table 9: Literature Review of Related SSM Papers

No	Year	Author	Sector	Journal / Article Title
1	1990	Macadam et al.	cotton	Agricultural Systems / The Use Of Soft Systems Methodology To Improve The Adoption By Australian Cotto Growers Of The Siratac Computer-Based Crop Management System
2	1995	Macadam et al.	livestock	Agricultural Systems / A Case Study In Development Planning Using A Systems Learning Approach: Generating A Master Plan For The Livestock Sector In Nepal
3	2000	Kirwan	nuclear power and process control	Applied Ergonomics / Soft Systems, Hard Lessons
4	1996	Kennedy	*not stated*	Australian Psychologist / Soft Systems Methodology In Applying Psychology
5	2017	Crowe et al.	health	BMJ Quality and Safety / Combining Qualitative And Quantitative Operational Research Methods To Inform Quality Improvement In Pathways That Span Multiple Settings
6	1999	Dias	construction	Civil Engineering and Environmental Systems / Soft Systems Approaches Eor Analysing Proposed Change And Stakeholder Response - A Case Study
7	2007	Petkov et al.	information and communications technology	Decision Support Systems / Mixing Multiple Criteria Decision Making With Soft Systems Thinking Techniques For Decision Support In Complex Situations
8	2009	Ariyatum et al.	medical device	Design Journal / Identifying Strategic Directions For Design Development Of General Hospital Equipment For Thailand
9	2000	Jagodzinski et al.	electronics design	Design Studies / A Study Of Electronics Engineering Design Teams
10	2015	Keeffe & Ormsby	logictics	Development in Practice / Logistics Support Framework: A Systems-Based Approach To Logistics Planning For Development Projects
11	2016	Antunes et al.	electricity sector	Energy Procedia / An Application Of Soft Systems Methodology In The Evaluation Of Policies And Incentive Actions To Promote Technological Innovations In The Electricity Sector
12	2017	Weaver et al.	business	European Journal of Operational Research / A Systems Approach To Understanding The Perspectives In The Changing Landscape Of Responsible Business In Scothland
13	1996	Boardman & Cole	capital goods manufacturing	IEE Proceedings-control Theory And Applications / Integrated Process Improvement In Design And Manufacture Using A Systems Approach
14	2017	Damenu & Beaumont	information security	Information and Computer Security / Analysing Information Security In A Bank Using Soft Systems Methodology

15	2012	Tavella & Hjortsø	organic food	International Food & Agribusiness Management Review / Enhancing The Design And Management Of A Local Organic Food Supply Chain With Soft Systems Methodology
16	2015	Santiago-Santiago et al.	clothing	International Journal of Clothing Science and Technology / An Expert System To Improve The Functioning Of The Clothing Industry A Development Methodology
17	1998	Kirk & Pine	hospitality	International Journal of Hospitality Management / Research In Hospitality Systems And Technology
18	2012	Ngai et al.	textile	International Journal of Production Economics / Development Of The Conceptual Model Of Energy And Utility Management In Textile Processing: A Soft Systems Approach
19	2013	Erkoyuncu et al.	defence	International Journal of Production Research / Identifying Uncertainties For Industrial Service Delivery: A Systems Approach
20	1996	Hsu & Yeo	*all sectors*	International Journal of Project Management / A Systemic Approach To Re-Engineer A Public Research Institute (PRI) For Commercialization
21	2003	Crawford et al.	public	International Journal of Project Management / Managing Sof Change Projects In The Public Sector
22	2011	Doloi	construction	International Journal of Project Management / Understanding Stakeholders' Perspective Of Cost Estimation In Project Management
23	2015	Proches et al.	sugar	International Journal of Qualitative Methods / An Application Of Soft Systems Methodology In The Sugar Industry
24	2017	Palm & Lilja	public	International Journal of Quality and Service Sciences / Key Enabling Factors For Organizational Ambidexterity In The Public Sector
25	1994	Bin Yusoff & Jenkins	public	Journal of Information Technology (Routledge, Ltd.) / An Approach To Development Of Decision-Support Systems For A Public-Sector Administration
26	2009	Shankar et al.	automotive	Journal of Knowledge Management / Soft-System Knowledge Management Framework For New Product Development
27	2017	Beall & Brocklesby	land-based	Journal of Management and Organization / Exploring With Maori Organizations Comparative Advantage In The Context Of Climate Change
28	2014	Erkoyuncu et al.	defence	Journal of Service Management / An Innovative Uncertainty Management Framework To Support Contracting For Product-Service Availability
29	1999	Jones	hospitality	Journal of the Operational Research Society / Yield Management In UK Hotels: A Systems Analysis

30	2009	Hindle & Franco	public	Journal of the Operational Research Society / Combining Problem Structuring Methods To Conduct Applied Research: A Mixed Methods Approach To Studying Fitness-To-Drive In The UK
31	2009	Pollack	public	Journal of the Operational Research Society / Multimethodology In Series And Parallel: Strategic Planning Using Hard And Soft OR
32	2017	Hildbrand & Bodhanya	sugar	Kybernetes / Exploring The Complexity Of Sugarcane Supply Chains Via Systemic Approaches
33	1999	Mobach et al.	pharmacy	Pharmacy World and Science / An Application Of SSM In The On-Farm Labour Situation In The New Zealand Dairy Industry
34	2015	Behera et al.	construction	Production Planning & Control / Understanding Construction Supply Chain Management
35	2017	Mello et al.	shipbuilding	Production Planning & Control / Improving Coordination In An Engineer-To-Order Supply Chain Using A Soft Systems Approach
36	2016	Fischbacher-Smith	security sector	Security Journal / Breaking Bad? In Search Of A (Softer) Systems View Of Security Ergonomics
37	2005	Fielden & Malcolm	education	Systemic Practice and Action Research / Aligning Academic Activities: Implications For Teaching And Research In A New Zealand Institute Of Technology
38	2005	Rodriguez-Ulloa & Paucar-Caceres	seamless steel tubular products	Systemic Practice and Action Research / Soft System Dynamics Methodology (SSDM): Combining Soft Systems Methodology (SSM) And System Dynamics (SD)
39	2009	Clemens	public	Systemic Practice and Action Research / Environmental Scanning And Scenario Planning: A 12 Month Perspective On Applying The Viable Systems Model To Developing Public Sector Foresight
40	2011	Hardman & Paucar-Caceres	education	Systemic Practice and Action Research / A Soft Systems Methodology (SSM) Based Framework For Evaluating Managed Learning Environments
41	2017	Sepehrirad et al.	petroleum	Systemic Practice and Action Research / A Soft Systems Methodology Approach To Occupational Cancer Control Problem: A Case Study Of The Ministry Of Petroleum Of Iran
42	2011	Yasui	insurance	Systems Engineering / A New Systems Engineering Approach For A Socio-Critical System: A Case Study Of Claims-Payment Failures Of Japan's Insurance Industry
43	2007	Taylor et al.	entertainment	Systems Research and Behavioral Science / Using Soft Systems Methodology For Computer Game Design

44	1999	Reid et al.	dairy	Systems Research and Behavioral Science / An Application Of SSM In The On-Farm Labour Situation In The New Zealand Dairy Industry
45	1999	Taylor & DaCosta	warehousing and distribution	Systems Research and Behavioral Science / Soft Issues In IS Projects: Lessons From An SME Case Study
46	1995	Lehaney & Hlupic	health	The Journal of the Royal Society for the Promotion of Health / Simulation Modeling For Resource-Allocation And Planning In The Health Sector
47	2009	Morimoto & Agouridas	aircraft manufacturing	Transportation Research Record / Supporting Aircraft Manufacturers To Formulate And Implement Sustainable Development Strategies Systematically
48	2008	Kayaga	water	Water Policy / Soft Systems Methodology For Performance Measurement In The Uganda Water Sector

CHAPTER 4

EMPIRICAL FINDINGS: TWO STRANDS MODEL OF SSM FOR WORK PROCESSES

4.1   Company Introduction

The firm that is investigated in this thesis is an SME that operates in defense and automotive component industries as a subcontractor with its 35 employees. They do not do mass production, only make production by order. The company was established in 1992 in Ankara, Turkey. They introduce themselves as "*a leading manufacturer of a broad range of products used in military and commercial platforms.*"

Meeting the quality standards of the customers is their primary task. That's why they give high importance to the way of the jobs they are doing. They explain this situation by saying "*we always focus on how we do it whether than what we do*". To achieve that goal qualified human capital, well-working machines and quality certificates are significant parts of their jobs.

They divide their capabilities into three categories: manufacturing, electronic and mechanical. They manufacture in automotive component and defense industries by designing all its products itself. Their electronic capabilities include special underwater connectors, guidance wires, testing equipment cards and launcher fire systems. They manufacture "*the electromechanical control units, torpedo underwater cables (guidance wires, "A" cables etc.), batteries charge-discharge and assembly systems for underwater weapons systems, and the cards employed for torpedo and testing equipment*" to fulfill the needs of Turkish Defense Industry, Turkish Land Forces and Turkish Naval Forces.

The company has involved in various National Classified projects and developed project management experience. By considering the customer expectations and quality requirements they use this experience to "*design and manufacture mechanical parts and components that require precision machining, mechanical manufacturing of components*

for land vehicles, electronic manufacturing and cabling and mechanical and electronic assembly".

Their quality policy aims to meet customer expectations by achieving a sustainable product and service development. In order to achieve this goal, ISO-9001:2008 Standard and AS/EN 9100C Aviation, Space, and Defense Standard requirements have met and certificates received. The basic principles of their quality policy includes; fully understanding customer expectations and meeting them, never get satisfied with the current success, always working for the better, being aware of the significance of "Team Work" for the success, handling each work properly at first trial, following our quality management system requirements and continuously improving it.

Certificates are an essential part of their business. They are the holder of National and NATO Facility Security Clearances as well as AS/EN 9100C and ISO-9001:2008 quality certificates. It is not possible to make production without having required certificates for each customer.

Certificates, work benches, machines and qualified people who can use them are significant requirements for the company. Currently, there aren't enough employees in the company, especially in the workshop. Company urgently needs a machinist, CNC milling machines operator, and apprentices. One worker is working with two workbenches and CWM is working on the jobs he/she is not supposed to do according to his job description in order to handle the workload.

A very large portion of their business is with prime contractors in the defense sector such as ASELSAN, TAI etc. Other than these contractors, they conduct projects with Turkish Naval Forces, Turkish Land Forces, and some private organizations. They manufacture for the automotive component industry but it is a very small portion of their businesses. In this study, the company work processes are explained over the business with prime contractors.

There is plenty of business potential in the sector. The company only needs more employees to increase its work capacity. Having insufficient staff limits the working capacity and they miss business opportunities.

Employees in the firm do not have clearly described job definitions. If a need occurs, employees are asked to do a task which is not in their job definition. This creates confusion in the work processes a displeasure among employees.

The company needs well-described job descriptions. For instance, accountant and purchasing agent (PM) also work as a secretary and driver for the company. This makes this employee's job arduous to handle. PM is having difficulty in focusing each different role at the same time. PM has to take care of the company car, kitchen needs, company bills, raw material supply, payments for those materials etc. These roles also necessitate physically being different parts of the company facility and make it more tiring for the

employee. Sometimes, the priority of jobs overlaps. For instance, PM urgently needs to make a raw material purchase, but at the same time, he/she urgently needs to deliver something to somewhere as a driver. One of the motivations to keep these jobs doing is his/her close relationship with the GM. However, as soon as the GM finds an adequate employee and allocate a budget for a secretary or a driver, these tasks should be taken over him/her.

