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AN EMPIRICAL INVESTIGATION OF POTENTIAL RELATIONSHIPS BETWEEN ORGANIZATIONAL CULTURE TRAITS AND PROBLEM SOLVING PRACTICES TO SUPPORT LEAN TRANSFORMATIONS

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THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of
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By

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ABSTRACT

AN EMPIRICAL INVESTIGATION OF POTENTIAL RELATIONSHIPS BETWEEN ORGANIZATIONAL CULTURE TRAITS AND PROBLEM SOLVING PRACTICES TO SUPPORT LEAN TRANSFORMATIONS

Organizational culture can be defined as a set of values and behavior that contribute to the unique social and psychological environment of an organization. It is the major contributing factor in determining the progress of an organization towards the desired objectives. The importance of organizational culture for successful Lean transformation has been emphasized prior research.

Lean implementation is based on continuous improvement, the achievement of which is based on problem solving practices. For sustained continuous improvement, problem solving must be done in a repeatable and disciplined way. However, not many organizations follow a structured approach towards problem solving. Some preliminary research indicates that organizational culture appears to be an important factor that influences the nature of problem solving practices used in an organization.

This research, therefore, is focused towards establishing whether a relationship exists between these two aspects, namely, organizational culture and problem solving practices in relation to an organization's success with Lean transformation. A comprehensive survey was developed to evaluate these two aspects. The survey was then administered to employees at different organizations, designations, various sectors and geographical regions. The survey results were analyzed to evaluate if an organization's culture influences the problem solving practices used.

Keywords: Organizational Culture; Culture traits; Problem Solving; Lean Transformation.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

In an era of extreme competitiveness and drive for quick success, a vast majority of organizations are making efforts to implement the practices of the Toyota Production System (TPS). Manufacturing organizations are always under tremendous pressure to improve productivity and quality while reducing costs, which has led to many organizations implementing the TPS, otherwise known as Lean manufacturing (Liker, 2004; Womack, 2003). Some examples of various Lean tools currently being implemented include the following: 5S, 8-step problem solving, Kaizen, SMED (single minute exchange of dies), and Kanban systems for replenishment of materials.

Lean is not simply a set of tools and concepts which can be implemented by command and control but a fully integrated management and manufacturing philosophy and approach in which human dimension is the single most important element for success (Ahrens, 2006). Rosenbaum, (2013) quoted the Institute for Healthcare Improvement (2005) as stating that Lean can be simply described as utilizing as little resources as possible to create a perfect process in which each step is valuable to the customer. The process should be capable of creating excellent results every time, be readily available for producing the desired output, be adequate enough to not cause delays, and be flexible and linked by continuous flow. Lean is a practice that is based on continuous improvement and aims to increase value by reducing waste, variation, and poor working conditions (Radnor et al, 2012). It involves setting standards to eliminate waste (Allen, 1995).

There are five major principles of Lean (Waring & Bishop, 2010; Radnor et al, 2012, O'Neill et al, 2011):

1. Specifying the value created by the process.
2. Identifying value streams for the processes.
3. Creating flow throughout the processes.
4. Establishing pull to meet the needs of the customers.
5. Striving for perfection through continuous improvement.

However, these principles leave out some major steps required to implement Lean and successfully transform an organization. These steps include the involvement of team members, respect for the work-force, and empowerment. Empowering workers by providing them with necessary tools and culture to drive work area change is the cornerstone of TPS. Once workers are indoctrinated in the Lean philosophy, they can drive out waste and strive for continuous improvement using the five principles outlined (Dickson et al, 2009).

Lean, as described based on the TPS, has two sides - a hard side and a soft side. The hard side refers to the operational tools and techniques that are utilized in improving the work environment, while the soft side is the underlying fabric and culture that allows Lean to succeed. Success in Lean transformation comes from applying both of these aspects together (Badurdeen et al, 2010a). A description of the two sides of Lean is shown in Figure 1.1.

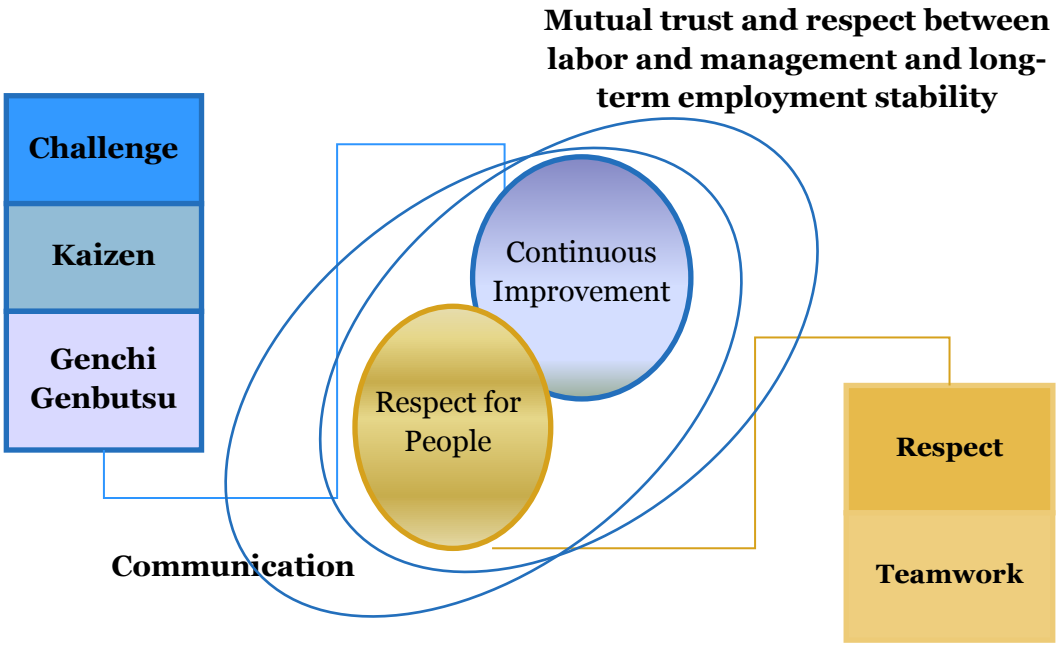


Figure 1.1: Two sides of Lean transformation as described by Toyota Production System. (Modified from: Toyota Way 2001)

Figure 1.1 illustrates that successful Lean transformations require both the hard side (tools) and the soft side (culture) playing equally important roles. "Continuous improvement" involves Challenges, Kaizen, and Genchi Genbutsu. Challenges raise the standards and targets and compel efforts to reach them. Genchi Genbutsu is utilized to 'go and see' the problem affected areas, make observations about the problem, and solve the problem by eradicating the root cause. To address a problem through a Kaizen event, an 8-step problem solving process is followed in the TPS. The steps support the goals of eliminating the root cause of the problem and avoiding reoccurrence. Similarly, when a Kaizen event is planned, special attention is given to involve the people on the specific team experiencing problem impact and who will benefit from solving it. This approach shows respect for the team members by seeking their input and giving them a sense of team work. As a result, this process builds the softer side of the Lean. Communication

and mutual trust between the team members and the management are also essential ingredients. A detailed discussion pertaining to the importance of Lean is provided in the following chapters.

1.2 Background

Several previous studies and a wide range of related literature has suggested that Lean implementation is sought after for its direct relation to business performance (Moori et al, 2013). Lean manufacturing is based on the premise of removing activities that do not add value to the productive system, particularly those associated with elapsed times, methods, processes, places, people, and movements (Womack et al., 1992). The elimination of non-value adding activities allows for more productivity in the same available time, and, as result, improves profits. Accordingly, profit increase comes from the cost reductions that improve the business performance of any organization (Shingo, 1996). A study conducted by Ibrahim (2011) has shown a key difference between the traditional versus Lean way of running an organization. In the traditional way, production was driven by sales forecasts and firms tended to stockpile inventories in case they were needed; But, in Lean manufacturing, the production is completely driven by real customer demand.

In the past, many researchers have obtained conclusive results supporting removal of waste, non-value added activities, and implementing Lean by following disciplined problem solving practices which has resulted in business growth all across the globe (El-Namrouty et al, 2013). Enaghani et al. (2009) illustrated that Lean is a ‘culture’ for quality improvement that starts by revolutionizing the minds of employees. Prior research conducted by El-Kourd (2009) concluded that using Lean construction for the Gaza Strip

reduced the total number of steps for the entire project by 57%. Interestingly, the non-value adding activities decreased drastically from 81% to 14% over the duration of the project and the total cycle time of the project was reduced by 75%.

Hallgren and Olhager (2009) found that Lean manufacturing had a significant impact on cost performance for plants across seven countries, whereas traditional manufacturing did not have much of an impact in contrast. Piercy and Rich (2008) reported that service call centers for three financial services companies in the United Kingdom utilizing Lean were able to meet traditionally competing priorities of both operational cost reduction and increased customer service quality.

Czabke (2007) concluded that all manufacturing plants surveyed through his research became more efficient and, hence, more cost effective and profitable after the implementation of Lean manufacturing in the US and Germany. McGrath (2007) found that Irish companies had made great improvements in terms of the value streams of their respective plants and in the reduction of waste and inventory. Koh et al., (2004) concluded that lower production costs can be achieved when Lean manufacturing practices, such as Total Quality Management and Just In Time, are used. Yamashita (2004) concluded that higher quality products with less resources and capital are achieved by implementing Lean manufacturing and that Lean manufacturing leads to reductions in scrap, rework, returns, and waste. Abdullah (2003) concluded that the driving force behind Lean implementation in US steel companies was cost reduction.

With all of the above mentioned advantages, the main challenge of Lean is sustaining it. To sustain the transformation a culture of problem solving is significantly

important. One source of inspiration for this study is preliminary research conducted by Dawson, (2010) to examine what relationships might exist between organizational cultural traits and problem solving techniques used for Lean transformation. An Analytical Hierarchy Process (AHP) was utilized for the analysis of data collected through a survey. AHP allows ranking multiple items with continuous (non-discrete) output. Some conclusions showed that few designations in an organization were beneficial in inculcating some cultural traits that assisted in making sure that related problem solving steps were followed. In using the AHP, Dawson (2010) was not able to correlate individual surveys to compare organizational cultural traits and problem solving steps because the consistency ratio was too high.

1.3 Culture and Problem Solving for Lean Transformation

Extensive literature purports the importance of culture and problem solving in Lean implementation. A very recent study by Worley and Doolen, (2015) concluded that the role of Lean implementation positively affects employee problem solving skills. Puvanasvaran et al., (2010a) stated that in order to become fully Lean, it is important to understand that the right processes will produce the right results made possible by continuously developing people and partners through continuously solving problems. Many times, organizational leaders have tried to implement the Lean tools and did not achieve desired results for Lean transformations. Puvanasvaran et al., (2014b) explained that the reason behind this failure is not realizing the importance of training people in problem solving and making daily improvements for Lean implementation. Culture is another crucial factor in successful Lean transformations as frequently emphasized in the literature (Kumar et al., 2009; Crute et al., 2003; Czabke et al., 2008; Achanga et al.,

2006; Badurdeen et al., 2011). To ensure the organization culture is ready for the Lean initiative, Kettinger and Grover (1995) and Bhasin (2011) together indicated that cultural issues must be addressed first before even thinking of Lean transformation. Thus, it appears the cultivation of problem solving skills and having a suitable organizational culture is of great importance for successful Lean transformations. While different studies have independently pointed to the importance of building the culture and problem solving skills, investigation of the impact of culture on problem solving skills is lacking. A review of existing literature does not include research on whether building a certain culture or cultural trait could support or prevent the development of problem solving skills. This study aims to provide insight into these factors and the impact of one on the other.

1.4 Scope of the Research

The primary objective of this research is to determine if there is a relationship between organizational culture and disciplined problem solving methods for successful Lean transformations. This study aims to:

a) identify various organizational cultural traits that could support the development of problem solving capabilities, and

b) establish whether there are any statistically significant correlations between different cultural traits and problem solving steps.

An introduction to the importance of Lean and its acceptance in industry is covered in Chapter 2.

Chapter 3 includes a discussion about problem solving practices utilized in a variety of large companies (Toyota, Ford and General Motors) and generic problem solving steps that can be established based on these organizations' method l The importance and advantages of disciplined problem solving practices and how they are related to Lean implementation are also discussed.

Chapter 4 is dedicated to a discussion of organizational culture, its various definitions, and its importance in successful Lean transformations. The chapter also proposes some of the essential cultural traits that need to be present to support problem solving for Lean transformations.

To determine the relationship between problem solving and culture, the proposed research methodology is discussed in Chapter 5 with survey administration and hypotheses formation explained in detail. Chapter 6 includes a detailed investigation of the results and Chapter 7 presents conclusions and future work.

CHAPTER 2: LEAN PRINCIPLES AND PRACTICES

2.1 Introduction

Lean is a concept that has been widely recognized in the manufacturing sector that has evolved through various innovations in the TPS in Japan since the 1940s. (Fujimoto, 1999). Literature on TPS dates back to 1977 when Sugimori et al., (1977) wrote the very first paper in English discussing Just-In-Time (JIT) production and respect for employees. In the 1980's, there were several subsequent books published about JIT and TPS. (Ohno 1988, Shingo 1989). Ohno (1988) primarily discussed TPS in terms of continuous flow for automation and JIT (kanban systems). JIT still formed one of the two main pillars of Toyota house and other TPS tools like standardized work, kaizen, Heijunka, and Jidoka. The Toyota House is shown in Fig 2.1 below. Shingo (1989) published the first book in English on JIT in which he explained the TPS examining production as a functional network of processes and operations and discussed the mechanism to make JIT possible in manufacturing plants.

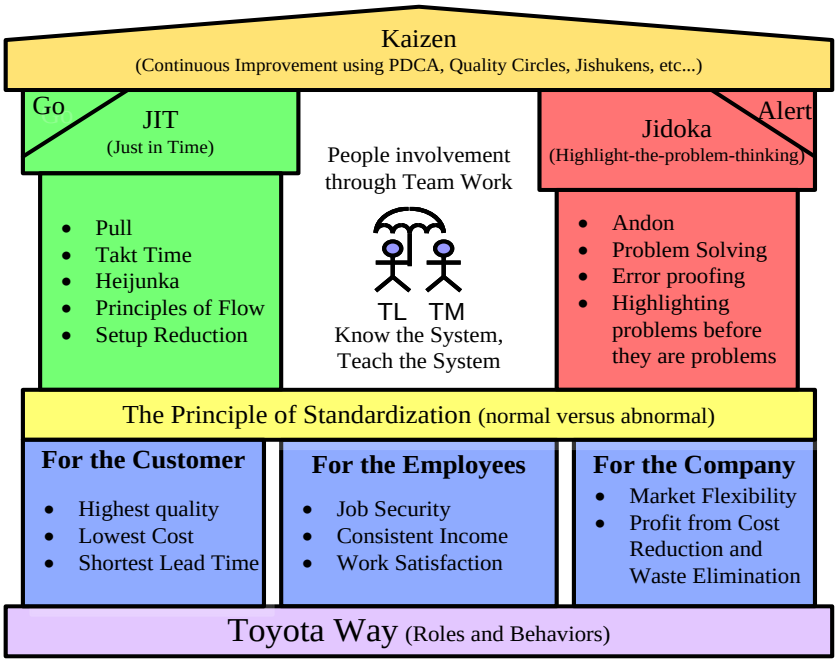


Figure 2.1: The Toyota House Model. Source: (Badurdeen, 2012)

The now popular term "Lean production" was first coined by Krafcik (1988), which Womack and colleagues popularized as "Lean manufacturing" in their book published in 1990. Various definitions of Lean have been proposed; however, most of the sources have described Lean production as waste reduction (Hopp & Spearman, 2004). Although Ohno's main focus was to reduce cost by eliminating waste (Holweg 2007), Gaitheir and Frazier (2002) equated Lean to the philosophies of JIT. Chase et al., (2006) equated Lean with TPS, considering it to be made up of various tools with JIT being just one of them. Although the Lean toolkit we now know consists of various tools, including JIT, TPM, kaizen, pull, continuous flow, and kanban systems, etc., it is mainly a way of thinking. Sharma et al., (2013) asserted that it is a way of thinking driven by dynamic knowledge and a customer driven process for continuously eliminating waste through employee involvement. Implementing Lean requires developing capabilities to identify

waste and build the value system. The hard side and the soft side of Lean are discussed in the following sections.

2.2 Lean Manufacturing Tools (Hard Side)

Modi and Thakkar (2014) described Lean manufacturing as a philosophy to produce better quality of products with lower costs and at the right time. To deliver products at the right time, Lean uses a concept called TAKT time. TAKT time is the pace at which the customer is demanding a part or product, originally a German word for cadence or pace (Simons & Zokaei, 2005). Currently, many companies are interested in implementing this particular principle of Lean to make their processes and resources more productive and meet their customers' demands on time. Identifying and eliminating waste in manufacturing to help achieve cost reduction, quality, and time objectives requires the use of variety of different tools. Some of the major tools essential to achieving continuous improvement in Lean include the following:

1. Kaizen: Kaizen can be described as continuous improvement involving everyone in the organization from top management to team members working on the line (Thessaloniki, 2006). The word Kaizen originated from two Japanese words, 'Kai' and Zen', meaning "to break apart and investigate" and "to improve upon the existing situation", respectively (Thessaloniki, 2006).

2. 5S: 5S is a disciplined workplace organization technique with every object having a location and every location having a specific use. 5S stands for the Japanese words Seiri (Sort), Seiton (Straighten), Seiso (Sweep), Seiketsu (Standardize), and Shitsuke (Sustain), (The Folk Group, 2009). 5S assists in optimization of the work flow with reduction of waste and process inefficiencies.

3. JIT: According to Kootanaee et al., (2013), Just In Time is a way to deliver right products of the right quality and quantity in the right place and at the right time. It has been widely reported that JIT implementation results in increased quality, productivity, efficiency, and reduction in costs and waste.

4. Visual Management: Modi and Thakkar (2014) stated, “”Visual Management is promoted at a workplace where all associates understand and manage their own work in safe, Lean, organized environment that fosters open communication, pride, and continuous improvement which helps anybody in the workplace to know what the current status of the work is and what to do next.” Visual Management essentially conveys information regarding work environment safety, standardized work instructions, storage, quality, and equipment through the use of visual means.

5. Value Stream Mapping (VSM): VSM is a tool used to visually display the flow of materials and information throughout the production process starting with acquiring raw materials and ending with delivery of the finished product (Lee, 2001). VSM is an excellent manufacturing tool for identifying and reducing wastes, such as defects, unnecessary inventory, and motion. (Goriwondo et al, 2011)

6. TPM: Total Productive Maintenance is a way of designing a comprehensive productive-maintenance strategy to maximize equipment effectiveness (McKone et al, 2001). It is a type of maintenance management established across the entire organization and divided into long-term and short-term elements, referred to as planned and unplanned maintenance tasks, respectively.

7. Standardized Work: Standardized work is the collection and implementation of the best practices currently known to perform a certain operation or process. It includes what is mandatory to both begin and complete the procedure. Standard Work is the sequential method for defining best practices and ensuring that every operator strictly follows them to endow value to the customers (Kulkarni et al., 2014).

8. Single-Minute Exchange of Die (SMED): SMED refers to theory and techniques used in the reduction of equipment setup times for the first run of the day and for changeovers taking place while the line is running (Moreira, 2011). SMED aims to reduce the equipment set up to single digit time, although not all set ups can be reduced to that level. Nevertheless, the main goal is to lower the set up time as much as possible to strive for single digit time interval, i.e. 1-9 minutes.

9. Problem Solving: As these words imply, it is the approach used to solve a problem and prevent it from ever occurring again. Because the term being used is very generic, no particular definition can be considered a standard. The majority of large organizations have their own problem definitions and corresponding solving methods. For example, Toyota defines a problem as a gap between the current condition and the ideal condition and recommends the use of the 8 step problem solving process. This approach aims to eliminate the problem by identifying and rectifying the root cause.

In Lean manufacturing, problem solving provides the foundation for continuous improvement. It is expected that the team members and management will focus on finding where the problem exists in its current state and figuring how it can be eliminated. Thus, problem solving can be considered the practice that is most important

for an organization in improving its performance through the application of other tools for successful Lean transformations.

There are other hard side tools of Lean manufacturing which include Andon technology, Cellular layout, poke-yoke devices etc. Most of these tools aim to reduce waste, defects, motions, search time (5S), set up time, etc., all of which are non-value added activities with elimination resulting in successful Lean transformation.

2.3 Lean Manufacturing - Culture (Soft Side)

As discussed in Section 2.1, Lean is often perceived as being limited to a set of tools and methodologies rather than the appreciation and cultivation of a culture conducive to learning those tools and implementing them (Atkinson, 2010). Ford and Honeycutt (1992) stated that it is essential to understand the underlying culture before rushing towards a Lean transformation. Thanopoulos and Leonard (1996) also affirmed that cultural factors are the main constraint in adoption of Japanese technology (Lean) management style. Badurdeen et al., (2011) quoted Schein (1992) in describing a culture's strength and degree of integration as a function of the kind of growth process it had, its length of time of existence, and its nature of acceptance or avoidance. Dahlgaard-Park (2006) reiterated that an organization's attention toward human factors for building the right culture could support the Lean journey. Mokhtar and Yosof (2010) stated that employee involvement is a necessary feature of a Lean system to create the right working environment.

Many studies suggest that a majority of companies fail to implement and sustain Lean because they lack the culture necessary for a successful transformation. Organizational culture has been determined to be a vital factor for implementing a

successful strategy such as Lean manufacturing (Al-Swidi & Mahmood, 2011). Mejab (2003) affirmed that the majority of the failures in Lean transformations were due to culture and management issues, real obstacles to Lean implementation. Because Lean and related philosophies originated in Japan, replication has been difficult. AL-Najem et al., (2012) stated, "It is therefore important to recognize that Lean culture needs to be understood thoroughly for successful adoption and implementation." The research emphasizes the need for having a favorable culture in place. Mullins (1999) asserted that, before trying to evaluate the organizational culture, it is essential to scrutinize what factors are affecting that culture. There could be multiple organizational traits with direct impact on the culture.

Therefore to successfully implement and sustain Lean, an organization must cultivate a conducive culture; building the value system will enable the practice of structured problem solving and application of the variety of tools to sustain Lean transformations.

CHAPTER 3: PROBLEM SOLVING

This chapter is focused on a review of problem solving techniques used by Toyota and by other select major companies. Various definitions of problem solving will be presented, followed by a discussion of problem solving steps utilized in different organizations and the importance of disciplined problem solving steps, with a particular emphasis on Toyota's approach. Finally, a generalized set of problem solving steps will be identified that are based on the Toyota's 8-step approach and relevant practices used by other companies.

3.1 Problem Solving - Definitions

For more than fifty years, successful problem solving has been a very important endeavor for the industrial sector and many business ventures (Marone and Blauth, 2003). Kantowski (1980) stated that a problem is a situation for which the individual who confronts it has no algorithm that will guarantee a solution and that person's relevant knowledge must be put together in a new way to solve the problem. In a general context (not from a Lean perspective), a problem can be defined as the gap between the current state of processes or methods being followed and their desired future standard state (Kruskal et al., 2012). In other words, a problem is a state that deviates from standard or does not meet the target. One of the most important factors for improving performance is realizing and acknowledging that a problem actually exists.

Few employees in an organization fully believe that processes are running as they should with no problems, although that might be true in rare cases. In cases where no gap is seen between target goals and performance, there is always room for improvement by

continuously elevating the set targets. Thus, Ohno suggested “Having no problem is the biggest problem.” (Ohno, 1950). The biggest threat to any organization is having many opportunities for improvement that go unnoticed. When it is determined that a problem actually exists, there is opportunity to solve it by following suitable steps for implementing corrective action to prevent reoccurrence.

When a problem is encountered, a strategy must be in place to ensure the standardized process is followed every time. Various definitions of problem solving have been presented in the literature. For example, Krulik and Rudnick (1980) defined problem solving as the means by which an individual uses previously gained knowledge and skills to apply wisdom in satisfying an unfamiliar situation. Zarbo (2006) mentioned that problem solving is to ‘go and see’ to understand current conditions before suggesting process improvements. Mourtos et al., (2004) defined problem solving as a process used to obtain the best answer to an unknown or a decision subject to constraints. Problem solving, as presented by Til et al (2009), is a determined action directed at achieving a set target through the introduction of a nontrivial problem with several possible solutions. A process of problem solving involves transformation from the current state to the desired state by achieving planned goals (Lovett, 2002).

3.2 Problem Solving for True Lean

True Lean is a journey from current state to future state by standardizing processes and implementing small and continuous improvements. Disciplined problem solving has been associated with successful Lean implementation for many years. Puvanasvaran et al., (2010) affirmed that Lean manufacturing success is based on the capabilities of employees through development that enhance their problem solving

abilities. Thus, successful Lean deployment is directly related to disciplined problem solving methods in an organization. Til et al., (2009) argued that merely providing employees with the knowledge and skills to implement Lean principles to solve real industrial problems does not help or allow them to add value to the organization. They further asserted that to achieve this goal, problem solving must be explicitly taught for successful Lean implementation. One of the main pillars of the Toyota House, JIT, is assumed to decrease total cost by highlighting problems and solving them (Petterson, 2009). The above-mentioned studies indicate that disciplined problem solving is an essential element in successful Lean implementation.

3.3 Toyota's 8-Step Problem Solving

The problem solving approach used in the Toyota Production System could be considered one of the most comprehensive approaches given the company's success with implementing the tools and techniques commonly referred to as Lean manufacturing. The 8-step approach followed by Toyota in the TPS for structured problem solving is outlined in Figure 3.1. A detailed description of each of these steps is as follows:

Step 1: Clarifying the problem – To initiate this step, it is very important to find answers to the following questions: the ultimate goal of the work, the ideal situation to achieve the stated goal, and visualization of the gap in the current and ideal situation if it exists.

Step 2: Problem breakdown – After identifying the problem, it is broken down into smaller problems so that sub-problems can be identified and most critical ones can be prioritized and addressed. To break down a vague problem, it is necessary to actually observe the process affected by the problem.

It is important to not to jump to conclusions in finding a solution for the problem and to avoid asking the question, “Why?” at this step.

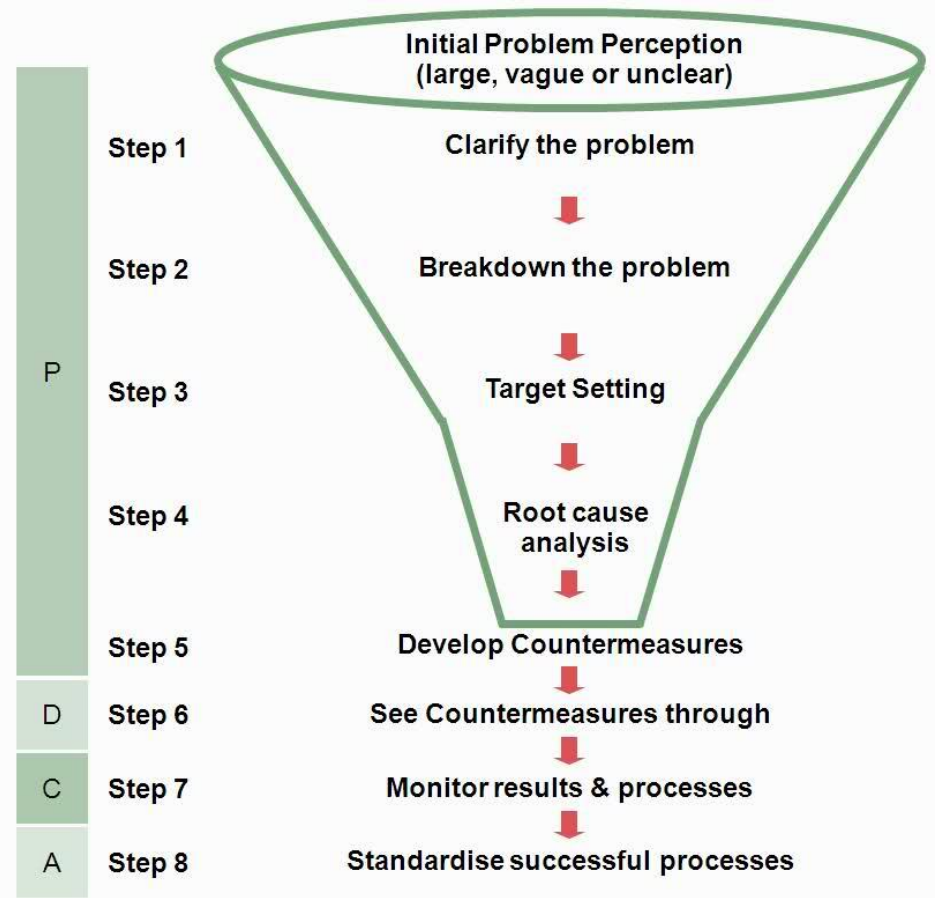


Figure 3.1: Toyota’s 8-step problem solving process (Dunn, 2010-2015)

Step 3: Target setting – Two important factors in this step are making a commitment to solve the problem and setting a measurable, concrete and challenging target. The target will be dependent on the gap between the ideal and current situation and its impact on productivity.