The driver has various tasks in the company. Firstly, the driver is needed to carry raw materials to the company. Secondly, the necessary machines parts should be searched in the market and be carried to the company. Most of those parts are special, hard to find equipment and cannot be found easily. Thirdly, the driver delivers the cargos. Also if a machine part breaks down, the driver urgently goes and purchases a new one in order to continue production. The driver has many small but important roles like shopping for the kitchen, paying the bills, driving sick employees to the hospital etc. These tasks take a lot of time.

4.1.1   How The Business Processes Works

- Getting and Fulfilling an Order

There is not only single way to get orders from their customers but the majority of their customers have their own websites (called portals) to announce their tender (bid) offers. By using those portals subcontractors can follow order information. When there is a new tender offer, prime contractor (tenderer such as ASELSAN, TAI, HAVELSAN etc.) send a notification email to the subcontractors to make their own price offers for the tender. The email contains a deadline for making an offer. There is not such a thing as accepting the tender if a company made a price offer for a tender that means they accept the tender conditions.

Prime contractors categorize their subcontractors as Group A, B, C, D and E. Those categories are determined by the subcontractors' production volume, number of employees, number of workbenches, their production quality and time of delivery success. If a large subcontractor cannot fulfill its quality and delivery expectations, they can be moved to a lower category. Prime contractors send tender notification emails according to these categories. The subcontractor in this study is in group C.

Production and Planning Manager (PPM) of the subcontractor checks the production capacity to see whether they are available to produce the order and calculate a price for all production process. Then General Manager (GM) goes over that information. If GM approves, they make a price offer the tender. One or two weeks after making the offer, if the company gets the tender; they receive an email that includes purchase order. GM receives that email and sends that to the PPM. This purchase order includes all details about the order such as technical drawings, quality requirements etc. It's their responsibility to make sure all necessary information is supplied to the subcontractor.

PPM creates the production planning and work order based on the information in the purchase order. Expected delivery time is the most important thing that is required to be considered. PPM plans what will be produced in which workbench. They used to prepare weekly production schedule but now because of some delayed orders they cannot apply it anymore. Then PPM passes this information to the Quality System Manager (QSM). QSM checks if the order requires a process that cannot be held in this company and needs an outside job. For instance, if the order requires a turning process, it needs to be done by a third party since the company has the necessary tools to do it inside. If there is a need, QSM arranges a proper subcontractor to make them do that job. This proper subcontractor must be an approved subcontractor by the prime contractor. QSM asks a couple of those approved subcontractors to give them a price offer. According to their delivery on time success, speed and quality QSM choose one of the offers. To be one of the approved subcontractors, the firms must keep their success rate (delivery on time, meeting quality standards) above a certain level.

The firm plans to expand its business range by doing as much as the work process by themselves. They need more space, tools and qualified employees. Using a third party for the parts they cannot produce, creates a dependency on another company and limits their profit. They would like to minimize this in the future.

If they use a third party for a part of the production, after the third party delivers the products they get a quality control from the Final Control Manager (FCM). If assembly requires FCM sends the parts to the assembly process.

QCM controls all produced parts and products in the production process. QCM is responsible for controlling if the machines are working properly in order to receive quality products at the end of the production process. QCM has too much responsibility in the company since he/she has to take care of every single product that they produce or assembly.

During the production process, FCM visually controls the first product that the machine produces. If there is a problem with the first product they control the machine and correct the mistake.

After the production process finishes, FCM checks whether the products need leveling. If it's needed he/she does the leveling. Then FCM does the final control of the products and if the products meet the quality requirements, FCM invite the prime contractors' quality control officer comes and controls the final product. If the final product passes the inspection, they package the products and prime contractor collects them. FCM carry out surface cleaning and levelling of the final products in order to prepare them for inspection. Then carry out the company's own inspection before inviting prime contractors' quality inspectors. Preparing the products for inspection and doing the inspection assigns the FCM incompatible duties. Because that means FCM inspects his/her own job. Inspecting the job that he/she performed, increases the chance of missing the mistakes and defects in the product. Preparing the products for quality

control and performing the quality control should be the responsibilities of different employees.

Some prime contractors send their quality control inspectors when their order is ready as a final product, but some of them also control the semi-products. The company invites these inspectors when the products are ready for inspection. That means, the company's quality controllers control the products first and if they approve, they invite the prime contractors' quality inspectors. Those quality inspectors come to the production facility and control their orders' quality. If they approve, FCM packages the products and prime contractor takes delivery of the packages. At that point, relations with those inspectors become critical. They may tolerate your trivial mistakes and give you a chance to correct them. If there is a serious defect in the product, company restarts the production and scraps the defected products. Some customers also demand those scraps. For other customers, the scraps are kept in the company for one year and are sold after that.

When the product is completed, final products are transported by the prime contractors' transportation company.

They also cooperate with other approved subcontractors if they detect an unplanned delay in the production. If they realize that they will not be able to deliver the product on time, they work with other subcontractors and share the production volume with them. Since the delivery on time is a significant part of the firm reputation, they put timing the first place and give up from a higher profit. In addition, they have to pay a penalty for each day of late delivery.

Some orders require special equipment for the machines. Supplying that equipment takes time to increase the cost of production.

One of their main prime conductors (customers) TAI provides raw materials for the production. For other orders, responsible employee measures the needed raw materials and prepares a material list and sends it to the Purchasing Manager (PM). PM supplies those materials. Since they are not doing mass production, they purchase raw materials specific to each project. To choose where to supply needed materials, PM receive price offers from three different suppliers and choose the best offer. Best offer mainly means the lowest cost offer. The purchased raw materials are stocked and taken out form the stock when they are needed in the production. They buy raw materials on credit and pay them 60 to 90 days after the purchase. Normally, the accountant of the company handles this payment task. However, in this SME the same person is responsible for both purchasing and accounting (PM). When the due date of the purchase approaches, the supplier informs the firm to remind them to make the payment on time. If the company delays the payment, the seller has lien and retention right. To restrain this, bilateral relations with the suppliers are crucial. If the company has close and confidential relations with the seller, they can ask for an extension of time of payment.
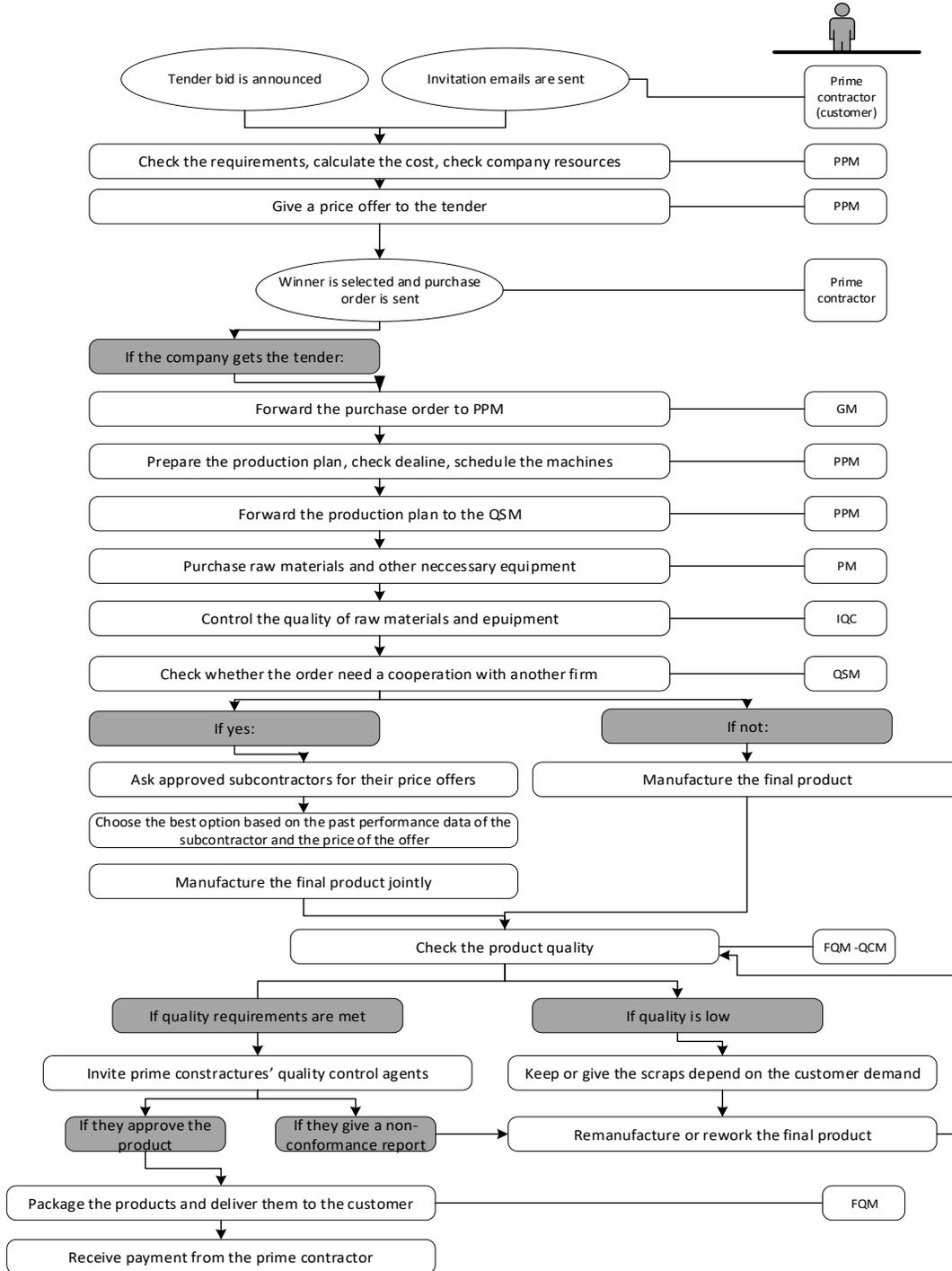
Figure 13: Summary of the Order Fulfilling Process

Incoming Quality Manager (IQM) controls the purchased raw materials and newly supplied equipment in order to check whether they are quality enough for production. There is a high variety of raw material in the sector so the purchasing the correct ones is essential. The seller also must provide the raw materials' certificates to the company.

Using the resources efficiently is an important issue for an SME that currently has budget limitations. Raw material cost should be kept at minimum not to waste the limited company cash. In order to avoid waste, workshop employees should be careful not to make mistake while doing their jobs. Each mistake means more raw material need. In some cases that cost even exceed the profit and end up with a loss from the order.

Majority of prime contractors such as ASELSAN, TAI etc. are large corporate firms with specific working principles. Their requirements and work processes are clearly described and following their rules are enough to work in a harmony with them. However, some managers complain that there is a lack of communication with the customers. When something goes wrong about the order and they want to inform the customer and need assistance with the problem solution, the customer does not respond on time. Their late answers cause a delay of the delivery. However, if the delivery delays, subcontractors' company quality score in the prime contractor's list decreases. Sometimes these late answers even can cause irreversible mistakes in the production and the final product cannot be used.

Electronics and Project Manager (EPM) is responsible for all electronics jobs in the received orders. Also manages and monitor all steps of special projects with government and private organizations. Those projects mostly require very specific and hard to find raw materials. It is essential to check their availability before giving price offer to those projects' tender bid. Finding those materials mostly depend upon the connections in the market. Some materials only supplied by a single producer and some materials needed to be imported from other countries. It is a difficult and time-consuming task to find and convince those sellers to sell their products.

- Hiring Processes

They advertise their open positions on a website to attract applicants. There are two methods of hiring in the company. If the position is for a white-collar job such as an engineer, accountant, manager etc. GM interviews the candidates. If the position is for a workshop job such as operator, apprentice etc. first Chief Workshop Manager (CWM) interviews the candidates and then GM interviews the selected candidates by CWM.

It is not a problem to find white collar employees, for each engineer position the company receives at least 150 applications. However, there is a qualified workshop worker scarcity in the sector. This gives an unwanted power to the blue-collar workers. They immediately quit if they do not like something in the company and easily can find a job in another company. The GM says "if they leave this building now, they can find a

new job before reaching the end of this street". They do not have a fear of losing their job or work commitment. They get paid three times higher than a newly graduate engineer and if someone pays even a little higher wage they quit and go to that company. This also makes it hard to meet the quality standards. One of the company's quality policies is producing correctly at the first trial. However, some workers do not care about wasting the resources and simply ignore taking the responsibility for that waste.

– Certificates, Training and Orientation

Running a business in the defense sector requires some certificates such as AS9100 (meeting Quality Management System standards), Facility Security Clearance Certificate (FSCC) and Production Permission Certificate etc. Firms do not have permission to make production without those certificates. Some certificates are given by the government and some are given by private organizations. These are required in order to control the producers of the military-related products to maintain security and keeping the quality standards as high as possible.

Each certificate has its own requirements, however generally speaking; first, the firm must meet physical requirements about the facility and prepare necessary documents related to it. For instance, FSCC requires a security staff at the entrance of the facility and wire fence around the facility; AS9100 requires a successfully working quality management system and the processes must be documented. After meeting those conditions, employees must get training related to the certificate. Some certificates also arrange exams at the end of the training and trainees must pass these exams to get the certificate. After receiving the certificate, the issuer of the certificate visits the company and control whether they are following the requirements. They repeat this inspection every year.

Each year the Ministry of Defense publishes the list of controlled products which includes war vehicle and equipment, weapons, ammunition and spare parts, military explosive materials, technologies related to these. The company needs a certificate called Production Permission Certificate in order to manufacture these products in the list. Production Permission Certificate is issued by The Ministry of Defense. That certificate assigns a serial number to each producer and by using that number government can track who is the producer of any defense related product. In order to receive that certificate firstly the company must apply nine other ministries and get their approval and then apply the Ministry of Defense. Ministry officers inspect the company for three days and demand a high amount of paperwork. Also, this certificate cannot be used for all products on the list. The company must specify which products they would like to produce and they only get permission for those products.

Besides certificate training, the company organizes its own training, especially for the workshop workers. If they employ an apprentice, his/her master gives the necessary training until the apprentice gain enough knowledge.

There is also training for new machines or new programs in the company. If they purchase a new machine or software, the seller provides necessary training to the company.

All new employees get orientation from the other related department employees. They introduce the facility and the other employees.

- Meetings

In the last couple of years, there were an almost double number of employees in the company. At that time they were arranging regular company meetings. However now, they do not do it anymore. They arrange meetings if a serious problem occur in the company. During the interviews, most of the managers said they find the meetings necessary to provide effective communication and quality information sharing. They demand regular meetings again.

- Customer Relations

Normally, communication with the customers is carrying out via email. Besides, in case of a problem, customers firstly call the company. Each employee is responsible for certain customers and the secretary of the company transfer the call to the responsible employee. If this employee cannot fix the problem, GM takes the responsibility and contact with the customer.

Dealing with the customers has been seen as one of the difficulties in this sector. All customers see their order as the most important job for the company. Even if the managers can handle the entire customer requests well, in case of a single failure the company is identified as a bad company by the customer. One of the main reasons behind that problem is planners of the customers do not know how their orders are produced; they do not have enough knowledge of the production processes. That's why they cannot understand the problems and their solutions during the production. Planners only consider the deadlines, not the process itself.

Since defense is one of the musts of a country, the defense sector is an appealing sector with its limitless job opportunities. Even though it is very difficult to survive, that's why there is a high demand to get in that sector. This results with a strong competition in the sector. High competition gives customers power to push their demands through the manufacturers. Companies are forced to accept customers' rules so as not to lose the customers.

Having ongoing relations with the customers is essential in order to survive in the sector. Prime contractors are attentive to choose their subcontractors which they get along with easily.

- Communication within the Company

Since there are only 35 of them, it is critical to have employees who can get along with each other in order to work in a peaceful and effective environment. When two people have problems with each other, it directly affects the company performance because everybody has an important duty in the SME. If they cannot solve a job-related problem because of their personal issues, it creates uneasiness in the organization.

Most of the internal communication of the company is conducted verbally. They use email if it is possible but especially with the workshop workers they communicate verbally. Most of the managers claim that this creates problems in the work process. Sometimes people claims they did not hear such information or they forget what has been told them. To avoid that, they repeatedly share the important information. Most of the managers told that they would prefer a more formal, written information sharing method. However, it should be kept in mind that written communication is not the best way with workshop workers. They are always busy with a hand work and disturbing them for paperwork might cause delays in the production.

4.1.2   Essential Issues of the Company According to the Interviews

In Table 10, based on the interviews with the managers, the key points for a successful company have been given according to each manager. The bold ones represent the most common answers. Effective communication within the company is the most important things in the company for most of the managers. They believe that works can be done smoothly and most of the problems can be prevented or solved by effective communications. Secondly, having qualified employees have seen as a significant part of a successful organization. The right person should be selected for the right job. They believe if everybody knows their responsibilities and have enough qualifications to achieve their tasks; works can be handled easier and better.

The table also illustrates the gender and experience information about the managers. The time spent in the organization seems not affecting the answers of the managers. Interview duration line shows the time spend with each manager during the interviews (see Appendix A). Each managers willingness to answer the questions changes from person to person. Those times do not represent the total time spend with each manager. For instance, with PPM many small meetings have been held for information sharing such as rich picture drawing and controlling, controlling the order process flow (see Figure 13) etc. All managers were willing to communicate with analyst via email or telephone anytime.

Table 10: Key Points of the Company According to Managers

Title	Production and Planning Manager	Quality System Mngr.	Purchasing/ Accounting Mngr.	Quality Control Mngr.	Electronics and Project Mngr.	Designer	Final Control Mngr.	General Mngr.
Gender	Female	Female	Male	Male	Male	Male	Female	Male
Job Experience in the SME	4 years	9 months	6 months	1 year	3 years	10 years	2 years	owner
Interview duration/min	70	35	70	40	50	35	90	45
	1	1	1	1	1	1	1	3
	2	2	2	3	2	13	14	4
	3	3	3	10	3		15	7
	4	6	6	11	6		16	9
	5	7	7	14	7			
	6		8		9			
	7		9		12			
			15					

1	**effective communication within the company**
2	**adequate number of employees**
3	**qualified employees**
4	adequate number of machines
5	creating the work plan
6	**relationships with other employees**
7	**relationships with other firms in the sector**
8	timely and quality raw material supply
9	delivery of orders on time
10	machines working properly
11	relationships with quality controllers of customers
12	following the work plan
13	properly making and reading the mechanical drawings
14	owning necessary equipment for quality control
15	well defined job definitions
16	peaceful working environment

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4.1.3   Company Hierarchy Table

The SME has a structure as shown in the Figure 14. The General Manager is the head and the owner of the company. Then there are five divisions as production and planning, marketing and sales, human resources, purchasing and accounting, and finance. Production and planning division has its own subdivisions. Since it is an SME almost all division includes one person in it. For instance; one employee takes care of marketing and duties while another employee is responsible for accounting.

As explained previously, not every division has its own employee. The same person is responsible for purchasing and accounting at the same time. Similarly, the Quality Management Representative is also the production and planning manager etc.
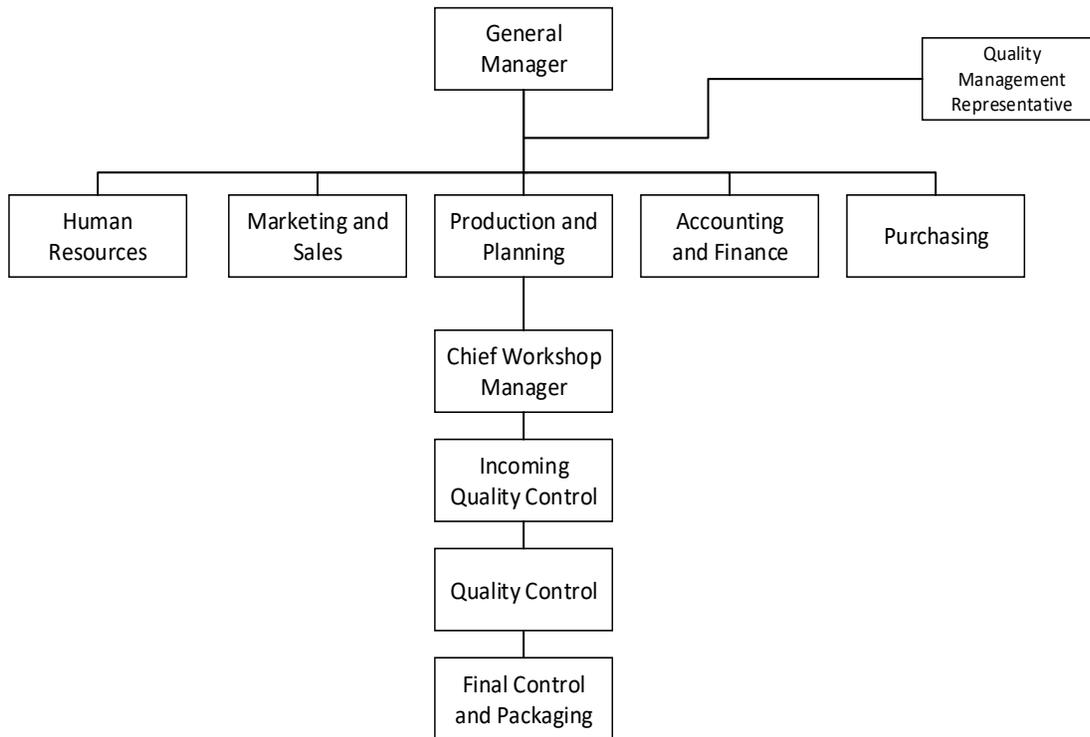
Figure 14: The Hierarchy Table of the SME

Table 11 below shows the minimum job requirements for each position in the company. It includes expected education, experience, language and other job-related qualifications in order to work in the company. Computer knowledge is required for almost all positions. As their main work activity is manufacturing, majority of jobs requires

technical knowledge. Ability of using CAD and CAM programs, operating CMM machine, mechanical drawing and reading are some technical job requirements.

4.1.4   General Manager Job Definition

Responsibilities and Authority:

- To create company policies, to determine quality policy, quality targets and commitments within the scope of AS9100 within these policies, to direct company employees in this direction, to provide coordination between departments.
- Control and monitor the effectiveness of the QMS through regular and scheduled management meetings.
- Ensuring the allocation of resources (budget) for the activities of AS9100 and the activities to be carried out according to these activities.
- To provide short, medium and long-term plans according to the changing market and market conditions of the company.
- To monitor the data related to customer satisfaction and to ensure that the necessary studies are carried out.
- Control service/production studies and plans, and direct service/production according to market conditions. Examining the target sectors and ensuring the creation of business plans for the sectors.
- To determine the company strategy and work plans in order to follow up and receive large scale or strategic jobs, and to provide the training in this subject.
- Reviewing product/service costs and initiating necessary corrective or preventive actions.
- Improving the working environment, ensuring that the necessary measures are taken regarding work safety and worker health.
- To determine the competencies and responsibilities of employees and to work on human resources and career planning.
- Representation of the company at the official authorities to ensure the conduct of business relations with major industrial establishments.