Step 4: Root cause analysis – Analysis has 3 sub steps, which include the following: brainstorming of possible questions, obtaining facts through Genchi-Genbutsu (go and see the affected process) by continually asking "why," and identifying the root cause from possible causes. It is important to never identify 'lack of motivation, skills or knowledge' as a root cause.

Step 5: Develop countermeasures – This step is another brainstorming activity that is recommended to look for as many countermeasures as possible. Depending on the overall effectiveness, feasibility, and judgment, a countermeasure is selected for implementation.

Step 6: Implement countermeasure – It is very important to implement a selected countermeasure quickly and effectively and to make an action plan with an assigned responsible person and target date.

Step 7: Track results and processes – Monitoring the implemented countermeasure for its progress and results is an essential part of this step. If the problem is solved, the selected countermeasure is considered successful. If the problem still persists, the countermeasure did not work as expected, and a switch to the next possible countermeasure is recommended.

Step 8: Standardize the improved process – If the countermeasure is successful, the new process is established as a standard process to be communicated across the organization or with involved team members. The next round of kaizen is initiated to keep up with continuous improvements.

In summary of this 8-step solving process in the TPS, first, a problem is clarified, broken down into smaller problems, and prioritized according to threats to productivity. Then, a feasible target is set to accomplish and is followed by brain storming for the possible root cause. When a root cause is agreed upon, another brain storming session takes place to generate all possible counter measures that can then be studied thoroughly for their feasibility and practicality. When one counter measure is agreed upon, it is implemented and monitored for changes in results. If the selected counter measure solves the problem, it is standardized and communicated to all team members impacted by the problem. If the problem is not solved, the next best possible counter measure is selected and all steps are followed from 5 through 8.

3.4 Other approaches to Structured Problem Solving

Many organizations have established their own approaches to structured problem solving. Some of these approaches are briefly discussed in this section. For example, Ford uses a method called TOPS (Team Oriented Problem Solving), more commonly known as 8D. The steps include the following: (Source: http://quality-one.com/eight-disciplines/)

D0: Prepare for the 8D – Collect the symptoms of the problem, run the problems through the symptoms checklist, and prepare an emergency response action.

D1: Form a Team – In the second step, D1, a core team structure is decided upon which enables the management to determine required members of the team. The second sub-step is team preparation in which the team is made aware of the problem according to the symptoms. A cross functional arrangement is generally preferred when forming a team.

D2: Describe the Problem – A 5 ‘Why’ analysis is conducted to determine the possible causes of problem occurrences and a problem statement is developed. An affinity diagram is used and a detailed description of the problem is presented.

D3: Interim Containment Action – The entire lot, with one or a few bad products that resulted in issues for customers, should be considered and all products need to be checked for the same faults. This control action verifies whether or not the same lot had more bad products with similar issues as reported by the customer.

D4: RCA (Root Cause Analysis) and Escape Point – This step is very important for 8D, in which the team brainstorms for the probable root cause. Various methods are used for root cause analysis and include Data Mining, Pareto charts, and Fishbone diagrams. This step also includes studying the point at which the particular defect escaped.

D5: Permanent Corrective Action (PCA) - The team brainstorms for all potential PCAs by considering customer satisfaction, cost, elimination of the root cause, and other factors in attempting to choose the best PCA from all available choices.

D6: Implement and validate – The unanimously selected PCA from D5 is implemented. One important point in this step is the verification of root cause elimination. To prove this, the team must be able to make the problem come and go at will by alternately applying and removing the PCA while still continuing to measure the process to ensure effectiveness.

D7: Prevention – Sustaining the implemented PCA prevents reoccurrence. To prevent the same problem from occurring again, the process is followed up multiple times

and randomly monitored to prevent backsliding. Any other potential areas where similar problems can occur are identified and the same PCA is implemented in those areas. All the standardized work practices, procedures, and related documents are updated.

D8: Closure and Team Celebration – This step is also very important in 8D. Team lessons learned are discussed and the before and after comparison is conducted to see improvements after successful implementation of the PCA. Finally, a celebration is called for to show appreciation to team members and increase the likelihood of their participation for the next issue.

In considering the general picture, basic steps include the following: describing a problem, verifying effectiveness of interim containment action, carrying out a root cause analysis, brainstorming on a permanent corrective action, implementing and validating the plan, and standardizing the plan to prevent the same problem from occurring again.

Another automotive leader, General Motors, has a special squad for their problem solving practices called Red X. Red X team problem-solving steps are identified as follows: (Source: http://asq.org/public/wqm/general-motors.pdf)

Queue: The queue is the staging area for projects needing support from the Red X team. In this step, the problem solver defines the project, prioritizes his/her workload, and orders warranty parts that are needed.

Duplicating the Green Y: This experimental step involves the problem solver re-creating the issue that the customer experienced so it can be observed to see where things actually went wrong.

Clue Generation: The problem solver utilizes his/her Red X training to focus on the root cause of the problem.

Implementation: The problem solver applies corrective actions and completes the project.

In Red-X problem solving steps, creating a staging area and ordering parts in warranty for testing is the first step. Next, a similar situation is re-created to cause the same problem to occur to observe the process and what things went wrong. Then in clue generation, the team dives deep to identify the root cause. After the root cause has been agreed upon by the team, corrective actions are applied and the project is declared complete. As a general thought, one essential step that is missing in General Motors' problem solving steps is verification to see if the problem is completely eradicated after the implementation of corrective actions.

3.5 Generalized problem solving steps

Based on review of Toyota's 8-step problem solving process, Ford's TOPS 8D, and General Motor's Red-X team problem solving, a generalized set of steps has been identified for use in this research. A comparison of three approaches to problem solving with similar steps identified by the same color are shown in Figure 3.2.

Generic Problem Solving Steps	Toyota	Ford	General Motors
Clarify & Breakdown	Clarify the problem	Prepare for 8D by forming a team	Queue
Generating countermeasures	Breakdown the problem	Describe the problem	Duplicating the problem
Selecting best countermeasure	Target Setting	Interim containment action	Clue generation
Implementing best countermeasure	Root cause analysis	Root cause analysis	Implementation
Communicating information about C/M	Develop countermeasures	Permanent corrective action	
countermeasure progress	See countermeasures through	Implement & validate	
	Monitor results & processes	Prevention	
	Standardize successful processes	Closure & team celebration	

Figure 3.2: Comparison of three problem solving approaches

Based on the review of the presented methods, and the similarities between them, the following six steps for structured problem solving have been deduced for use in this research. The first step is identifying, breaking down, and prioritizing a problem. In this step, the problem is clarified, broken down into smaller problems and the main problem impacting productivity the most is prioritized. This step is a result of combining the first two steps of Toyota's 8-step problem solving process by judging it can be combined into one step. The second step in these deduced problems solving steps is generation of

countermeasures. This step is a combined result of three steps from the 8-step problem solving method. The three steps include target setting, generating countermeasures, and developing countermeasures. For generating counter measures, targets need to be set and root cause needs to be addressed. The next step is the seeing the countermeasures through for their practicality and implementation feasibility. This step is the same as in the 8-step problem solving in TPS. Implementing the countermeasure and monitoring progress is the next step. It is similar to TPS' step 7. The next step is problem or countermeasure internal movement (i.e., the pace at which the information flows up/ down the hierarchy) and passing the information about process standardization. This step is the same as step 8 of the TPS (standardize successful processes). These six steps are shown in Fig 3.3

Generalized problem solving steps
Identifying, breakdown and prioritizing of the problems
Generating countermeasures
Selecting best countermeasure
Implementing best countermeasure and monitoring progress
Communication/ sharing information about the countermeasure
Problem/ countermeasure movement

Figure 3.3: Deduced generalized problem solving steps.

CHAPTER 4: ORGANIZATIONAL CULTURE

4.1 Definition of Organizational Culture

Hofstede (1984) defined organizational culture as a collective programming of the mind which distinguishes members of one group from another. One of the simplest definitions of organizational culture was presented by Lundy and Cowling (1996) as "the way" things are done in an organization. Organizational culture has been studied by many researchers in the field over a long period of time. This chapter examines this subject by reviewing some classical definitions, previous work that investigates the role of culture for Lean transformation, and literature that investigates the cultural traits in organizations that influence problem solving practices.

Bate (1984) also defined culture in a classic way, "It is predominantly implicit in the minds of men; it is not something that is 'out there' with a separate existence of its own; neither is it directly observable." Schein (1992) assayed organizational culture to be a pattern of shared basic assumptions learned by a group as problems of external adaptation and internal integration are solved. This pattern has been assumed to work well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems. Ogbonna (1992) declared that culture is the values, norms, beliefs and customs that an individual holds in common with other members of a social unit or group. Cameron & Ettington, (1988), O'Reilly & Chatman, (1996), and Schein, (1996) agreed with culture being a socially constructed attribute which serves as a "social glue" in binding an organization together. Badurdeen et al., (2010) cited Liker and Hoseus (2008) by describing culture at Toyota as

the way employees automatically think and act every day. This type of culture has developed into a second personality for those individuals who have spent decades with Toyota, but it is still a secret to most people outside of the Toyota world.

The majority of writers have reached consensus that culture refers to the taken-for-granted values, underlying assumptions, expectations, and definitions that characterize organizations and their members (Cameron, 2004). Bate (1984) defined culture in an organization as a customary and traditional way of thinking and doing things that is shared to a greater or lesser degree by all members of the organization. In addition, new members of the organization must be inculcated in this way of thought and, at least partially, accept it in order to be received into service within the firm.

In summary, an organization's culture could be viewed as the way in which problems are handled within an organization, the way people behave, or the prevailing ideology that the employees carry in their minds. Culture certainly influences the way the members of the organization think, feel, and behave.

4.2 Importance of Organizational Culture

Organizational culture in the research is focusing on the behavioral traits. It is imperative that new employees joining any organization acknowledge and, to a certain degree, conform to the patterns of thinking that potentially reach far back into an organization's history in order to maintain the culture of the organization. Schein (1992) asserted that organizational culture is even more important today than it was in the past. Increased competition, globalization, mergers, acquisitions, alliances, and various workforce developments have created a greater need for:

1. Coordination and integration across organizational units to improve efficiency, quality, design speed, manufacturing, and product delivery and services.
2. Product innovation.
3. Strategy innovation.
4. Process innovation and the ability to successfully introduce new technologies (e.g., information technology).
5. Effective management of dispersed work units and increased workforce diversity.
6. Cross-cultural management of global enterprises and/or multi-national partnerships.
7. Construction of meta- or hybrid- cultures that merge aspects of cultures from what were distinct organizations prior to an acquisition or merger.
8. Management of workforce diversity.
9. Facilitation and support of teamwork.

A culture conducive to change is of utmost necessity and can determine the success of an organization in a world of increasing competitiveness. According to Schein (1992), the reasons behind it are simple. Culture is important because it is shaped by:

1. What the organization considers as the "right decisions." Organization includes all the working team members and how much their opinions are taken into consideration in the decision making process and how much they feel they are being involved in final decisions. What employees consider appropriate behavior and how they interact with each other within the organization; behavior relates to the culture and the way employees respond to particular situations.

2. How individuals, work groups, and the entire organization deal with work assigned to them, defined as a team work culture.
3. The speed and efficiency with which things get done which determines whether or not communication is both fast and healthy.
4. The organization's capacity for receptiveness to change; receptivity is a necessary trait for a culture to support Lean transformation (discussed in more detail in the next chapter).
5. The attitudes of outside stakeholders toward the organization. Outside stakeholders often challenge an organization to perform according to their expectations. The ways in which the organization reacts to these expectations certainly shapes and defines the culture of the organization.

4.3 Role of Culture for Lean Transformation

Many researchers have placed more importance on organizational culture than on problem solving. Philip (2010) argued that transition from traditional to Lean manufacturing requires more of a cultural change than altering the manufacturing process or addressing technical issues. Organizations are less likely to effectively implement Lean manufacturing unless they have paid at least equal attention to creating the right culture, which, in turn, can become the basis for implementing changes (Ahmad, 2013). Badurdeen et al., (2009) asserted that pursuing Lean transformation does not merely depend on applying tools and techniques but developing a culture that supports Lean to derive the sustained benefits. Womack (2002) maintained that institutionalizing Lean principles requires a transformation in corporate culture, practices, processes, and management.

True Lean is defined as using systematic problem solving to improve the work done by employees toward achievement of the company's targets and goals when the existing culture is the reason for the progress. Thus, it defines the inclusion of systematic problem solving and culture for successful Lean implementation. True Lean is illustrated in the Figure 4.1 below:

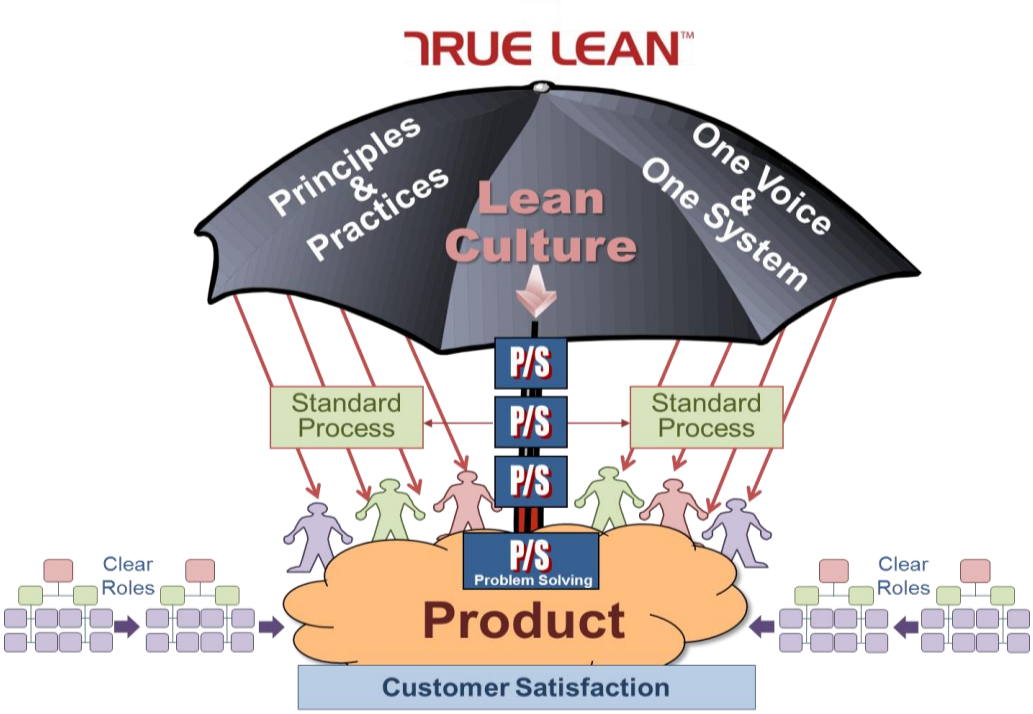


Figure 4.1: Lean Culture and Problem Solving for True Lean.

Source: (© Copyright 1994-2015 University of Kentucky/Toyota Motor Engineering & Manufacturing North America, Inc. (TEMA) All Rights Reserved)

As True Lean is defined, it requires a perfect combination of organizational culture and continuous improvement through problem solving with standardized processes. Culture is the people side of an organization that eventually connects to the problem solving/tool side of Lean. If the culture does not enable carrying out 8-step

problem solving for continuous improvements and establishing new standard processes, sustained Lean transformations cannot occur. If processes are running as desired and all targets and goals are met, True Lean calls for challenging the set targets, performing a kaizen activity, using structured problem solving for new standards, and eventually reaching new targets and goals. Clearly, culture and problem solving are both necessary for successful Lean transformations.

4.4 Organizational Cultural Traits

Desson and Clouthier (2010) suggested that a change in organizational culture is sometimes necessary. Circumstances might be any of the following: change in the expectations of stakeholders, circumstantial changes, change in the demographics of the organization, change in the objectives of the organization, or deployment of new technologies and ingrained attitudes producing negative outcomes. The manner in which these changes are received determines the strength of the organization and the culture.

In transforming an organization to implement Lean practices, the existent culture should be stable enough so that all members in an organization have a shared understanding about the need for change and that change takes place smoothly. Cultural traits can be studied to manage change better and ensure it is sustained by understanding appropriate behavior, the presence of team work, and team members' receptivity and reaction to change, etc.

The literature suggests that organizations successful in Lean transformations have a different culture (Liker and Hoseus, 2008). However, there are no known studies that have investigated organizational cultural traits that promote continuous improvement

through structured problem solving, a fundamental characteristic for successful Lean transformations. One of the very few studies that has examined cultural traits for problem solving was presented by Bate (1984). While Bate's work did not address Lean transformations, the identified traits presented a basis for discovering cultural traits that create an environment conducive to structured problem solving for true Lean. Because the study was done at a time when industrial practices were very different, the examples presented were somewhat archaic. Nevertheless, it should be considered one of the classical studies attempting to establish connections between observed organizational cultural traits and approaches to problem solving methods. Bate presented a number of traits that should not be present in organizations due to their hindrance to effective problem solving. These traits are shown and explained in Table 4.1 below:

Table 4.1: Bates' observed traits that impact problem solving.

Trait	Description
Unemotionality	Avoid showing or sharing feelings or emotions.
Depersonalization	Not taking individual responsibility.
Subordination	Never challenge those in authority, and always wait for them to take the initiative.
Conservatism	Better the devil you know.
Isolationism	Do your thing and avoid treading on other people's toes.
Antipathy	On most things, people will be opponents rather than allies.

Unemotionality is defined as avoiding emotion and personal information sharing because it might turn out to be vulnerability for the individuals who shared it in the first place. The workplace is not a setting for sharing personal grievances to gain sympathy.

Basically, share some personal information and repent for it later. Workplace is a place to come, work, and leave, unless talking about work related matters.

Depersonalization is defined as not pointing a finger at anyone in particular, most commonly done when a team member discovers a problem and he/she is blamed for it. The blaming deters him/her from highlighting a problem next time and, therefore, the problems do not surface. Depersonalization would certainly deter efforts to establish a disciplined problem solving process.

Subordination is defined as not challenging anyone in authority and always waiting for a supervisor or a higher authority individual to come and take the initiative. This negative trait does not support the problem solving culture or the effort a team member might make in addressing a problem. Supervisors must encourage team members in trying creative ideas for new solutions that might be a quick fix and time saving.

Conservatism is staying to oneself and, as a result, demonstrating less willingness to participate in team ventures. This trait does not support team work or any group activity requiring multiple employees to work together. Conservatism stems from individuals thinking that their participation would not change any situation at all or might even make it worse. They think, "It is better to stay away than participate."

Isolationism is doing things in a manner that pleases the individual which then leads to fellow team members copying similar types of behavior. No one tries to interfere with anyone else's work and no one thinks about whether or not what they are doing is right or wrong. Isolationism can result in an organization becoming divisionalized and,

even worse, departmentalized. With minimal to no connection between team members, problem solving as a team becomes a nearly impossible task. In short, everyone likes to be busy with their work and no one wants to be seen as trespassing.

Antipathy denotes the superficiality of relationships and includes low trust and isolationism. It is also related to extreme group formation, a specific group of people strongly believing in certain values that they defend despite the fact that their stance leads to more opponents than allies within the organization.

These important negative cultural traits were observed by Bate, (1984) when he interviewed employees in various designations within three different industries. This information brings up the question, "If these traits are negative with respect to implementing disciplined problem solving, what traits are recommended for a favorable setting for implementing successful problem solving in an organization?" To gain insight into answering this question from a Lean transformation perspective, the relationship of cultural traits and problem solving with respect to Lean transformation is presented in the next chapter's research methodology.

CHAPTER 5: RESEARCH METHODOLOGY

In previous chapters, the importance of problem solving for Lean implementation and cultural traits not favorable for implementing problem solving were discussed. Anecdotal evidence has indicated that only 2% of organizations attempting to implement Lean actually succeed in implementing true Lean (Badurdeen et al., 2012, Ransom, 2001). The reason for such a high failure rate might be having a primary focus on the hard side of Lean (tools) and ignoring the soft side (culture) (Badurdeen and Gregory, 2012). To succeed in Lean transformations, organizations must focus equally on tools and building a suitable culture. Since only 2% of organizations have succeeded, identifying cultural traits that must exist and that should be inculcated to support disciplined problem solving and continuous improvement can help companies be more successful in their Lean transformations.

5.1 Deduced problem solving steps and proposed cultural traits

The main objective in this research is to verify whether or not a relationship exists between different steps in structured problem solving steps and certain organizational cultural traits. In chapter 3, problem solving steps followed by Toyota in the TPS and other major companies were reviewed. Using that information, some generic steps were deduced. Those steps are outlined below in Table 5.1:

Table 5.1: Generic problem solving steps

Generic Problem Solving Steps
Identifying, breakdown and prioritizing problems
Generating countermeasures
Selecting best countermeasure
Implementing countermeasure and monitoring results
Communication/ sharing information about the solution/ countermeasure
Problem/ Countermeasure movement

Based on a trait review presented by Bate (1984), for Lean transformations and desired practices in the TPS such as those contained in the Toyota Way philosophy, a set of organizational cultural traits considered conducive to problem solving can be deduced. These proposed traits are identified to enable team building, encourage team members to take initiative in problem solving, encourage team members to express their ideas, generate possible countermeasures to select the best one, and enhance receptivity toward problems encountered. Some of the negative traits observed by Bate (1984) included subordination, which is waiting for a supervisor's approval in case a problem is encountered; isolationism, which is staying detached or unfriendly toward other team members; conservatism, which is being less willing to participate in a team venture or group activities; and depersonalization, which is not taking individual initiative when problems are encountered. Proposed culture traits desired for problem solving in Lean transformation that will be used in this research are listed in Table 5.2.

Table 5.2: Proposed Organizational Cultural Traits

Proposed Cultural Traits
Encouraging open expressions
Taking individual initiative
Collectivism/ team work
Unity/ goal alignment
Unemotionality
Receptivity

Thus the objective of the research is to establish if there exists any statistically significant relationship between the problem solving step identified in Table 5.1 and the cultural traits shown in Table 5.2.

5.2 Hypotheses Formation

To assess any potential relationship between deduced problem solving steps (6) and the organizational cultural traits likely to create a favorable environment conducive to problem solving (6), null hypotheses were formed relating these two aspects. The hypotheses are listed below with the relevant cultural trait and related problem step and a detailed description of the reasoning:

H10. Promoting open expression of problems does not influence problem identification, break down and prioritizing of the problem.

The two criteria incorporated in this null hypothesis are:

1. **Cultural trait**: Encouraging open expressions
2. **Problem solving step**: Problem identification, breakdown and prioritizing.

This hypothesis is developed on the premise that promoting open expression of problems will enable better performance of problem solving steps listed. Questions under this null hypothesis focus on whether or not the team members are encouraged to speak up about the problems they encounter/discover on the line and whether or not they are blamed for the problems or rewarded for reporting it. It also addresses whether or not speaking out about a problem is looked upon as if the individual has forgotten their status or place within the organization. These cultural traits encourage open expression which defines the pace of problem identification and prioritizing it after it is broken down into smaller problems.

Table 5.3: Questions Related to Cultural trait and problem solving step for H10.

Encouraging open expressions	Problem identification, breakdown and prioritizing
My immediate supervisor is interested in the ideas I have regarding the work.	I tend to focus on immediate problems.
I am allowed to speak for myself in the company.	Speaking about any problem is taken by the management as an indication of me not fully understanding.
I am held responsible for problems I identify	When I face a problem, I try to analyze the facts systematically.

H20. Team members taking the initiative to solve problems does not lead to increased possibility of generating solutions for the problem identified.

The two criteria incorporated in this null hypothesis are:

1. **Cultural Trait**: Taking individual initiative
2. **Problem Solving Step**: Generating countermeasures

Even if the first trait may appear to exist to some extent in an organization, it is also important to allow team members to take a lead in fixing some of the problems unless they have potential for impact on the process. This hypothesis focuses on letting the team members take individual initiative and not waiting for approval from the reporting supervisor or manager. Taking the lead in this kind of situation can make team members more empowered and, for this reason, it should be an appreciated cultural trait. This approach might prove to be the most practical and feasible by looking for solutions from the perspective of the team member who works hands-on on the line. It should lead to the increased possibility of countermeasures being identified for the problem.

Table 5.4: Questions Related to Cultural trait and problem solving step for H20.

Taking individual initiative	Generating countermeasures
I wait for my immediate supervisor to give me approval before attempting problem solving.	I normally solve problems quickly without wasting a lot of time on details
Taking individual initiative is an appreciated practice in the organization.	When necessary, I have no trouble making tough hard-nosed decisions.
I am blamed for the problems I face.	I really enjoy solving new problems by myself.

H30. Collectivism/team work hinders the process of selecting the best countermeasure.

The two criteria incorporated in this null hypothesis are:

1. **Culture trait**: Collectivism/team work
2. **Problem solving step**: Selecting the best countermeasure

Table 5.5: Questions Related to Cultural trait and problem solving step for H30.

Collectivism/ Team work	Selecting best countermeasure
I am more people oriented than task oriented.	Group meetings are held on a daily basis.
The organization has enough mechanisms for binding itself together as a team.	Any problem is usually worked upon by a team and not on an individual basis.
If a task is not achieved a particular team member gets blamed for it.	Before passing a decision, the top management considers the collective opinion of the team members.

Collectivism or team work is another key trait that should be encouraged in an organization as a part of a culture conducive to problem solving for Lean transformation. Collectivism encompasses the ability to work with various types of people with different attitudes. For example, arranging morning meetings allows the group to be made aware of the demand, the supply to meet it, and the current state of the group as one entity. While solving a problem as a team, there is distinct advantage in getting different views and generating many countermeasures. There is opportunity to look at a problem from varying perspectives and countermeasures. Also, maintaining team culture provides advantages in being able to listen to the opinions of the team in making specific decisions and brain-storming and selecting the best countermeasures by looking at both pros and cons. Giving the employees a feeling of being listened to and encouraging them to be more involved can motivate them to continue working as a team.

H40. Unity/goal alignment do not help in implementing countermeasures and monitoring progress.

The two criteria incorporated in this null hypothesis are:

1. **Culture trait**: Forming of unions
2. **Problem solving step**: Implementing countermeasures and monitoring progress

This trait refers to a "not so popular" topic among the management of an organization, unions forming in the plant. Unions are always looked upon by the management as a hindrance to changes in way of doing things or for cultural change. This hypothesis posits that unions must be allowed to form if their goals are aligned with the ultimate goals of an organization. It can give a sense of unity amongst team members and a sense of belonging to the organization. Overall, this cultural trait builds unity which can result in meticulous implementation of a particular solution throughout an organization.

Table 5.6: Questions Related to Cultural trait and problem solving step for H40.

Unity/ goal alignment	Implementing countermeasure and monitoring progress
The teams are intended to reach the organization's goals.	The division of work in different teams is flexible.
A team member feels that he/she has enough input in deciding his/her work-unit goals towards achieving the larger goals of the organization.	The unions need to be sanctioned by the management before coming into existence.
Forming unions is allowed in the company.	The organization only allows those groups striving for the achievement of the company's goals to be formed.
	The organization's planning and control efforts are helpful to its growth and development.

H50. Problem solving is faster when team members are emotional.

The two criteria incorporated in this null hypothesis are:

1. **Cultural trait**: Unemotionality
2. **Problem solving trait**: Pace of problem solving, communication/sharing of information

This trait focuses on how much importance is given to the unemotionality factor in an organization. According to Bate (1984), results were inconclusive as to whether or not unemotionality should be encouraged in an organization. These questions focus on the impact of emotionality on practicing problem solving. If emotionality is encouraged, then do co-workers form a dependency on one another, or do they, at some point in the future, feel vulnerable? Does the emotional atmosphere help the organization in achieving particular goals and creating healthy culture that promotes faster problem solving?