Table 11: Qualification Matrix of the SME – Expected Minimum Qualifications of Employees

TITLE	QUALIFICATIONS											
	Education	Experience	Language	As9100 QMS	As9100 internal audit	Ms office prog.	CAD-CAM prog.	Mechanical drawing/reading	Logo accounting prog.	Workbench ability	Cmm	Measuring device ability
General Manager	University	5 Years	English	☐		☐						
Assistant General Manager	University	3 Years	English	☐		☐						
Human Resources Manager	University	1 Year	English	☐		☐						
Accounting and Finance Manager	High School	1 Year	--	☐		☐			☐			
Purchasing Manager	High School	1 Year	English	☐		☐						
Planning Manager	University	1 Year	English	☐		☐	☐	☐				
Production Manager	High School	5 Years	--	☐		☐	☐	☐		☐		☐
Quality Management Representative	University	1 Year	English	☐	☐	☐						
Marketing and Sales Manager	High School	5 Years	--	☐		☐						
Chief Workshop Manager	High School	5 Years	--	☐		☐						
Quality Control Manager	High School	1 Year	--	☐		☐	☐	☐			☐	☐
Incoming Quality Control Manager	High School	1 Year	--	☐		☐						
Packaging and Final Control Manager	High School	1 Year		☐		☐		☐				
Operator	--	1 Year	--	☐				☐		☐		☐
Apprentice	Apprenticeship Sch. Student	--	--	☐								
Trainee	Vocational High School	--	--	☐								
Burr, Leveling Worker	High School	1 Year	--	☐								

*QMS: Quality Management System

4.2   Application of Two Strands Model of SSM to an SME

In this section, Soft Systems Methodology has been applied to an SME in order to offer define its problem situations and offer possible solutions to them. Two Strands Model of SSM which composed of two main parts as stream of cultural analysis and logic based stream of analysis are applied in this section.

This thesis applied the two strands version of Soft Systems Methodology and benefitted from an interaction with an SME in the defense and automotive component industry through document sharing and semi-structured interviews.

In order to define the problem situation, semi-structured interviews have been held with the employees. In order to make effective and efficient interviews, a questionnaire that consists of open-ended questions has been prepared previously.

One of the main information collection methods in SMM is interviewing with employees. However, each human has different skill levels to express their thoughts with words. Besides that, in SME's workers might abstain from sharing information due to potential conflict with the general manager. In one interview, one of the interviewees nervously asked if the general manager knows about that interviews and whether the analyst (as the professional to solve the problem situations) interviewed with the general manager before them. This problem is believed to be caused by the size of the organization. Since there are limited numbers of workers, the manager can find out the owner of the negative comments and end his/her job. This fear might affect the interviewee' openness and results with biased answers. In addition, in SME's generally, most of the workers are related to the general manager besides a work relationship. They are generally a friend or friend of a friend. This situation also prevents the interviewee give objective and honest answers.

To solve those problems, some questions (see Appendix A) are prepared before the sessions. Those questions were only to spark conversation and lead the speaker to continue to talk. The interviewees seemed more comfortable, after telling them there are questions to help their talking. Without the questions, they seemed confused and did not decide where to start talking even though the method and the aim of the study have explained them previously. In addition to that, it explained to them clearly that the general manager is informed about the interviews and will be carried out under his permission. This simple explanation also helped them to talk more and give information about the company.

The important point is the interviews were not limited to semi-structured questions. Each person has different roles in the organization. Some questions mean nothing for some of the interviewees. For instance, the accountant does not have significant knowledge on production processes. That's why the number of questions had been kept as much as possible by taking into account the diversity of departments. Also, interviewees did not

stop when they are off the topic, quite the contrary they are encouraged to share their thoughts freely. This helped the interview process work more informal and made employees talk more freely.

It took at least two hours for each worker to talk about their job and the company. It observed that women tend to share more information and seem more comfortable during the interview process. Some interviews took up to five hours.

Besides the interviews, some necessary documents are demanded from the company. Their attitude about sharing documents with an outsider was favorable. They provide all required documents such as hierarchy table job descriptions, organization guide, required certificates for production and operation, security rules etc. However, during this process, it is found out that some of the documents were out of date and needed an update. For instance, information about the employees was not kept properly and the hierarchy table was not updated. It was including non-existing job titles and it wasn't clearly defined who is responsible for which job.

Another important point is that the interviewer, the analyst in this study, has a part-time job experience in the company for three months in the past years and has basic knowledge of the work processes of the company.

4.3 Cultural Stream of Analysis

Cultural stream of analysis consists of two main parts. First, based on the interviews, research, and analysis the rich picture will be drawn and in the second part Analysis one, Analysis two and Analysis three will be held.

4.3.1 Rich Picture:

The rich picture is a hand-drawn cartoon that visualizes the company's work processes and working environment. It aims to easily and clearly explain the company's current situation. This picture has been drawn according to the insight collected from interviews and company reports. After the analyst prepares the first draft, it has been discussed with the Production and Planning Manager as he/she knows about all the business processes of the company. The final rich picture has been created based on the PPM's corrections and additions. Anybody can have a basic idea about the company by looking at the rich picture.

The relationships between components of the rich picture that shown with arrows have explained in the company description. The stars indicate the critical persons in the company. They have a high level of authority in the organization and heir worldview affects the company success.

Ministries, quality certificates, employee trainings, competitors and the machines and workbenches that the company owns are the significant parts of company environment.

Therefore, they included with proper symbols in the rich picture. Even tough, General Manager does not directly get involved all of the activities in the company; he monitors all the processes within the company. Therefore, GM is placed at the center of the rich picture.

4.3.2   Analysis One: Intervention Analysis or Role Analysis

This analysis investigates the roles of the employees in the firm to be able to analyze the intervention itself. There are three important roles in this analysis which are "client", "the problem owner" and "the problem owner".

According to the SME in this study, these roles are defined as follows:

- The client(s): The General Manager of the firm. He is a very open-minded, experienced manager that seeks improvements in his company. Also, he is the owner of the company that makes the intervention application easier by supporting the problem solvers to make necessary changes in the organization.
- The problem solver: Ayşe Begüm Kılıç, General Manager, Production and Planning Manager (PPM) (Mechanical Engineer). General Manager is the most powerful person in the organization. It is not possible to make any changes without his consent in the organization. And PPM is the second important person in the company. She organizes the work processes and orders start and end with her in the company.
- The problem owner: Owner of the firm and the firm employees
- Resources: SSM, managers, employees, subcontractors, certificates, Ministry of National Defense and Ministry of Science, Industry, and Technology circular and legislation, one year project time.
- Limitations: The time, high employee turnover rate in the sector, intensive working hours.
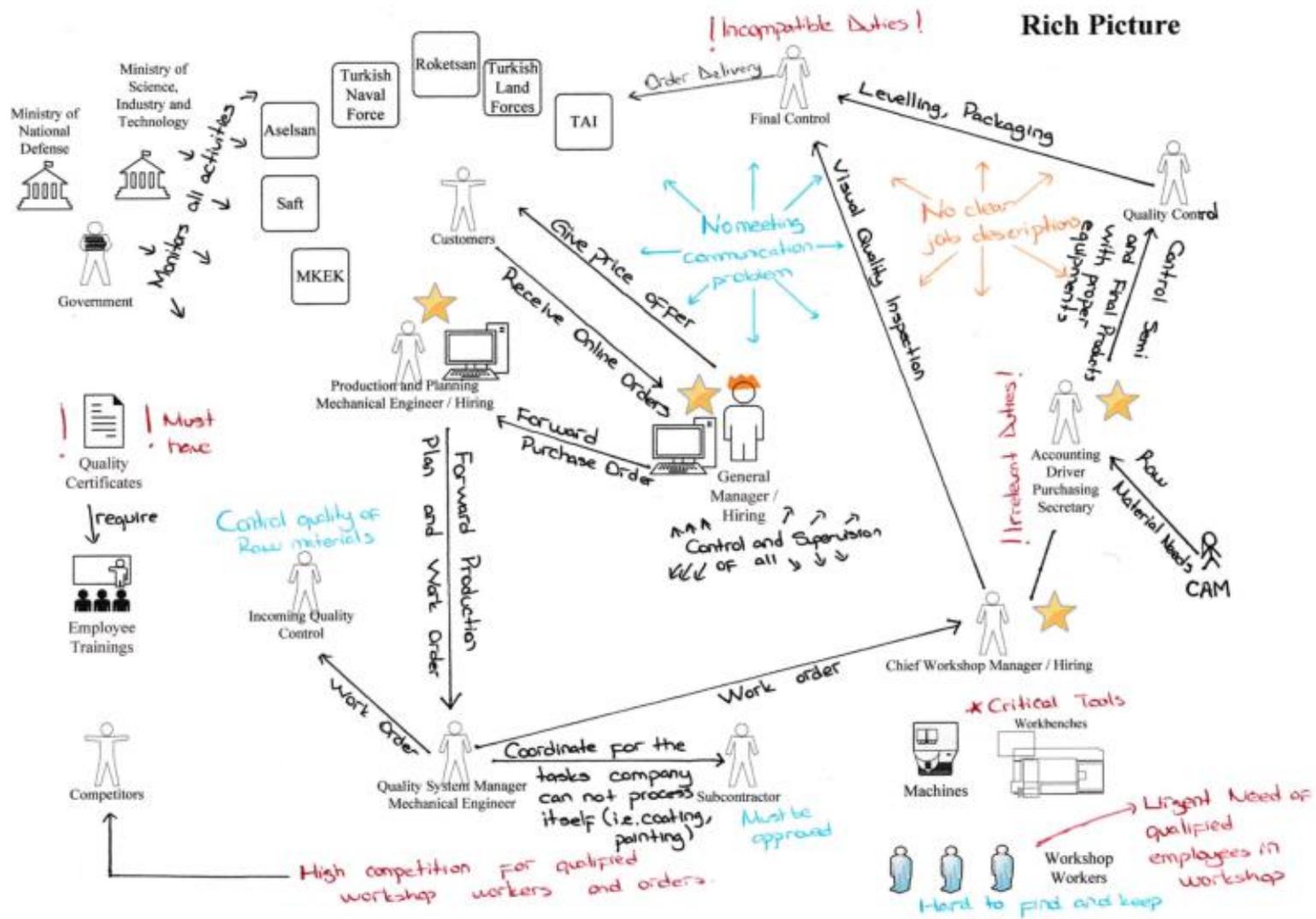
Figure 15: Rich Picture of the Company

4.3.3   Analysis Two: Social System Analysis

The Social system analysis consists of roles, norms and values of the company. The roles are the job positions in the organization chart. The norms are expected behaviors of employees due to their roles. And the values are the standards that decide whether a behavior is good or bad.

i.   Roles:
- General Manager
- Human Resources Manager
- Accounting and Finance Manager
- Purchasing Manager
- Planning Manager
- Production Manager
- Quality Management Representative
- Marketing and Sales Manager
- Chief Workshop Manager
- Quality Control Manager
- Incoming Quality Control Manager
- Packaging an Final Control Manager
- Operator
- Apprentice
- Trainee
- Burr, Leveling Worker
- Secretary
- Customers

ii.   Norms:
- Professional attitude toward customers; such as knowing how to talk with a customer when an unexpected problem occurs etc.
- Taking care of the order details carefully; since they produce for defense and automotive industry even a tiny mistake in the production process results with a huge loss.
- Continuous learning; to be able to operate in the sector the company has to hold the required certificates. Those certificates include obligatory employee training in order to meet the certification qualifications.
- Meeting customers' expectations; such as quality and timing while delivering the orders.
- Following the newest technologies in order to survive in the sector

iii. Values:
- Providing a secure and clean working environment for all employees, especially for production workshop workers
- Working with a collaboration of all employees by adopting the firm vision and mission
- Having positive and constructive attitude towards customers in order to maintain a continuous relationship with them
- Having fair and responsible managers in the organization to maintain a peaceful working environment
- Having the necessary machines and programs to run the business and hiring qualified people to use them
- Effective use of resources; such as human, time and money
- Being honest towards both customers and other employees in the company

4.3.4   Analysis 3: Political Analysis

This analysis deals with the power distribution within the organization. It requires asking questions such as how the power is obtained, used, how it is defended, to whom it can be passed on and how it can relinquish etc.