Table 5.7: Questions Related to Cultural trait and problem solving step for H50.

Unemotionality	Communication/ information sharing
My relationship with my supervisor is a harmonious one.	I consider myself a self motivator.
Personal sharing of feelings or emotions is encouraged in the organization.	I can always talk to my supervisor regarding a work-related problem.
After sharing emotions with co-workers, I feel vulnerable in some situations.	Personal relationships with co-workers create dependency in work relationships.

H60. Organizational receptivity to problem identification leads to poor problem communication up/down the hierarchy.

The two criteria incorporated in this null hypothesis are:

1. **Cultural trait**: Organizational receptivity
2. **Problem solving step**: Problem/countermeasure movement

This null hypothesis, H60, focuses on the importance of communication in an organization. The questions are framed to ascertain if healthy communication assists in better travel/movement conditions up/down the hierarchy for problems. How often and quickly do the problems, demands or grievances of the team members reach management officials? Does management take into account the concerns of team members before developing a particular policy for the organization? All of these things certainly impact the way team members view management and can improve ways in which team members work towards problem identification as they think more about the welfare or betterment of their organization.

Table 5.8: Questions Related to Cultural traits and problem solving steps for H60.

Organizational Receptivity	Problem/ countermeasure movement
I understand my supervisor's efforts to influence me via his/her frequent motivational communication.	New management policies and procedures reach me in a timely manner.
Communication is transparent throughout the organizational hierarchy.	New technical information is shared with the team members wherever it is needed.
The management's decisions take into consideration my ideas and opinions.	My grievances and demands reach top management easily.

5.3 Survey Instrument and Evaluation Approach

Survey instrument: Once the hypotheses were formed, data must be gathered to assess potential relationships between the cultural traits and the problem solving steps. In order to do this, a software tool called Qualtrics was utilized to develop an electronic survey of the identified questions. The tool uses a 7 point Likert scale, a psychometric method used mostly in questionnaire research. The survey instrument was well secured with a log in identification and password accessible only to the researcher and principle investigator. A link was sent via email to list serves with a cover letter describing the survey and its intentions. Respondents were informed that no personal identifiers, such as name, email address, ethnicity, or gender would be collected. In addition, respondents were notified that no question was mandatory (i.e., any question could be skipped if the respondent chose to do so and the survey would continue). These arrangements were made to increase the response rate by providing flexibility to skip questions.

All research conducted by U.S. universities and affiliates using human participants is overseen by the Institutional Review Board (IRB). Its purpose is to facilitate human subject's research and ensure that the rights and welfare of human subjects are protected during their participation. There are certain guidelines deemed mandatory by the IRB in order to grant approval depending on the human subject's involvement. IRB approval was applied for and received to conduct the work outlined in this thesis.

The survey began with a few demographic questions about the size of the organization (small, medium, large), number of years the employee has worked in the organization, the sector in which the organization could be classified (manufacturing,

healthcare, defense, apparel, etc.), country where the survey was being answered (for regional analysis across the globe), and the age group of the respondent. After the demographic questions, the questions related to problem solving and organizational culture were presented with a 7 point response scale as follows:

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Agree	Strongly Agree

Figure 5.1: 7-point Likert response scale

Evaluation approach: Responses were automatically saved in the results section of the software tool as they were submitted by the respondents. Responses were then imported to MS Excel for further statistical analysis. The skipped questions were considered zero while 1 was a strongly disagree designation and 7 was a strongly agree designation. The question responses related to each trait were evaluated in correspondence with question responses related to the problem solving step by computing the coefficient of relation 'r' to ascertain the strength of the relationship.

Null hypotheses were then analyzed to determine if they could be rejected or they failed to be rejected. A two-tailed T-test was used for this analysis with a 95% confidence interval. A two tailed test is more conservative than a one tailed test because a two tailed test takes a more extreme test statistic to reject the null hypothesis. For the 95% confidence interval, the critical value of t ($t_{critical}$) is 1.98. Thus, if the test statistic value t_t is greater than $t_{critical,}$ then the hypothesis would be successfully rejected; if it was lower than $t_{critical}$, then we fail to reject the null hypothesis. The test statistic was computed by using the formula:

$$t_t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$ Equation 5.1

Rejection criteria: If $t_t > t_c$ then the null hypothesis can be rejected.

The data collected through this survey is discussed and analyzed in the following chapter.

CHAPTER 6: RESULTS, ANALYSIS AND DISCUSSIONS

This chapter describes how the survey was administered and how statistical analysis was conducted to evaluate the data. A detailed sector-wise and country-wise analysis of survey responses is also presented.

6.1 Survey Administration and Data Collection

The survey was administered by sending the survey link online through individual email addresses and various list-serves. A cover page was sent with the link that described the purpose of the survey, the type of questions included, and with an indication that no personal identifiers would be collected. The requested demographic information included the location of the organization (country), sector of the industry (manufacturing, healthcare, education services, healthcare, etc.), the size of the organization (very small, small, medium, or large), the number of years an employee had worked in the organization (5 groups), and the respondents' age group (4 age groups). After the demographic questions, questions related to problem solving and organizational culture were presented.

After IRB approval, the survey link was sent out and data was collected from July 25, 2012 to July 2, 2013, with a total of 246 responses. Responses were tabulated with the distribution shown below. The distribution of responses is reported in terms of country, sector, organization size, and number of years of experience.

Table 6.1: Country distribution of the responses.

Country		No. of Responses	%
Australia		0	0%
Canada		0	0%
China		0	0%
Denmark		0	0%
Finland		0	0%
Germany		0	0%
India		1	1%
Japan		0	0%
Norway		0	0%
Sri Lanka		42	22%
United States of America		145	76%
Other		3	2%
Brazil		0	0%
Mexico		0	0%
Russia		0	0%
Malaysia		0	0%
Total		191	100%

Table 6.1 illustrates the country-wise responses with the majority of responses (145) from the United States, followed by Sri Lanka (42). Although the total numbers of responses was 246, no question was mandatory and it appears that the rest of the respondents decided not to answer this question since only 191 responses were collected. A contributing factor to the United States yielding the highest number of participants was that the majority of email addresses in various list-serves were from the U.S.A contributing factor to Sri Lanka yielding the second highest number of participants was collaboration with an industry in that country for the study of Lean transformations.

Table 6.2: Industry Sector distribution of the responses.

Category		No. of Response	%
Mining		2	1%
Construction		0	0%
Wholesale and retail trade		1	0%
Manufacturing-Other		39	18%
Transportation and warehousing		1	0%
Finance and Insurance		0	0%
Real estate, rental and leasing		0	0%
Educational Services		7	3%
Health Care		113	52%
Arts, entertainment and recreation		0	0%
Accommodation and food services		2	1%
Government		2	1%
Nonprofit organizations		1	0%
Apparel		32	15%
Other		7	3%
Manufacturing-Aerospace/Defense		6	3%
Manufacturing-Automotive		2	1%
Manufacturing-Electronics		2	1%
Total		217	100%

Table 6.2 illustrates responses based on the respondent's type of industry. 52% of the total respondents who chose to answer this question were from the healthcare sector, followed by manufacturing (18%) and apparel (15%), with a few of them from manufacturing (aerospace/ defense), mining, automotive, or electronics manufacturing. The large percentage of responses from healthcare and apparel sectors is attributed to targeted efforts to collect data from companies in these sectors that were collaborating with the university in other research projects.

Table 6.3: Organizational size distribution of the responses (No. of employees).

Size		No.of Responses	%
Less than 100		14	7%
100-500		15	7%
500-1000		24	11%
More than 1000		162	75%
Total		215	100%

With the classification of "very small" for less than 100; "small" for 101-500, "medium" for 501-1000; and "large" for more than 1000 employees utilized, results show that 75% of the respondents were from large organizations with the next largest respondent group (11%) from medium sized organizations. It is most likely that more responses are from large companies because they are more aware of Lean, its related advantages and more curious to know the study's results related to their particular sector. Another reason might be that more email addresses of employees from large companies are available through list serves since they tend to have more affiliations with a wide range of societies and educational institutions for other project related research.

Table 6.4: Years of employment with the same organization.

No. of Years		No. of Responses	%
Less than 1 year		18	8%
1-3 years		16	7%
3-7 years		39	18%
7-10 years		28	13%
More than 10 years		116	53%
Total		217	100%

As the above table shows, a large proportion of respondents (53%) had more than 10 years of service with their current organization. These results could partly be attributed to the fact that most of the targeted effort for obtaining responses was aimed at senior managers in organizations.

In addition to the overall analysis, an in-depth analysis from the perspective of industry sectors is included in later sections of this chapter to determine if there are major differences between sectors.

6.2 Data Analysis

The total number of recorded responses was 246. The responses were imported to MS Excel for further calculation and statistical analysis. The coefficient of correlation 'r' was calculated which gave the strength of the relation between two parameters viz. the organizational cultural trait and the problem solving step for each specific hypothesis. The test statistic was calculated using Equation 5.1.

For a 95% confidence interval, with n-2=244, gives $t_c = 1.98$. The r^2 values were computed using survey data and were utilized to compute a t-statistic for each hypothesis. The calculation approach is illustrated here for hypothesis H10. Based on survey results, the correlation coefficient between responses for cultural trait-related questions (Q1, Q4, Q6) (Question numbers are shown in Appendix I) and problem solving step-related questions (Q3, Q2, Q5) is $r = \left| 0.604 \right|$

Thus for H10, the test statistic is

$$t_t = \frac{0.604\sqrt{244}}{\sqrt{1-0.365}}$$ Equation 6.1

$$t_t = 11.773$$ Equation 6.2

This approach was used in calculating t_t for all the hypotheses. Similar calculations were conducted for all the hypotheses and are tabulated below in Table 6.5.

Table 6.5: 'r' values and t_t values for all the hypotheses.

Hypothesis number	**Hypotheses**	**r**	**t_t**
H10	Promoting open expression of problems does not influence problem identification, breakdown & prioritizing.	0.604	11.773
H20	Team members taking the initiative to solve problems does not lead to increased possibility of generating solutions for the problems identified.	0.304	4.713
H30	Collectivism/team work hinders the process of selecting the best countermeasure.	0.097	1.520
H40	Unity/goal alignment does not help in following the implemented solution.	N/A	N/A
H50	Problem solving is faster when team members are emotional.	0.109	1.71
H60	Organizational receptivity to problem identification leads to poor problem communication up/down the hierarchy.	0.642	13.08

Based on analysis illustrated for hypothesis H10, if test statistic t_t is greater than $t_{critical}$, then the null hypothesis can be rejected. Conclusions that can be made based on the values of t_t for each null hypothesis shown in Table 6.5 and the t_c value is included below in Table 6.6. Results are discussed in detail in the following section.

Table 6.6: Analysis of hypotheses.

Hypothesis number	Hypotheses	Result
H10	Promoting open expression of problems does not influence problem identification, breakdown & prioritizing.	**Reject**
H20	Team members taking the initiative to solve the problems does not lead to increased possibility of generating solutions for the problems identified.	**Reject**
H30	Collectivism/team work hinders the process of selecting the best countermeasure.	**Fail to reject**
H40	Unity/goal alignment does not help in following the implemented solution.	**Inconclusive**
H50	Problem solving is faster when team members are emotional.	**Fail to reject**
H60	Organizational receptivity to problem identification leads to poor problem communication up/down the hierarchy.	**Reject**

6.3 Discussion of Overall Results

This section discusses the overall results of all hypotheses, those which were rejected and those which failed to get rejected. There was also a trait that was inconclusive and the explanation for including that trait and potential reasons for inconclusive results are also presented.

Hypothesis H10: Promoting open expression of problems does not influence problem identification, breakdown & prioritizing.

The general understanding about successful Lean transformations is that promoting open expression of ideas or problems encountered by team members can promote problem identification. The H10 null hypothesis is the converse of that general

understanding and was successfully rejected through the statistical analysis of survey results. Since this hypothesis was rejected, it reveals that the encouragement of open expression is a cultural trait correlating with better problem identification, breakdown and prioritizing in these organizations based on experiences in industry. Rational thinking also supports this condition. If team members working on the line encounter a problem and are encouraged to share that information, problems are more likely to be resolved quickly. If open expression is not allowed and a problem occurs, it is less likely to be exposed if team members are fearful of being blamed for it.

The graphs illustrated below show detailed responses to questions related to this hypothesis. The organizational culture trait-related questions are on the left and the problem solving step-related questions are on the right. (Abbreviations in the graphs: STRD – Strongly Disagree, D – Disagree, SMD – Somewhat Disagree, NAND – Neither Agree Nor Disagree, SMA – Somewhat Agree, A – Agree, STRA – Strongly Agree)

As shown by the graphs, the majority of respondents indicated that their supervisors are interested in their ideas, they are encouraged to speak out, they are focused on identifying problems, and analyzing systematically and speaking about problems is not viewed as forgetting their place in the organization. The only question with mixed responses related to whether or not they are held responsible for the problems identified by team members. The responses to this question could be a potential reason why this hypothesis did not yield as large of a t_t as H60.

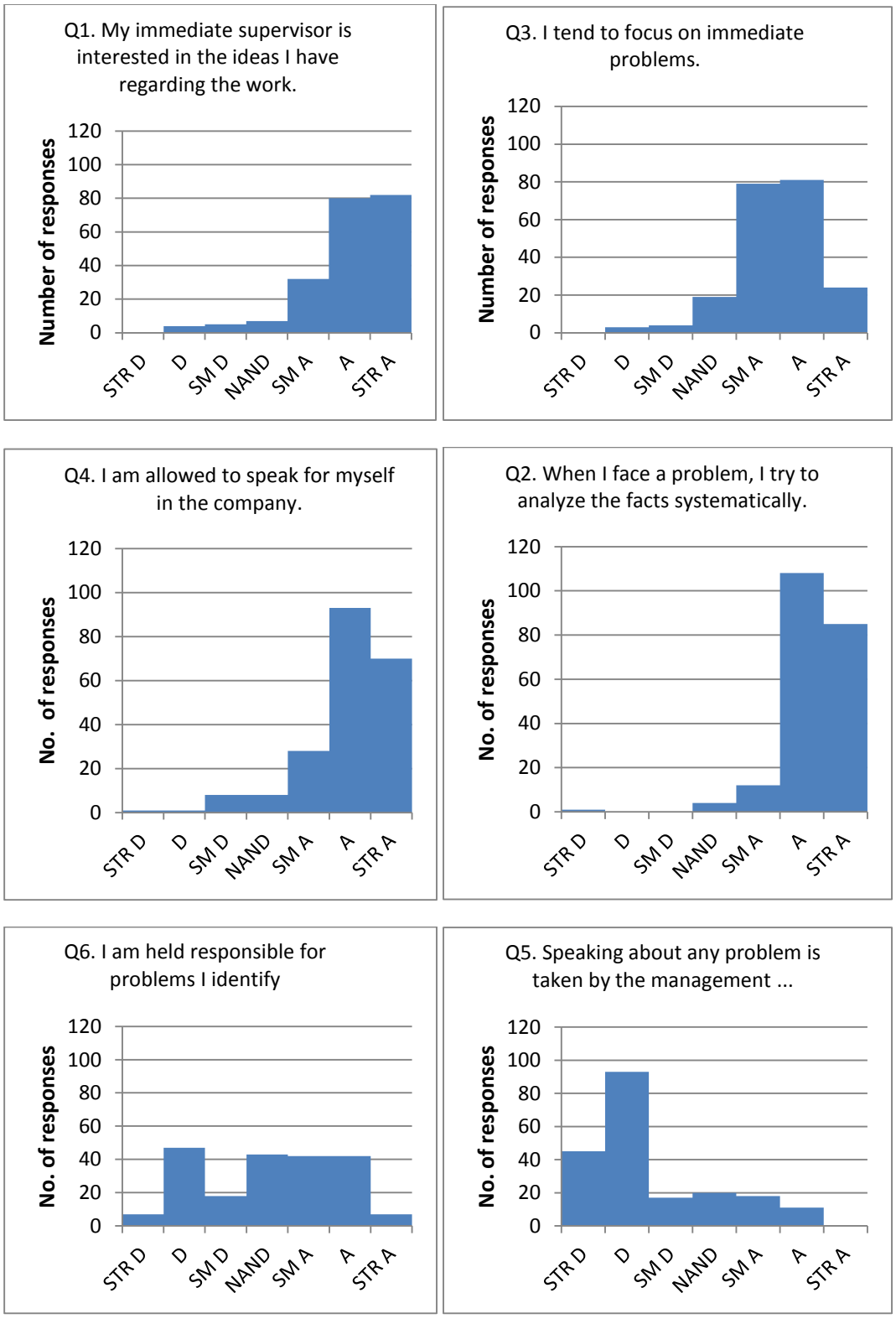


Figure 6.1: H10: Response Distribution.

Statistical analysis supports the premise that open expression of problems should be promoted in organizations seeking Lean transformations because it can positively influence problem identification, breakdown and prioritizing.

Hypothesis H20: Team members taking the initiative to solve problems does not lead to increased possibility of generating solutions for the problems identified.

This null hypothesis was successfully rejected. A common perception of this cultural trait is that team members taking the initiative to solve problems as soon as they encounter them without having to wait for superior's approval (which is the case in many traditional organizations), often results in much time being saved. Also, since the team members are the ones who work on the line all of the time, they are more likely to come up with better solutions. Statistical analysis supports the converse of the hypothesis. Thus, it can be concluded that there exists a strong relationship between team members in an organization taking the initiative to solve problems and the ability to generate solutions for identified problems. Analysis supports the premise that the cultural trait of taking individual initiative should be promoted for generating more effective countermeasures for successful Lean transformations. The distribution of responses to questions related to this hypothesis is shown in Figure 6.2 (cultural trait-related questions are in the left column and problem solving step-related questions are in the right column).

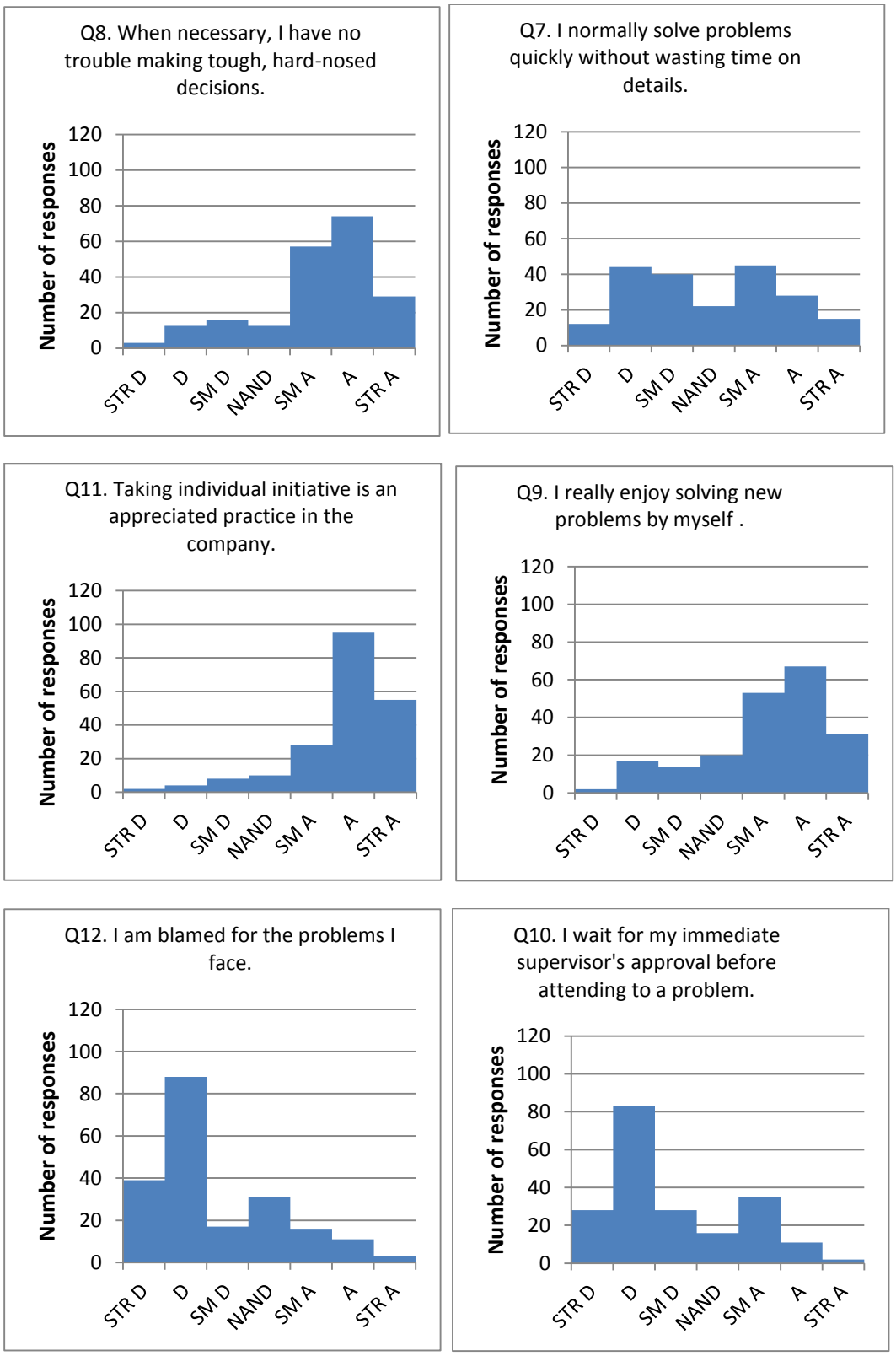


Figure 6.2: H20: Response Distribution.

Hypothesis H20 was successfully rejected and supports the premise that taking individual initiative is a good practice and should be promoted in an organization for successful Lean transformations. The independent responses for each question showed a similar trend in providing evidence to reject the null hypothesis. The majority of the respondents indicated that they do not have difficulty in making conclusive decisions when needed, that taking initiative is mostly appreciated in their organization, that team members enjoy solving problems, and that they are rarely blamed for the problems they identify.

Hypothesis H30: Collectivism/team work hinders the process of selecting the best countermeasure.

The data collected through the survey failed to reject this hypothesis. Using rational thinking, team work should definitely assist in selecting the best countermeasure since it would be an agreed upon decision by more than one person. The $t_{critical}$ value is 1.52, which is very close to 1.98, showing a reason for this null hypothesis to be rejected. One potential reason for these results might be the need for a larger sample size (only 200 respondents responded to this hypothesis). It is likely that a greater number of respondents would have yielded results indicating rejection of this hypothesis. The distribution of responses to questions addressing this hypothesis is shown in Figure 6.3 (cultural trait-related questions are in the left column and problem solving step-related questions are in the right column).

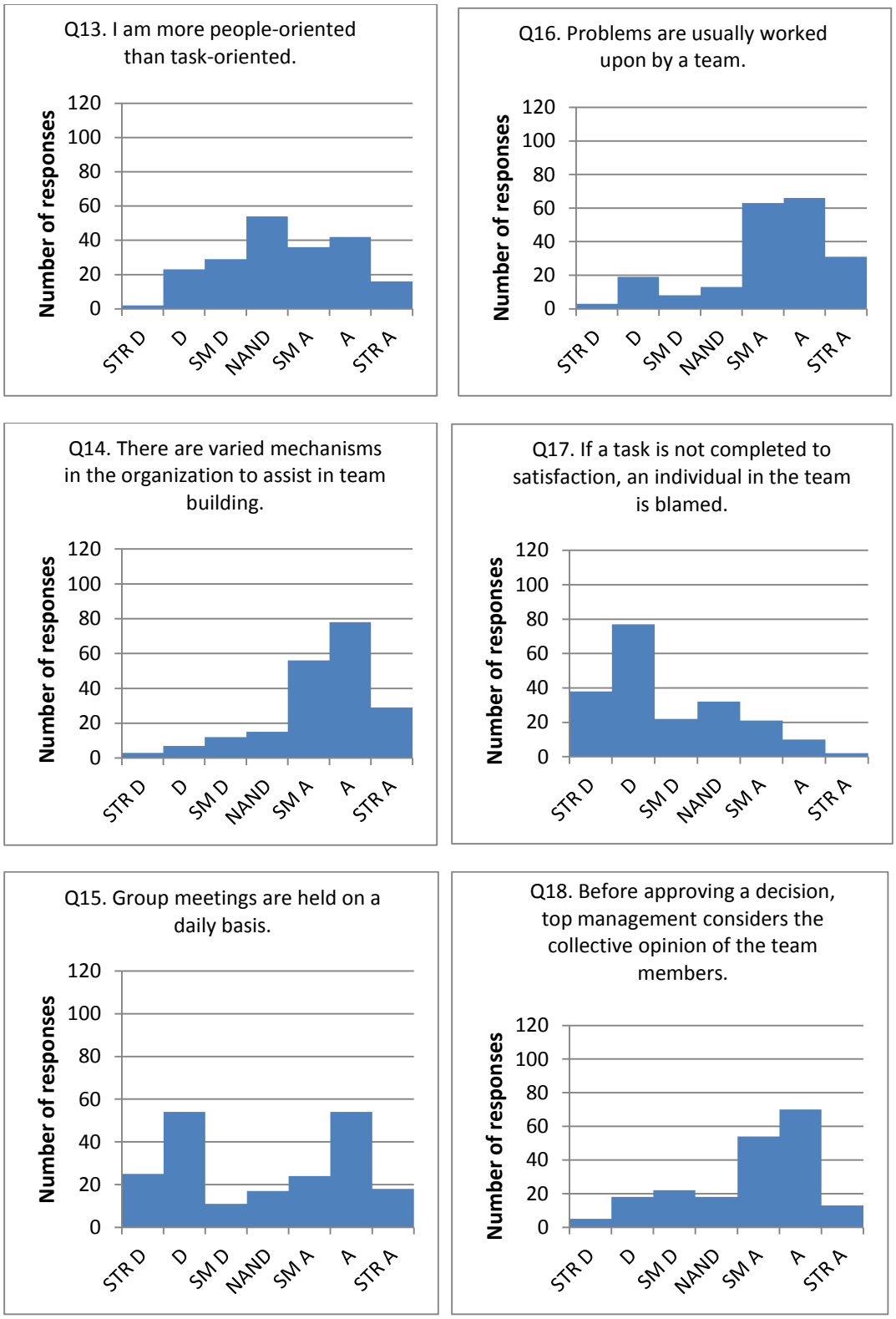


Figure 6.3: H30: Response Distribution.

The reason for insufficient evidence to reject this hypothesis is clear from the response distribution shown. With the exceptions of Q14 and Q17, all other questions show mixed responses with no trend supporting or rejecting the questions raised. Hence, the null hypothesis could not be rejected. Probable success could potentially be found by increasing the sample size and re-analyzing the results.

Hypothesis H40: Unity/goal alignment does not help in following the implemented solution.

The results for this hypothesis were inconclusive due to a number of reasons related to the questions included in testing the hypothesis (see Fig 6.4 below). It is possible that the respondents belonged to organizations which are non-unionized and chose not to respond as these conditions do not apply to them. Additionally, respondents may have simply chosen not to answer these questions due to it being related to a miscellaneous somewhat sensitive topic. The reason these union related questions were included in the survey were because unionization, in general, is considered a hindrance to major organizational change. Maleyeff (2014) emphasized this point, indicating that unions can be a hindrance, especially when their approach is inconsistent towards organizational cultural change or when unions are perceived as being held responsible for the program's success. Unions as a hindrance can also be a pre-determined belief of managers. Chen (2007) suggested that managers typically tend to regard unions as a hindrance to workplace flexibility and timely response. The inclusion of these types of questions was also partly influenced by the researcher's experience of working in a unionized plant for 2 years with observation of similar circumstances. Further research is

needed to assess this hypothesis. The use of more generic questions could be attempted; alternatively, different approaches to collecting information, such as short interviews, could also provide better information. The distribution of responses to the questions related to this hypothesis is shown in Figure 6.4 (cultural trait-related questions are in the left column and problem solving step-related questions are in the right column).