In this kind of small organizations, mostly the power belongs to the owner of the company. In this case, the owner is also the general manager of the company. That's why he is the most powerful person in the firm. As mentioned before, due to the small size of the company generally each division only has one employee and each person in the organization has different job tasks. When a person quits, since there is nobody that can substitute that person, it gives a really hard time to the company. This gives the employees power of dependency towards the general manager. Similarly, there is a qualified blue-collar worker scarcity in the sector and it is impossible to use expensive machines and produce the orders without them. This gives the workshop employees an unnatural and undesired power in the organization.

Another, important power holders are the Ministry of National Defense and Ministry of Science, Industry, and Technology. They set the industry entrance and working rules and companies have to follow them.

4.4   Stream of Logic Based Enquiry

In this part of the analysis, the relevant systems were determined, named, listed, selected and modeled. After that, the conceptual models are compared with the problem situation within the rich picture. Lastly, according to the comparison results, some suitable and possible changes are recommended.

4.4.1 Determining, Listing and Selection of Relevant Systems of the SME

The relevant systems were determined by problem solver based on the interviews with problem owners. Without regarding the importance of the relevant system all systems are listed below. At final, 18 human activity systems were determined. Those are:

1. A system to improve customer satisfaction

2. A system to minimize delay time of the order fulfillment

3. A system that maintains rules and regulations of Turkish Ministry of National Defense and Ministry of Science, Industry and Technology

4. A system to improve blue-collar workers' work satisfaction and decrease employee turnovers

5. A system that enables efficient information sharing within the company

6. A system to decrease the number of product returns

7. A system that can easily adopt the changes in Turkey's political environment

8. A system to provide adequate and skilled labor force specialized in defense and automotive component industry

9. A system that easily and correctly receives the orders

10. A system to sustain and maintain essential physical conditions of the production facility due to the safety regulations

11. A system to create harmonization among departments of the company

12. A system to improve workers abilities to use the machines properly

13. A system to keep and track the paperwork properly

14. A system that all employees are aware of their job definitions and duties that determined with distinct lines

15. A system that runs formally without affected by personal relationships among workers

16. A system to profit enough to hire sufficient amount of personnel

17. A system to improve customer relationship

18. A system to conduct projects properly with 3rd parties

After determining and listing the relevant systems, a meeting arranged with the general manager of the company. The list has been presented to the manager and the most important three systems have been selected by him. Then, the practitioner (who applies SSM) selected the four most important systems by considering both general managers ideas and other employees' thoughts in the interviews. The final selection has not been made by the general manager's choices because there were some significant problems that were revealed by lower level employees. Unfortunately, they had fear of sharing their problems with the general manager due to the size of the company and relationship with the manager.

4.4.2   Naming and Modeling Selected Relevant Systems

All 18 relevant systems are seen as relevant to the problem situation. However, as explained in the previous section the most important three systems have been selected by the practitioner. The selected systems in the list are number 5, 8 and 14. In this section, these four relevant systems will be modeled.

It has given a high importance to make the root definitions as clear and simple as possible. Root definitions have been created by using CATWOE and PQR analysis that is suggested by Checkland & Scholes (2010).

- **_Relevant System Number 5:_** A system that enables efficient information sharing within the company

Root Definition
A system owned by GM which aims to provide an effective communication system to the company employees by purchasing a system, within the frame of company's budget and employees' skills, that might improve internal communication within the company and increase the company profit.

PQR:
P: Having an internal communication system
Q: Purchasing a system that meets the company's needs and requirements
R: Improving the internal communication within the company

CATWOE
C: Company employees as users of the system
A: GM as the purchaser
T: Inefficient and interrupted flow of information -> effective and easy communication
W: Improved communications can increase the company profit
O: GM as the owner of the company
E: Company's budget, employees' abilities to use the system

| 3'E Criteria |
| --- |
| **Efficacy:** Having an effective and easy communication within the company |
| **Efficiency:** Company's budget for the system |
| **Effectiveness:** Increased profit due to improved communication |
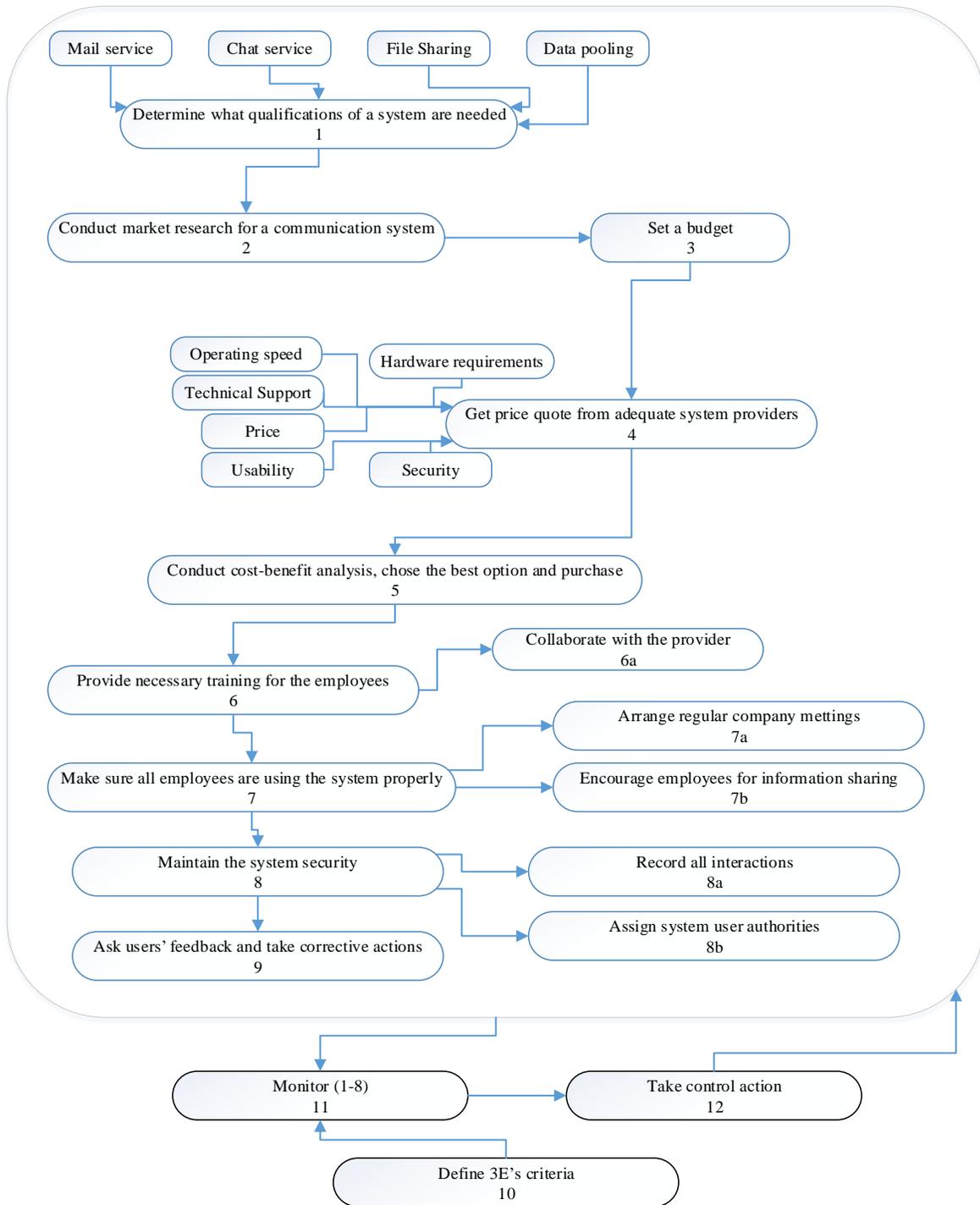
Figure 16: Conceptual Model for Information Sharing

Table 2: Elements of Conceptual Model for Information Sharing

The Elements of Conceptual Model *(Information Sharing)*
Determine what kind of qualifications of a system the company needs such as mail service, chat service, file sharing and data pooling.
Conduct a market research for a communication system and set a budget coordinated with Finance Department
Choose adequate system providers and get a price quote from them. Make the selection by considering hardware requirements, price, usability, security, operating speed and technical support options.
Conduct a cost/benefit analysis, chose the best option and purchase it.
Provide necessary training for the employees provided by the system provider
Make sure all employees use the system properly. Arrange meetings to encourage employees to share information and their ideas face to face beside using the system. Also, encourage employees for information sharing.
Record all interaction goes within the system to maintain security. Assign system user authorities to control who uses the system and limit access.
Ask users' feedback and take corrective actions

- *__Relevant System Number 8:__* A system to provide adequate and skilled labor force specialized in defense and automotive component industry

Root Definition
A system owned by GM which aims to provide adequate and skilled labor force specialized in defense and automotive component industry by spending GM's time and other company resources, reaching new candidates through suitable channels in order to fulfill the company's desire to fill open positions with adequate persons in the company and keep the company work going.

PQR:
P: Providing adequate and skilled labor force specialized in defense and automotive component industry **Q:** By spending GM's time and other company resources, reaching new candidates by using suitable channels and interviewing them **R:** Filling open positions in the company in order to run the business

CATWOE
C: Company itself **A:** Recruiter (GM) **T:** Need to recruit adequate employees -> the need met **W:** Demand of the company to hire skilled employee(s) **O:** GM **E:** GM's time, availability of candidates (deficient number or blue-collar workers), company resources (wage amount etc.)