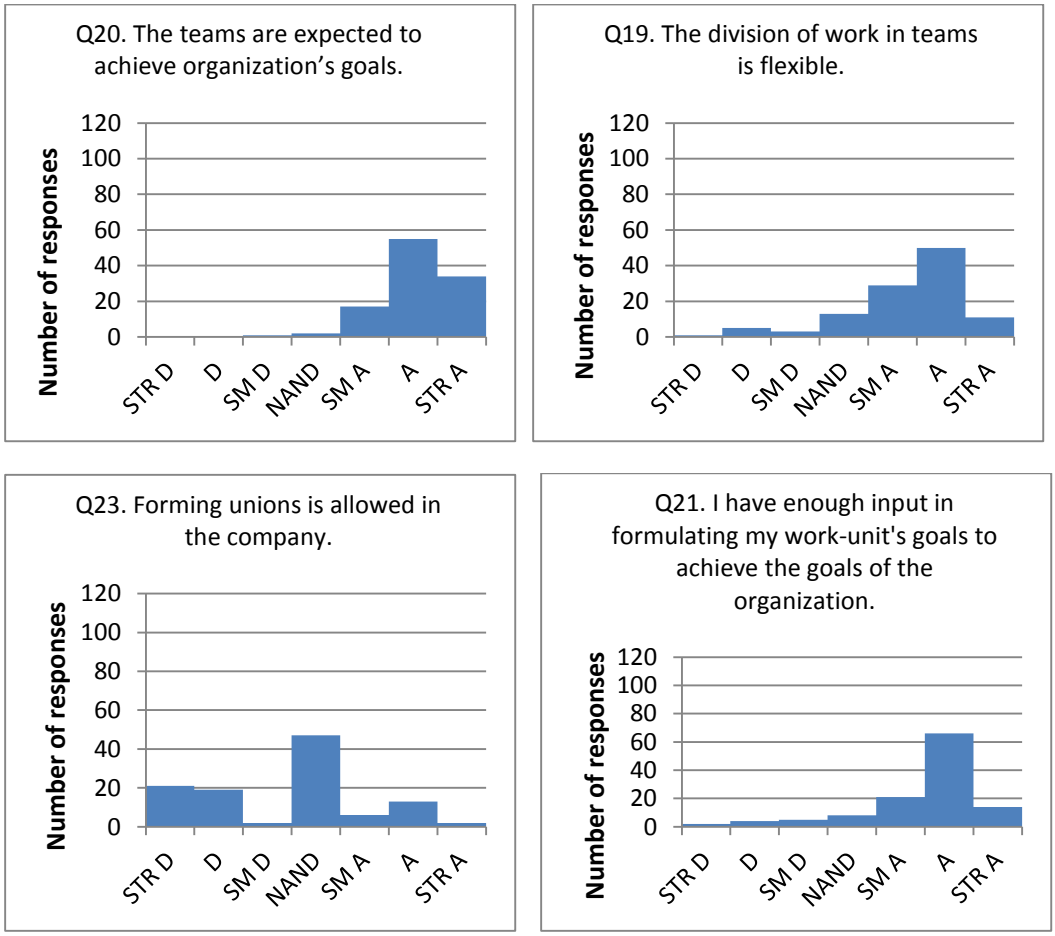
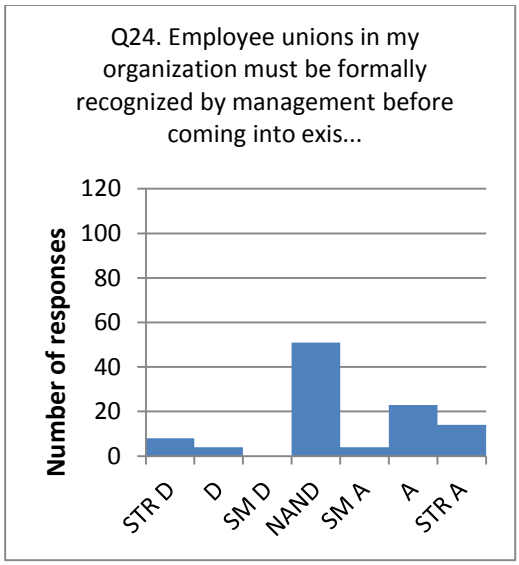
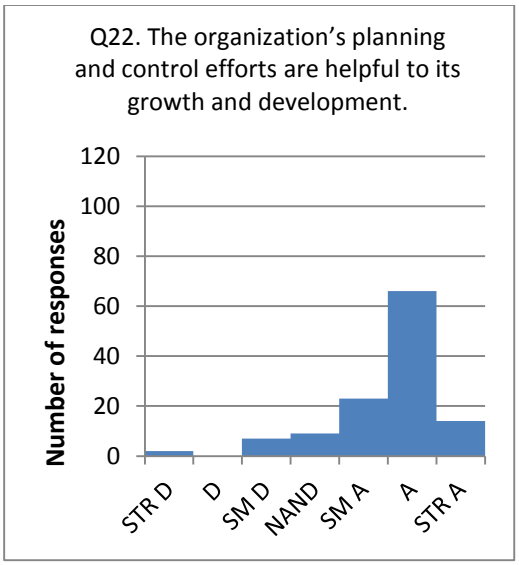


Figure 6.4 H40: Response Distribution, continued on page 63





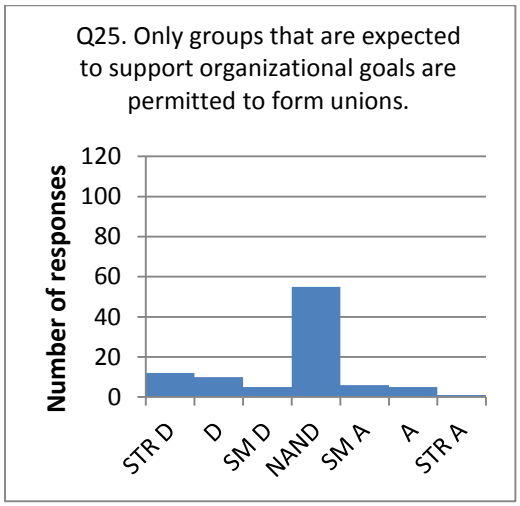


Figure 6.4: H40: Response Distribution, continued from page 62.

Hypothesis H50: Problem solving is faster when team members are emotional.

The data failed to reject this hypothesis. There were mixed responses to questions as illustrated in the graphs shown in Figure 6.5. It is likely that there were two populations of respondents for this hypothesis, one supporting emotionality and the other supporting unemotionality. Support for one condition or the other completely depended

on the team members' thinking and to which stance the organization harnessed more often. A common perspective on this hypothesis is that being emotional at the work place and talking about such matters wastes time and slows down processes. Additionally, these behaviors can be a hindrance in the future by creating a vulnerable situation from personal information shared when two team members were close. It is possible that unemotionality might have been a dominating trait if the survey had been administered to a larger group of people. The distribution of responses to the questions related to this hypothesis is shown in Figure 6.5 (cultural trait-related questions are in the left column and problem solving step-related questions are in the right column).

This null hypothesis could not be rejected and the related histograms prominently highlight the results. Amongst all six related questions to this hypothesis, only two questions were answered in strong agreement, 1) the relationship with the supervisor being harmonious and 2) considering oneself a self-motivator. Four other questions failed to generate answers of either strongly agreed or strongly disagreed. The responses were distributed across either agree or disagree.

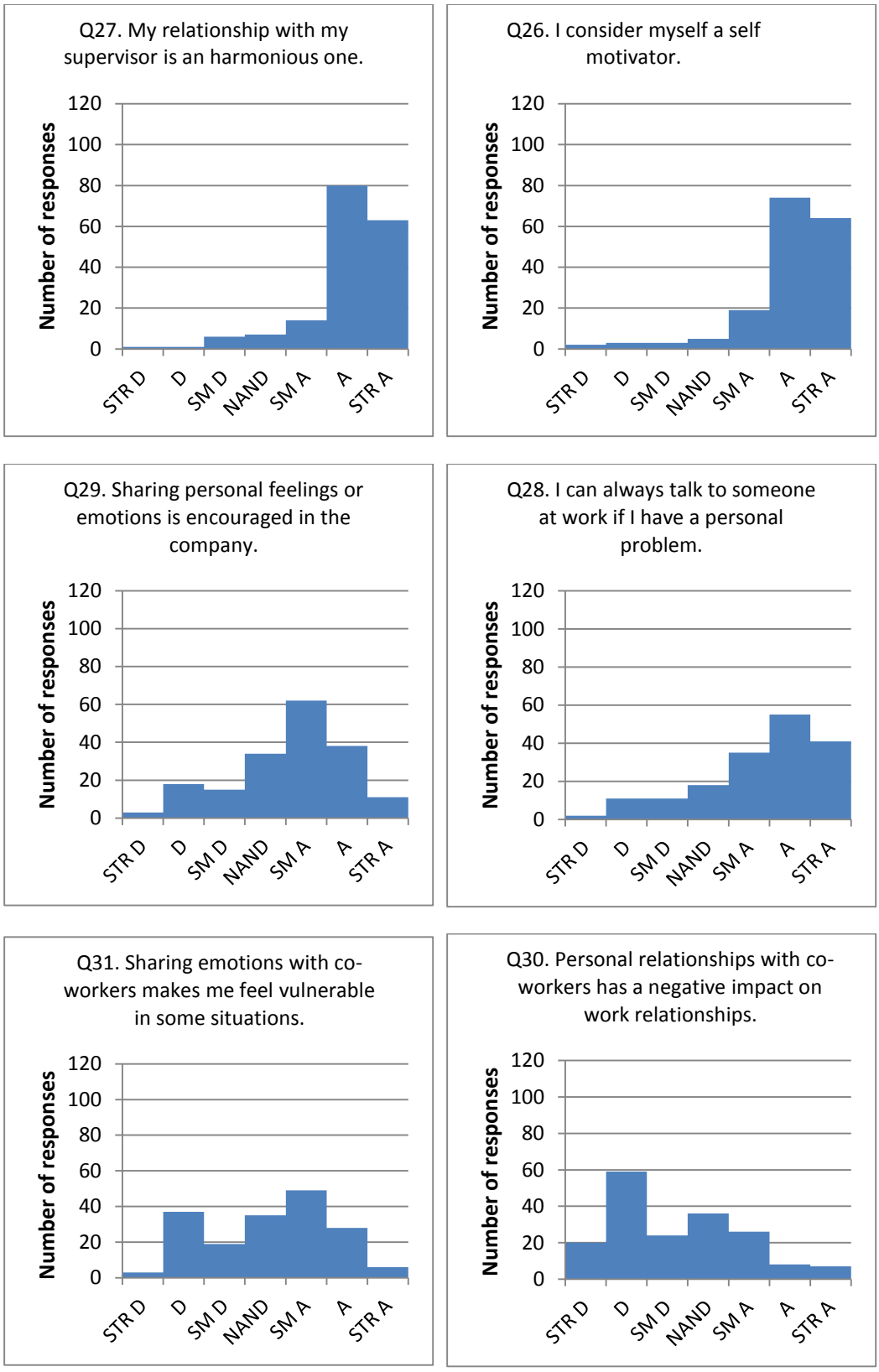


Figure 6.5: H50: Response Distribution.

Hypothesis H60: Organizational receptivity to problem identification leads to poor problem communication up/down the hierarchy

This hypothesis was strongly rejected and supported the premise that better receptivity in an organization leads to better communication and, therefore, enables faster countermeasure implementation and sharing. If management is not receptive enough to listen to what a team member has to say about problems or possible countermeasures, the team member might not bother to inform the supervisor the next time a problem is encountered. Thus, managerial receptivity for team member input can be considered an important cultural trait to be promoted in an organization's culture for disciplined problem solving. The distribution of responses to the questions related to this hypothesis is shown in Figure 6.6 (cultural trait-related questions are in the left column and problem solving step-related questions are in the right column).

In observation of responses to the six questions for hypothesis H60, the response trend is toward the 'strongly agree' side of the Likert scale indicating strong evidence to reject the null hypothesis. More receptive management can lead to better movement on problems and better countermeasures developed.

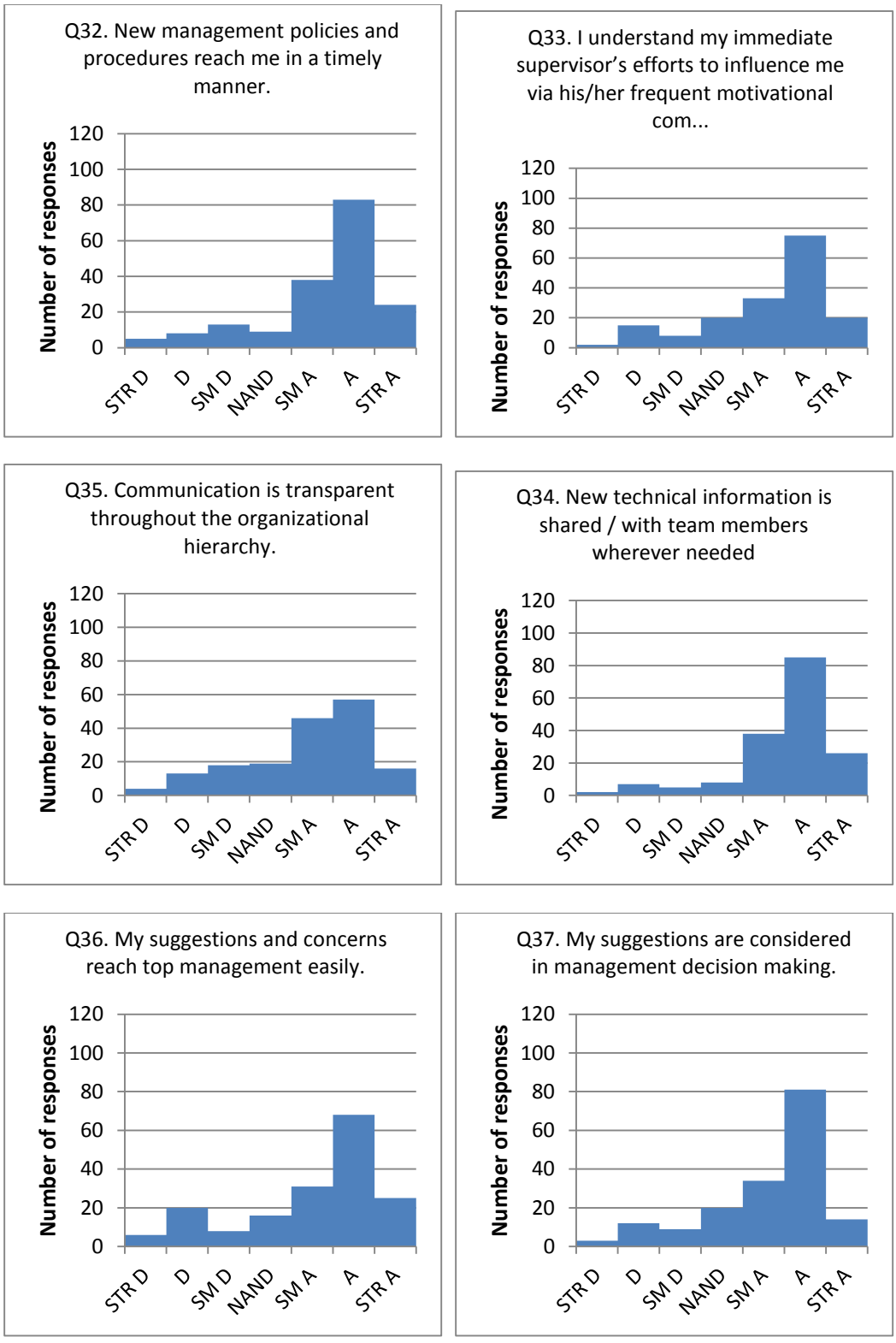


Figure 6.6: H60: Response Distribution.