3'E Criteria
Efficacy: Filling all positions with adequate employees **Efficiency:** GM's time and other company resources (money, paper, internet etc.) **Effectiveness:** The business runs smoothly with a sufficient number of skilled employees
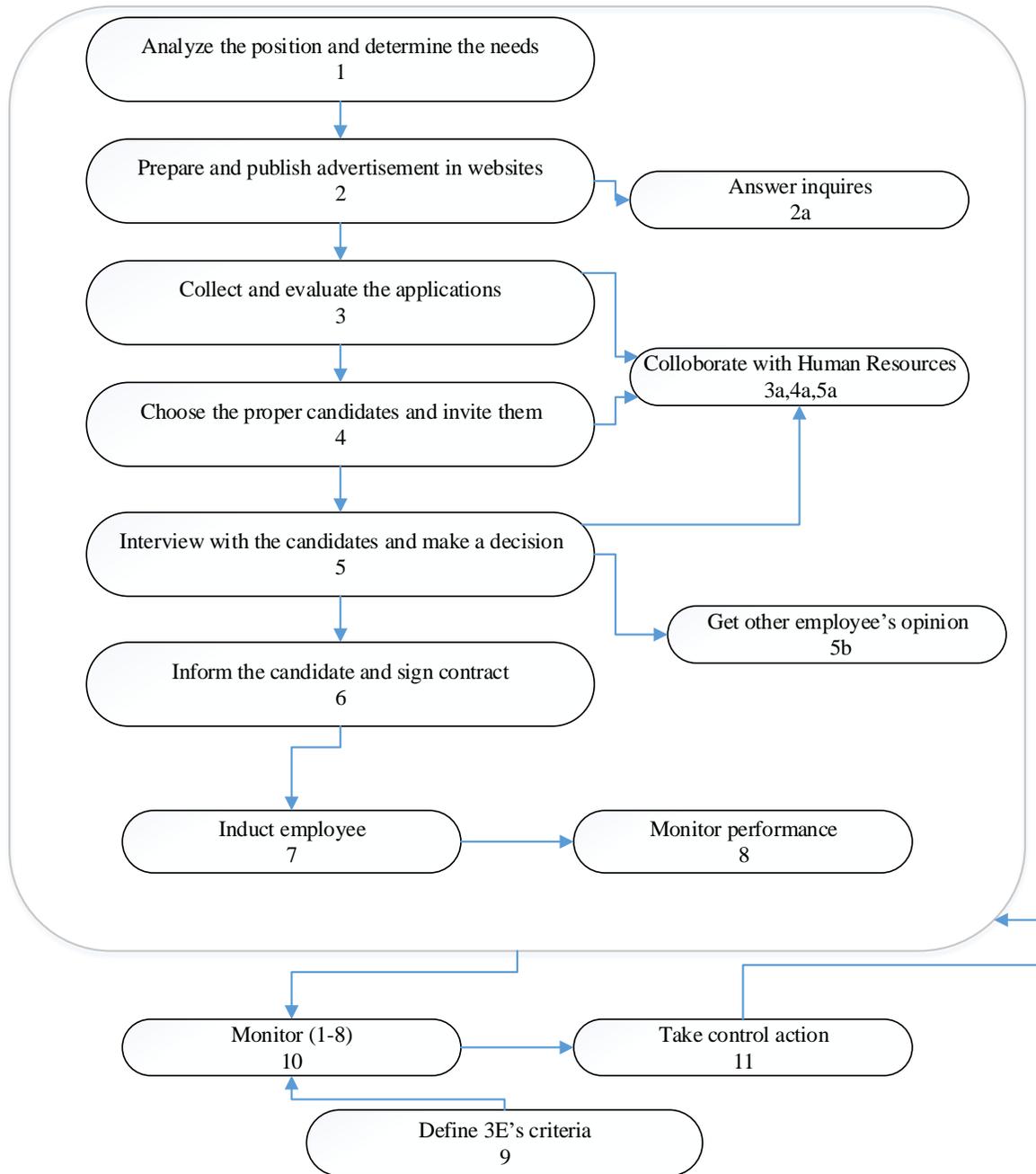
Figure 17: Conceptual Model for Providing Adequate and Skilled Labor Force

Table 12: Elements of Conceptual Model for Providing Adequate and Skilled Labor Force

The Elements of Conceptual Model *(Provide adequate and skilled labor force)*
Analyze the open position and determine the position's required skills according to the job description
Design an advertisement and publish it on related websites. If required, answer inquiries related to the job announcement
When the application deadline is over, collect the applications and evaluate them in coordination with the Human Resources Department (HRD)
Select the proper candidates and invite them to the company for an interview in coordination with HRD
Interview candidates with HRD and make a decision. If a position has a manager, ask for his/her opinion
Inform the successful candidate and sign contract
Induct the new employee
Monitor new employee's performance

– _**Relevant System Number 14:**_ A system that all employees are aware of their job definitions and duties that determined by distinct lines.

Root Definition
A system owned by GM which aims to prepare job descriptions and specifications by assigning an employee from the company in order to improve employee satisfaction and provide them clear aims by solving the confusion caused by unclear job descriptions.

PQR:
P: Preparing job descriptions and specifications

Q: Assigning an employee from the organization

R: Improving employee satisfaction by solving the confusion caused by unclear job descriptions |

CATWOE
C: Company employees

A: Assigned employee

T: Unspecified, confusing job descriptions ->clear job descriptions and specifications

W: Well-defined job descriptions improve employee satisfaction and performance

O: GM

E: Assigned employees abilities, time limit |

3'E Criteria
Efficacy: Improving employee satisfaction by having well-defined job descriptions

Efficiency: Assigning minimum number of employees and spending minimum time

**Effectiveness:** More successful company with improved employee satisfaction |
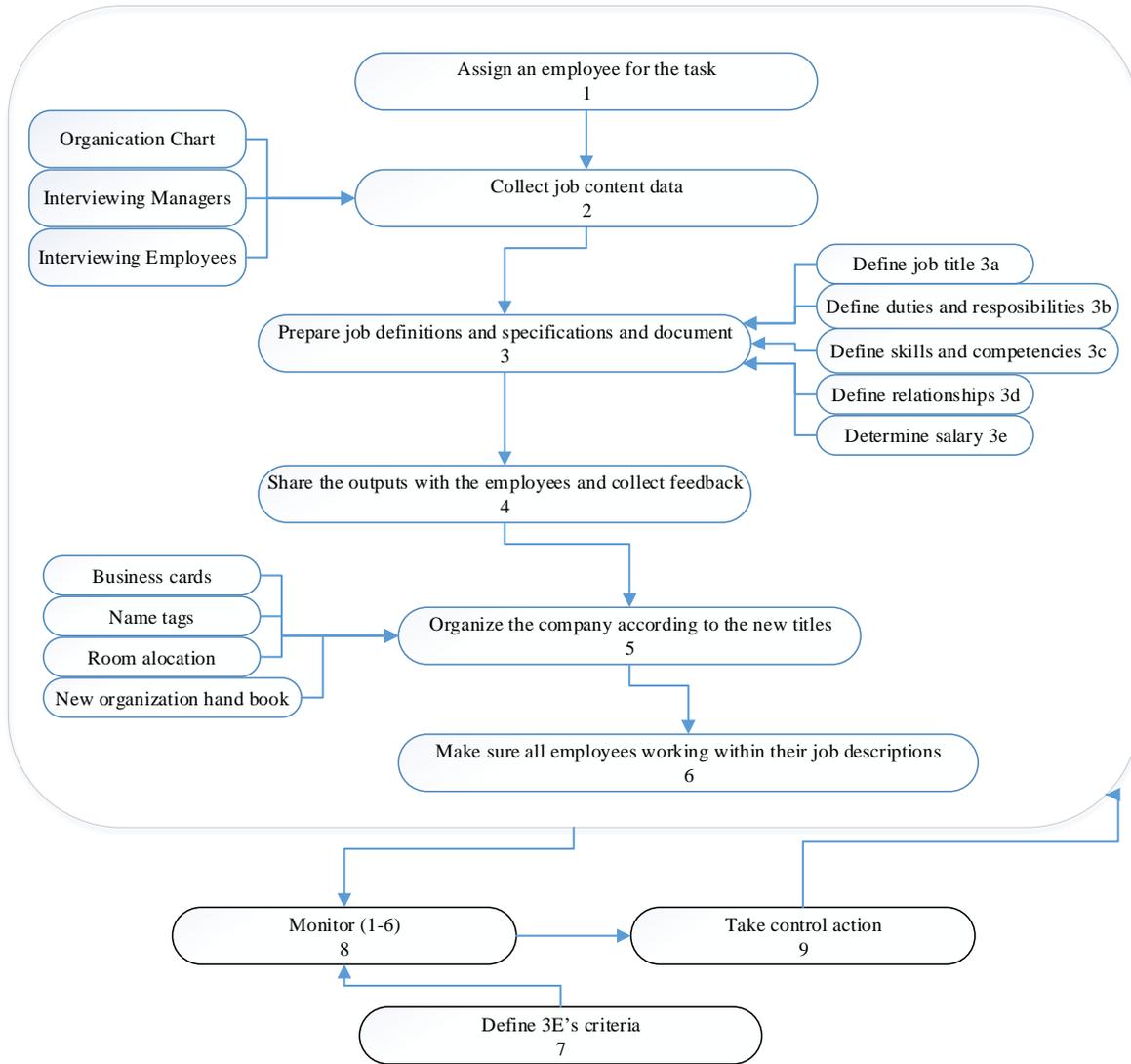
Figure 18: The Conceptual Model for Preparing Job Descriptions and Specifications

Table 13: The Elements of Conceptual Model for Improving Blue-Collar Workers' Satisfaction and Decrease Employee Turnovers

The Elements of Conceptual Model *(*Preparing Job Descriptions and Specifications*)*
Assign an employee to prepare the job descriptions and specifications
Collect job content data from related documents like organization chart. Interview with both managers and employees to understand the needs of the employees.
Prepare job definitions and specifications by defining the job title, duties and responsibilities, skills and competencies and relationships. Then determine the salary for each job and document.
Arrange meetings and share the outcome with the employees and listen to their feedbacks. If necessary make changes.
Organize the company according to the new titles with new business cards, name tags, new room allocation based on the role of the employee and update organization handbook to keep all information documented.
Control whether all employees are working within their job descriptions.

4.4.3   Comparing Conceptual Models with the Perceived Existing Problem Situation

In order to compare conceptual models in previous sections with real-world situations, the matrix method has been applied. The left-hand side of the matrix shows the required activities in order to achieve the conceptual model's objective. The next column states whether this activity already exists in the real world or not. If yes, the next column explains how it is happening in the organization. The next two columns show if these activities are desirable and feasible in the organization. Then finally the right column shows the comments and suggestions on achieving that activity.

To fill the matrix, a meeting has been organized with GM and an engineer who visualized as a critical person in the rich picture. After the activities listed by the analyst, they discussed within the group. GM and the engineer shared their opinions in order to fill the matrix as accurate as possible.

Table 14: The Matrix of Comparing Information Sharing Conceptual Model with Real-World Situation

Activity	Exist or not in real world	How is it done?	Desirable	Feasible	Comments
1. Determine the required system qualifications	No	None	Yes	Yes	GM can assign an employee(s) to determine the needs. The system should include mail service, chat service, file sharing and data pooling.
2. Conduct market research for a communication system	No	None	Yes	Yes	Most of the system providers have detailed websites suitable for research. Since it is an expensive task, the research part is very important.
3. Set a budget	No	None	Yes	Yes	According to market research, a budget should be set for the new system. This step should be done under GM's supervision.
4. Get a price quote from adequate system providers	No	None	Yes	Yes	Needs of the company should be clearly expressed to the provider. Based on that information providers might offer different prices than their online catalogs.
5. Conduct cost-benefit analysis chose the best option and purchase	No	None	Yes	1. Yes 2. Partially	1. The analysis can be conducted by an employee. 2. The company may not afford a project budget in the short term.

6. Provide necessary training for the employees	No	None	Yes	Yes	Employees must learn how to use the new system properly. If not, the project becomes a waste of money. Different job categories might require different levels of training. Employees' education background must be considered.
6a. Collaborate with the provider	No	None	Yes	Yes	Training must be provided by the system provider. They should also give technical support after the training. These should be stated in the contract.
7. Make sure all employees are using the system properly	No	None	Yes	Yes	Getting used to the system might require some control and pressure on the employees.
7a. Arrange regular company meetings	No	None	Yes	Yes	Communication in the organization can not only be supported by a system. In order to have a proper communication regular company meetings must be organized. This also decreases the unnecessary workload on the system.
7b. Encourage employees for information sharing	No	None	Yes	Partially	Being an SME both make communication easier and harder. It is easy to reach people, but hard to communicate openly due to close relationships. This must be considered and employees must feel free to share their opinions.

8. Maintain the system security	No	None	Yes	Yes	Security should be maintained by both the system provider and the users. Especially, competitors might want to steal the inside information of the company. Defense industry requires strict security. Information sharing must be limited and under control.
8a. Record all interactions	No	None	Yes	Yes	All the system interactions including chats, file sharing must be recorded and controlled.
8b. Assign system user authorities	No	None	Yes	Yes	Users should have access according to their position in the company. Since GM has the highest position in the company, he should have the full access authority.
9. Ask users' feedback and take corrective actions	No	None	Yes	Yes	Users might not like some features or demand additions to the system.
Relationships 2-4 3-4-5 6-7					

Table 15: The Matrix of Comparing Providing Adequate and Skilled Labor Force Conceptual Model with Real-World Situation

Activity	Exist or not in real world	How is it done?	Desirable	Feasible	Comments
1. Analyze the job position and determine the needs	Yes	The GM and experienced employees in the open positions' department specify the need.	Yes	Yes	They already know what the qualifications and personal traits of a new employee should be. Since it is a small sized organization, the need can be determined quickly. An external research for candidates such as from competitors' employees can be conducted.
2. Prepare and publish advertisement at websites	Partially	The job ads only published in a limited number of websites.	Yes	1. Yes 2. Partially	1. The number of websites, including their own website, should be increased. 2. Using job searching websites might not be an effective way to reach blue-collar workers. Using existing employees to find new employees to work in production might be a better idea.
2a. Answer inquiries	No		Yes	Yes	GM can assign an employee to answer questions of candidates. Email address of this employee can be added to the ads and ask candidates to email in case of an inquiry. Since all employees are already busy with an excessive workload, asking candidates to only contacting with email can save time. Answering questions also save time by eliminating unsuitable candidates.

3. Collect and evaluate the applications	Yes	One of the engineers is responsible for that job.	Yes	1. No 2.Yes	1. Using an engineer for this task is wasting that employee's skills. Assigning an employee from the management side would be better. However, there is not any employee who is suitable for that responsibility. 2. Collecting the applications online can save both applicants' and company's time.
3a,4a,5a. Collaborate with Human Resources	No	None	Yes	Partially	The organization should have a Human Resources Department a Human Resources Manager.The company should allocate a budget for that department, despite it seems difficult in near future due to money shortage. An HRM should have a voice in step 3, 4 and 5 in order to make a rational and successful choice.
4. Choose the proper candidates and invite them	Yes	GM selects the candidates and the engineer invites them by calling.	Yes	Yes	An invitation email would be better in order to have a written document of the selection process. Besides, only emailing might not be a proper way to reach blue-collar workers.
5. Interview with the candidates and make a decision	Yes	Blue collar workers first get interviewed by CWM, then GM interviews the selected candidates. White collar workers directly get interviewed by GM.	Yes	Yes	If there is, the manager of the related department should join the interviews. Questions should be previously prepared.

5b. Get other employee's opinion	No	None	Yes	Yes	If there is, asking other employee's (who has a close working relationship with the open position) opinion make the employee feel respected. This affects their motivation positively.
6. Inform the candidate and sign contract	Yes	The engineer informs the successful candidate and the new employee signs a contract	Yes	Yes	A trail contract should be made in order to see the new employee's performance. The new employee should be clearly informed about the position's job description.
7. Induct employee	Yes	After signing the contract new employees start their job.They get orientation from an available employee. Training mostly provided by the employee who is going to leave the job after transferring the necessary information to the newcomer.	Yes	Yes	Necessary training and orientation should be provided to the new employee.

8. Monitor performance	Yes	The GM evaluates the performance	Yes	Yes	A performance evaluation system can be used in order to make evaluations regular and objective.
Relationships 1-2 3-4-5-6 2-3 6-7 3-4 7-8 4-5					

Table 16: The Matrix of Comparing Providing Preparing Job Descriptions and Definitions Conceptual Model with Real-World Situation

Activity	*Exist or not in real world*	*How is it done?*	*Desirable*	*Feasible*	*Comments*
1. Assign an employee for the task	No	None	Yes	1. Yes 2. Partially	1. An experienced employee who knows the organization culture and work processes well can be assigned for the task. 2. Since the company is an SME with a limited number of employees and has many open positions, each of them has an excessive workload. It might be hard to find a proper employee to handle this task. It would be suggested to hire a new employee for the management tasks. However, due to budget constraints, it might not be a feasible solution for the near future.

2. Collect job content data to define titles	Partially	Organization Hand Book includes Organization Chart	Yes	Yes	The organization chart in the OHB needs to be updated according to the changes in the organization. It still shows former employees and unused departments. Interviewing managers and employees can provide sufficient information.
3. Prepare job definitions and specifications and document them	Partially	OHB includes part of it	Yes	Yes	Some jobs already have their definitions and specifications in the OHB. However, they need to be updated and new titles should be added to the OHB.
3a. Define job title	Partially	OHB includes part of it	Yes	Yes	Some titles are already stated in the OHB. However, they need to be updated and new titles should be added to the OHB.
3b. Define duties and responsibilities	Partially	OHB includes part of it	Yes	Yes	Some job duties and responsibilities are already stated in the OHB. However, they need to be updated and new titles should be added to the OHB.
3c. Define skills and competencies	Partially	OHB includes part of it	Yes	Yes	Some job skills and competencies are already stated in the OHB. However, they need to be updated and new titles should be added to the OHB.
3d. Define relationships	No	None	Yes	Yes	Reporting lines and working relationships must be included in the job descriptions.

3e. Determine salary	No	None	Yes	Yes	This step should be handled under GM's supervision. Company budget and market conditions should be considered in order to satisfy the employees.
4. Share the outputs with the employees and collect feedback	No	None	Yes	Yes	Several meetings with different job levels can be arranged. Missing or disquieting points can be corrected.
5. Organize the company according to the new titles	No	None	Yes	Yes	Employees' business cards, name tags should be updated in order to prevent confusion. This also directly affects relationships with customers. They want to make contact with the right person in the company. Employees' rooms should be reallocated according to the job relations in order to save company resources while working. OHB must be updated according to all new information to keep everything documented.
6. Make sure all employees are working within their job descriptions	No	None	Yes	Yes	It is important to stayin the job boundaries while working, to not disturb other employees. It affects the working environment and success of the organization.
Relationships 2-3 3-4 3-5					

4.4.4   Determining the Desired and Feasible Changes in the Organization

There are three kinds of changes: changes in structure (changes in task and role responsibilities), changes in procedures (change in process and work activities) and changes in attitudes (changes in people's perception of the situation) (Checkland, 1995, p.180). It is important that the changes must be feasible and desirable for the organization in order to apply them in real life. The suggested changes are given separately for three conceptual models.

1. The necessary changes in order to improve the internal communication within the company by purchasing a communication system are listed below.

a. Structural Changes:

- An employee should be assigned to determine the needs and the assignment should be done under the GM's supervision (desirable and feasible).

- An employee should be assigned to conduct a cost-benefit analysis (desirable and feasible).

- GM can arrange regular company meetings at first, and in time the meetings can be conducted by department managers (desirable and feasible).

- In order to maintain security users should have access to the system according to their job position in the organization (desirable and feasible). GM can have the full access authority due to its highest position in the company (desirable and feasible).

b. Procedural Changes:

- The assigned employee should conduct a market research for a new communication system by using the providers' websites (desirable and feasible).

- The GM should determine a budget by considering the market research results (desirable and feasible).

- According to the set budget, the employee should ask for a price offer from adequate providers. Needs of the company should clearly be expressed to the provider to fulfill all the needs (desirable and feasible).

- Conducting a cost-benefit analysis can provide a professional view of the situation (desirable and feasible).

- The proper system that meets the company needs and expectations should be purchased after the selection of the best option (desirable and infeasible).

- To use the system properly, the system provider should provide the necessary training to the employees. Employee's educational background might diversify the context of those training (desirable and feasible).

- It should be clearly stated in the contract that the service provider will provide the training and technical support after the purchase (desirable and feasible).

- Meetings have significant importance in order to keep a healthy information sharing and communication in an organization. These meetings are a must to support the communication system and reduce the unnecessary workload on the system (desirable and feasible).

- Security of the system should be maintained by both the system provider and the users. Defense industry requires strict security (desirable and feasible).

- All interactions within the new communication system should be recorded in order to limit and keep under control the information sharing (desirable and feasible).

c. Attitudinal Changes:

- The assigned employee should be aware of the importance of the duty and be willing to work. Especially conducting a market research and getting a price offer requires employee's attention (desirable and feasible).

- The relationships with the provider can both affect the price and the after-sales services (desirable and feasible).

- The company includes different type of workers who have different levels of education. These differences affect the perceptions' of the employees to a new communication system in the organization. Each worker should clearly understand why there is a need for such a change and accept being a part of that change (desirable and feasible).

- The top management should ensure employees use the new communication system properly. Otherwise purchasing a system does not mean anything but a waste of money. This can require some pressure from the top management to the employees to enforce the usage of the new system. Employees should be aware of the benefits of the system (desirable and feasible).

- Employees should be open to information sharing. The size of the organization limits the employees' openness due to a potential conflict with the GM. Therefore it is really important to get a support information and idea sharing from the GM (desirable and feasible).

- Employees' feedback should be collected in order to take corrective action. As system users, they might not like some features or demand additions to the system (desirable and feasible).

2. The necessary changes in order to provide adequate and skilled labor force are listed below.

a. Structural Changes:

- Since the company does not have an HRD there should be an employee who is officially in charge of hiring duties (desirable and feasible).

- GM should assign an employee to answer queries of the people who wish to apply the open job position (desirable and feasible).

- Instead of an engineer, an employee from the management should be assigned for hiring duties (desirable and infeasible).

- The company should allocate its budget to have an HRD and a human resources manager (desirable and infeasible).

- In order to select the most adequate candidate, interviews should be held by the GM and department managers (desirable and feasible).

- An employee for each department should be assigned to fulfill the orientation duty (desirable and feasible).

b. Procedural Changes:

- Open positions' job requirements and qualifications and personal traits of the people who will be hired should be determined (desirable and feasible).

- Competitors' current employees can be checked to offer the open job position to them (desirable and feasible).

- Job advertisements should be prepared and published at job searching websites (desirable and feasible).

- Amount of the websites to advertise the job ads can be increased. Company's own website can be used, too (desirable and feasible).

- Using job searching websites might not be an effective way to reach blue-collar workers. Using existing employees to find new employees to work in production might be a better idea (desirable and feasible).

- Email address of the employee who is in charge of answering the queries should be provided in the job advertisement so the candidates can reach the company (desirable and feasible).

- Answering the questions by email can save time by eliminating unsuitable candidates (desirable and feasible).

- Collecting online applications for the open job position can save both applicants' and the assigned employee's time (desirable and feasible).

- By considering the company's requirements proper candidates should be selected from the applicant and get invited to the company (desirable and feasible).

- Besides a phone call, invitations should be sent via email in order to have a written document of the process (desirable and feasible).

- It should be taken into account that using the email might not be the best way to reach the blue-collar workers to announce the hiring results (desirable and feasible).

- GM and the manager should prepare the questions previously and conduct the interview (desirable and feasible).

- If there is, the opinions of the employees who are going to have a close working relationship with the candidate should be taken into account during the selection process (desirable and feasible).

- After the selection process, a trial contract should be signed with the new employee in order to monitor his/her performance for a certain period of time (desirable and feasible).

- Necessary training and orientation should be provided to the new employee to introduce her/him the company and people (desirable and feasible).

- The company can use a performance evaluation system or tool in order to handle newcomers' performance evaluations regularly and objectively.

c. Attitudinal Changes:

- Since all employees already have excessive workload, asking the candidates to contact the company only via email can be very helpful for the assigned employee (desirable and feasible).

- If there is, the manager of the open position should join the interviews (desirable and feasible).

- Asking other employees opinions about the new prospective candidate can make the employees feel respected and improve their motivation towards the work (desirable and feasible).

- The new employee should be fully aware of his/her duties in the company to able to meet the company's expectations (desirable and feasible).

- Since the company manufactures for the defense industry, the products are very sensitive and detailed products. Especially, the workshop employees should be very careful and attentive throughout the production process (desirable and feasible).

3. The necessary changes in order to prepare job descriptions and specifications to improve employees' satisfaction by solving the confusion caused by unclear job descriptions are listed below.

a. Structural Changes:

- An experienced employee who knows the organization culture and work processes well should be assigned to determine the job descriptions and specifications (desirable and feasible).

- Since the company is an SME with a limited number of employees and has many open positions, each employee has an excessive workload. It can be hard to find a proper employee to handle this task. The company can hire new employees to help management tasks (desirable and infeasible).

- Employees' should be informed about the new organization chart. The new chart might cause some changes in reporting order and hierarchy within the company (desirable and feasible).

b. Procedural Changes:

- The assigned employee should do research about the present job positions within the company to figure out what jobs need to be described. Interviewing managers and employees can provide sufficient information about employees' tasks (desirable and feasible).

- A new organization chart should be created by updating the old one in the OHB that includes former employees and unused departments (desirable and feasible).

- Job definitions and specifications should be documented for each present job in the company (desirable and feasible).

- Job titles should be updated by making necessary changes and additions (desirable and feasible).

- Job duties and responsibilities should be updated by making the necessary changes and additions (desirable and feasible).

- Required job skills and competencies should be updated by making the necessary changes and additions (desirable and feasible).

- Job relationships which explain reporting lines and working relationships should be defined and added to the OHB (desirable and feasible).

- OHB should be updated with all changes and additions mentioned above (desirable and feasible).

- Salaries of each job should be determined under GM's supervision by considering company budget and market conditions (desirable and feasible).

- Meetings should be arranged to announce the new titles etc. and ask employees' for feedback (desirable and feasible).

- The company should be reorganized according to the new titles. Employees' business cards, name tags should be updated in order to prevent confusion. Employees' rooms should be reallocated according to the job relations in order to save company resources while working (desirable and feasible).

- Customers should be informed about those changes. Customers want to contact the right person in the company (desirable and feasible).

c. Attitudinal Changes:

- New organization chart might change some employees' hierarchical order within the company. Those changes should be accepted by the current employees (desirable and feasible).

- Market conditions should be investigated while determining the salaries to ensure the satisfaction of the employees (desirable and feasible).

- Separate meetings can be held with different job levels for the new structure announcement to promote idea sharing (desirable and feasible).

- For a successful healthy working environment employees should be aware of their new job descriptions and stay within their job boundaries while working (desirable and feasible).

CHAPTER 5

CONCLUSION

5.1   Discussion

This discussion part aims to discuss of SSM and its use based on the question-answer part in (Checkland & Poulter, 2006).

SSM does not identify the ideas for the improvement on the system on its own. It is just a tool to help the analyst to identify the ideas. It guides those using SSM to define the problem situation and find their way to figure out the reasoned ideas for improvement. SSM enables its users to use their intellectual capacity to carry out a thinking process.

(Checkland & Poulter, 2006) claim that there is not a wrong way to use SSM. However, implementing the methodology very strictly, instead of thinking about each step of the application may decrease the value of the methodology. Following a prescriptive approach, may affect the users' perspective of the situations which is a significant concept for proper SSM application. Each step that taken in the SSM requires thinking and learning about the matter at hand.

SSM can be used in any human situation which seems like it could be improved. The feeling of something needs to done about this situation is a sufficient reason to apply SSM. Once the method internalized as a way of thinking, it can be used to handle the operation of managing anything.

SSM does not have a timescale. It depends on the expectation of the user. Some studies have taken years. However, even in daily life SSM can be used partially. For instance, in a meeting by using CATWOE and PQR analysis, a certain problem situation can be examined in a couple of minutes.

SSM uses hand drawn and smooth cornered diagrams to reflect an organic view instead of mechanical impression as in the engineering and management science. Hand-drawn pictures and diagrams seem more humanly and easy to makes change on them in a changing environment.

5.2   Conclusion

Small and Medium Sized Enterprises have significant value for the economy as being a source of employment opportunities and creating a large portion of the total added value. Guiding them to solve their problems or improving their work processes is beneficial for both parties as researchers gain real-world experiences. This thesis aims to improve an SME's work processes by adopting the Two Strands Model of Soft Systems Methodology.

This study showed how Two Strands Model of SSM can be applied in order to improve the performance of an SME in defense and automotive component sector. The results showed the methodology is applicable to such an organization. At the end of the study, the possible solutions are shared with the problem owners and discussed how they can be implemented in the company. Some of the suggestions such as arranging meetings has been started to applied and positive changes in the company environment has been observed. Not only making suggestions at the end of the study but also implementing the SSM was a very interactive process. As the interviewees told, asking basic questions during the interviews such as "what does this company do?" or "what is your duties in the company?" made them think of their current position in the company and review the company processes.

This study offered possible solutions to the three of the company's main problems. Firstly, hiring adequate and skilled labor force was a very urgent necessity of the company. Especially, lack of qualified blue-collar workers is one of the significant problems of the company. The hiring process is critical in order to reach those needed skilled people. Secondly, during the interviews, some managers complained about not having well-defined work definitions that limit people and make them focus on their own jobs. Some managers are dealing with excessive workload results from having unrelated and incompatible duties. Having well-defined job descriptions is also required in order to carry on a successful hiring task. Third problem situation was ineffective communication in the organization. Almost all of the managers complained that information sharing is too informal and ineffective in the organization. This study expects to improve company performance by offering possible solutions to these three important problems. As increasing the profit is the primary task of a non-profit organization, improved performance is an essential help for the company.

Another conclusion is that this study uncovered many problem situations, especially in the defense sector. To develop such an important sector and increase its performance working on these problems might be very beneficial for the national economy.

The most difficult part of the SSM application was data collection. The interviewees willingness to share data is essential part of the application. In order to collect quality data, all employees in the organization must be convinced to share information with the analyst. Employees should be clearly understand what the aim of this study is and why the analyst wants to ask those kind of questions to them. After the data collection part,

when the analyst understand and learn the environment and how the organization work and familiarize with the organization, all other SSM steps are easy to follow.

Another essential point is that only interviewing the employees and collecting the documents are not enough to apply SSM to an organization. Spending some time in the organization and seeing their everyday flux is a must. By doing this, the analyst could figure out some biased answers of the employees and realize the problems that employees are not aware of by seeing the big picture.

5.3   Contribution to Learning

The literature review results impose a high importance to this thesis as it provides an insight about a topic that has not been studied yet. As found in the literature this thesis is the first study that applies Two Strands Model of SSM on defense and automotive components industry, also one of the firsts in applying the methodology to a real-life case.

It can be concluded that there is a need for more studies to reach sufficient knowledge about SSMs application to SMEs. Also, lack of studies in defense and automotive component sectors also constitutes a gap in the literature. More importantly, there are very few researches that focus on Two Strands Model of SSM. Therefore, this study is expected to provide significant insight into SMEs that operates in those sectors in Turkey and serve as a model of the methodology in the literature.

5.4   Limitations of the Study

The data collection in this study depends on interviewees' willingness to share their ideas and knowledge, also the degree they share their documents. There might be missing points due to the lack of information sharing with the analyst.

5.5   Challenges of the Study

Providing quality data was the main challenge of the study. Firstly, since it is a small organization, fear of sharing information due to potential conflict with the general manager was affecting the accuracy of data. Unfortunately, this fear affects the interviewee's openness and results with biased answers. Mostly the workers are related to the general manager besides a working relationship. They are generally a friend or friend of a friend. This situation also prevents the interviewee give objective and honest answers.

The second issue is the accessibility of data. Again, because of the size of the organization, each person has completely different job tasks. When a person quits, the information leaves with that person. It makes it harder to collect data.

Another challenge is SMEs does the paper works at a minimum level. It makes it hard to track their operations and past interactions.

Mostly the SME employees are not familiar with the academic jargon. During the data collection, explaining the terms might take time so the questions should be clear for all parties.

5.6   Delimination of the Study

In this research, the interviews only conducted the significant employees in the company. The significance is determined based on the analyst's past job experience in the company and guidance of the General Manager.

This study focuses on a defense sector and auto-component supplier in Turkey. Therefore, this work is limited by the organizational culture, location, business model and the sector in which this research was done.

5.7   Recommendations for Future Research

The study can be conducted in a more detailed way. Instead of investigating the organization as a whole, a particular work process or department can be selected to improve its performance.

In future studies, larger organizations can be investigated and with the collected large amount of data quantitative analysis can be conducted in order to support the SSM findings. The effect of gender or time spend in the organization to the interview can be investigated.

There are other qualitative methods such as Grounded Theory. Those methodologies can also be investigated and evaluated if they are applicable for such cases in this study. And the results can be compared and discussed.

A future study might explore the defense and automotive sectors more deeply and research can focus on sector-specific problems. Also, this study revealed many problems within the sector and offered possible solutions to only three of them. Future studies can work on the other problems and help the organization to solve them.

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APPENDICES

APPENDIX A

QUESTIONNAIRE

Those questions were only to spark conversation and lead the speaker to continue to talk. The interviews were not limited with those questions.

Q1. What is the name of your firm? In which sector are you operating? Can you summarize what your company is doing?

Q2. How is the hiring process in your company? Who decides whom to hire?

Q3. Do employees get any training after the hiring?

Q4. Do you have an organization chart?

Q5. Do you clearly know your job definition and your duties?

Q6. Do you regularly have meetings?

Q7. What is the most essential thing in your job according to you? What are the things that your company needs in order to survive?

Q8. Who is responsible for customer relations? Who is dealing with customers? Do you think you are successful on that?

Q9. How do you supply your raw materials? Who is responsible for that duty? What are your supplier selection criteria?

Q10. What are your steps when you received an order?

Q11. Do you think there are enough personnel in the company to run the business successfully?

Q12. What are the main problems that you face in the company either related with company or the sector?

Q13. What are the difficulties that results from the nature of your business?

Q14. Are collaborating with your competitors in any project? Would you like to do it?

Q15. Do you have partners? What are your selection criteria?

Q16. How do you achieve information flow in the company? Are you satisfied with the current situation?

Q17. Do you have an institutional/professional work environment? In what extend the bilateral relations are effective on business? Is that causes any problem?

Q18. In what extend the customers are effective on business? Can they cancel or return the orders?

Q19. In what extend the quality certificates are important for your business? Is there anything necessary besides certificates to do your job?

Q20. Do you have any expectations from your company to do your job better or make your company more successful? Is there anything you think it should change about the company?

Q21. Do you think the sector is dealing with any problems? What are the difficulties in the defense and automotive sector?

Q22. Are there any missing points that we have not discussed related to your duties in the company? Do you have anything significant for you to add besides the questions?