6.4 Industry Sector Based Analysis

In order to evaluate whether or not there are industry sector-specific differences in the hypothesized relationships between cultural traits and problem solving steps, a separate analysis was conducted. Results of this analysis are described in detail in the section below.

The survey included a question to gather information about the industry sector of each respondent. The intention of this question was to evaluate if certain sectors have more awareness about Lean than others and to discover any further insights related to behavior and practices within these sectors. The two industry sectors with the target number of respondents were healthcare (113) and the apparel industry (21). Following the same approach previously described, findings are discussed in further details below.

6.4.1 Healthcare sector

The results from the statistical analysis for this sector's analysis (113 responses) are displayed in the Table 6.7. The healthcare sector followed a trend similar to the overall survey results. Hypothesis questions and responses to them are illustrated with the help of histograms in Appendix II

Hypothesis H10 is successfully and strongly rejected. The graphs in Appendix II.1 illustrate a trend similar to overall hypotheses analysis indicating that the healthcare industry reflects good pursuance of a culture of problem solving by encouraging open expressions to identify, breakdown and prioritize the problems.

Table 6.7: Analysis of hypotheses (Healthcare Industry).

Hypothesis number	Hypotheses	Result
H10	Promoting open expression of problems does not influence problem identification, breakdown & prioritizing.	Reject
H20	Team members taking the initiative to solve the problems does not lead to increased possibility of generating solutions for the problems identified.	Reject
H30	Collectivism/team work hinders the process of selecting the best countermeasure.	Fail to reject
H40	Unity/goal alignment does not help in following the implemented solution.	Inconclusive
H50	Problem solving is faster when team members are emotional.	Fail to reject
H60	Organizational receptivity to problem identification leads to poor problem communication up/down the hierarchy.	Reject

H20 for healthcare is also rejected successfully but not as strongly as H10. The graphs in Appendix II.2 illustrate team members taking initiative in finding a possible countermeasure as a well appreciated practice in the healthcare sector. The employees are rarely blamed for the problems they face or report to management, and they mostly attempt to problem solve before the supervisor arrives at the problem site.

Hypothesis H30 for the healthcare industry could not be rejected based on statistical analysis. It is evident from the plots (Appendix II.3) that most responses are scattered around either agree or disagree. Reasons for these results might be that the healthcare industry generally does not focus on collectivism/team work or that the survey needs to be administered to more respondents from the healthcare sector and results must

be monitored. A common perspective is that collectivity/team work assists in selecting the best possible countermeasure because it gives the chance for brain-storming and, as a result, supports problem solving culture.

Hypothesis H40 was inconclusive. The main reason may be that the healthcare sector is mostly non-unionized and, therefore, many of the respondents may have skipped the question related to formation of unions. The total responses from healthcare were 113, but for this specific hypothesis, there was no question with more than 60 respondents. To obtain more responses, survey data could be collected from employees of unionized health care facilities to support more conclusive results.

Hypothesis H50 in the healthcare sector could not be rejected. In examining survey responses, (Appendix II.5) employees neither comply with unemotionality nor do they follow emotionality. The staggered responses across neither agree nor disagree indicate failure in rejecting the null hypothesis.

Hypothesis H60 in the healthcare sector is successfully rejected with most responses moving toward “agree strongly.” (See Appendix II.6) It is asserted that the healthcare sector is quite receptive, in terms of ideas, to problem flow and information sharing. With regard for the healthcare sector, three null hypotheses were rejected out of six, one hypothesis related to union formation was inconclusive, and two null hypotheses failed to get rejected.

6.4.2 Apparel Sector

This section provides an in-depth statistical analysis of the apparel sector, with 21 responses, the second highest number of respondents after healthcare. A similar approach to the overall analysis of hypotheses was followed for statistical analysis of apparel sector responses. Results are tabulated below.

Table 6.8: Results for statistical analysis of the apparel sector.

Null hypothesis Number	Hypotheses (Apparel)	Result
H10	Promoting open expression of problems does not influence problem identification, breakdown & prioritizing	Reject
H20	Team members taking the initiative to solve problems does not lead to increased possibility of generating solutions for the problems identified	Fail to reject
H30	Collectivism/team work hinders the process of selecting the best countermeasure.	Fail to reject
H40	Unity/goal alignment does not help in following the implemented solution.	Inconclusive
H50	Problem solving is faster when team members are emotional.	Fail to reject
H60	Organizational receptivity to problem identification leads to poor problem communication up/down the hierarchy.	Reject

The responses for each question and their response trends are analyzed. They are shown in Appendix III.

Hypothesis H10 is rejected for the apparel sector, following the same pattern observed with the overall response and healthcare sector. The plots (Appendix III) illustrate that supervisors are interested in the ideas that team members generate, team

member are encouraged to express themselves, and, on very rare occasions, the team members are held responsible for the problems that they identify. These qualities of culture assert that the converse of the null hypothesis is true.

Null hypothesis H20 could not be rejected. There is likely more than one reason for these results. First and foremost, the sample size is very low (21). Not all people responded to all the questions and it is possible that a conducive culture for problem solving is close to non-existent within the sector.

From the data gathered and analyzed for this sector, this hypothesis H30 also failed to get rejected. The graphs illustrate (See Appendix III) scattered responses around either agree or disagree. It is possible that collectivism/team work may be lacking or that structured disciplined problem solving is not followed in the apparel industry.

Hypothesis H40, as in all other cases, was inconclusive. To begin with, there were only 21 respondents, and, in each question for this hypothesis, there were no more than 17 respondents answering each question. In this study, responses came from apparel sector employees of a non-unionized plant. In order to obtain more conclusive results, a review needs to be conducted as to whether or not respondents are from unionized organizations before sending out union formation related questions.

Hypothesis H50 failed to get rejected for the apparel sector as well. Probable reasons for these results may be a low sample size, no culture of problem solving actually in place, or team members that are too emotional. The responses illustrated in the graphs (Appendix III) do not appear to follow a particular trend; hence, results indicate failure to reject the null hypothesis.

Null hypothesis H60 is successfully rejected by a close margin. The graphs (in Appendix III) illustrate the trend because most bars are inclined towards "strongly agree." Results indicate the converse of the null hypothesis to be true and signify a presence of receptivity in the apparel sector. After the overall and sector-wise analysis, research conclusions and scope for future work are discussed in the next chapters.

CHAPTER 7: CONCLUSIONS AND FUTURE WORK

This research focused on finding if a relationship exists between structured problem solving methods and organizational cultural traits for successful Lean transformations. Hypothesis testing is the method used to verify this. A set of questions was developed to evaluate each of the six hypotheses. A survey was developed using a software tool called Qualtrics, and administered to employees working in different organizations and the feedback was evaluated. It has been observed that organizations trying to implement Lean in a rush, or wanting a quick change to make profits, fail miserably. One of the main reasons is thought to be management's focus on the hard side of Lean (tools like 8-step problem solving, kaizen, kanban systems, etc), making a recognizable mistake by ignoring the soft side of it (culture, respect for people).

To conclude, for the overall survey, null hypotheses H10, H20 and H60 were successfully rejected. Thus the converse of these hypotheses hold good which will be H1: Promoting open expression of problems does help in easy identification, breaking down and prioritizing of the problem, H2: Team members taking the initiative to solve a problem does help in generating solutions for the problem identified, H6: Organizational receptivity to problem identification leads to excellent problem communication up/down the hierarchy.

Thus looking at the results from the overall analysis of the hypotheses, it can be said that there does exists a relationship between organizational culture traits and structured problem solving steps for sustained Lean transformations.

H10 and H60 were rejected in the healthcare and apparel sector, highlighting the awareness and accepted importance of encouraging open expressions and the receptivity being high. Both hypotheses are related to the cultural trait of being expressive and communicative, thus helping identifying the problem and elevating up/down the hierarchy faster while H20 was rejected in the healthcare sector, similar to the overall, it failed to get rejected for apparel sector. Hypotheses H30 and H50 failed to get rejected, in both the sectors, just as for the overall study.

Hypothesis H40 regarding forming of unions and goals alignment was inconclusive in both the sectors as well. In general, regarding the ease of Lean implementation in healthcare, it might be said that the industry is following some principles of Lean, especially the soft side, but still has to go long way to implement the Lean completely and see the rewards. Also, the apparel sector industry was a non-unionized organization. As is located in an Asian country, where Lean implementations and culture for problems solving is followed on a grass root level. A study by Sohal (1996) indicates that "most western manufacturers have been aware of the need to improve their performance and competitiveness for nearly three decades now, developing economies their adoption is very slow. Especially in an Asian country like Bangladesh, some work has been done (Harun, 1990) regarding the theoretical aspect of JIT but a little work has been done in the area of Lean practices. The powerful Lean manufacturing approach that has proved successful as an operations model in developed economies, as well as in some large Indian companies, is recently increasingly being recognized by the small- and medium-size enterprises (Panizzoloa et al., 2012). This literature gives us an

insight that Lean is still not that widely implemented in developing Asian countries, which supports the results in the analysis mentioned above.

In apparel sector industry, Hypotheses H10 and H60 have been successfully rejected making a point that awareness of good communication and encouraging open expressions does exists, but it does not reflect if it is strongly rooted.

Hypotheses H20, H30 and H50 could not be rejected. Few of the reasons might be, lack of presence of these particular cultural traits viz. taking individual initiative, collectivism/ team-work and unemotionality.

The work presented here is expected to guide organizations on their journey of Lean transformations. However, there are many facets of this research that can be improved further to assist the implementation of Lean in traditional organizations. While this study was able to establish a positive correlation between a number of organizational culture traits perceived conducive to promote several steps in structured problem solving, causality between them was not verified. One of the important future studies can be focused on establishing if a causal relationship exists to check if organizational culture affects problem solving methods directly or vice versa and if it does, how strongly they are related.

Ultimately, the goal of this study is enabling Lean transformations. Thus, to measure how much Lean has been implemented in an organization, a matrix can be developed and the extent of Lean transformation or Leanness can be measured. Sector wise analysis can be taken to further depths mainly for size of an organization, hierarchical transformations of Lean can be known by adding a question about the

designation in the demographic questions, along with submitting the survey to a larger sample. It would certainly create better awareness in an organization with traditional culture, and focus on softer side of the Lean which is equally important as the problem solving methods for successful Lean transformations.

This work also provides an insight to the need to investigate and study more cultural traits and to explore their importance for problem solving. Also, the problem solving steps mentioned in this research are mostly derived from generic steps followed in a few companies; they can be made more specific to be initiated when a problem is encountered.

APPENDIX I: SURVEY QUESTIONS

H10:
Q1. My immediate supervisor is interested in the ideas I have regarding the work.
Q2. When I face a problem, I try to analyze the facts systematically.
Q3. I tend to focus on immediate problems.
Q4. I am allowed to speak for myself in the company.
Q5. Speaking about any problem is taken by the management as an indication of me not fully understanding...
Q6. I am held responsible for problems I identify

H20
Q7. I normally solve problems quickly without wasting time on details.
Q8. When necessary, I have no trouble making tough, hard-nosed decisions.
Q9. I really enjoy solving new problems by myself.
Q10. I wait for my immediate supervisor's approval before attending to a problem.
Q11. Taking individual initiative is an appreciated practice in the company.
Q12. I am blamed for the problems I face.

H30
Q13. I am more people-oriented than task-oriented.
Q14. There are varied mechanisms in the organization to assist in team building.
Q15. Group meetings are held on a daily basis.
Q16. Problems are usually worked upon by a team.
Q17. If a task is not completed to satisfaction, an individual in the team is blamed.
Q18. Before approving a decision, top management considers the collective opinion of the team members.

H40
Q19. The division of work in teams is flexible.
Q20. The teams are expected to achieve organization's goals.
Q21. I have enough input in formulating my work-unit's goals to achieve the goals of the organization.
Q22. The organization's planning and control efforts are helpful to its growth and development.
Q23. Forming unions is allowed in the company.
Q24. Employee unions in my organization must be formally recognized by management before coming into existence.
Q25. Only groups that are expected to support organizational goals are permitted to form unions.

H50
Q26. I consider myself a self motivator.
Q27. My relationship with my supervisor is a harmonious one.

Q28. I can always talk to someone at work if I have a personal problem.
Q29. Sharing personal feelings or emotions is encouraged in the company.
Q30. Personal relationships with co-workers have a negative impact on work relationships.
Q31. Sharing emotions with co-workers makes me feel vulnerable in some situations.

H60

Q32. New management policies and procedures reach me in a timely manner.
Q33. I understand my immediate supervisor's efforts to influence me via his/her frequent motivational com...
Q34. New technical information is shared / with team members wherever needed
Q35. Communication is transparent throughout the organizational hierarchy.
Q36. My suggestions and concerns reach top management easily.
Q37. My suggestions are considered in management decision making.

APPENDIX II: HEALTHCARE SECTOR – HISTOGRAMS

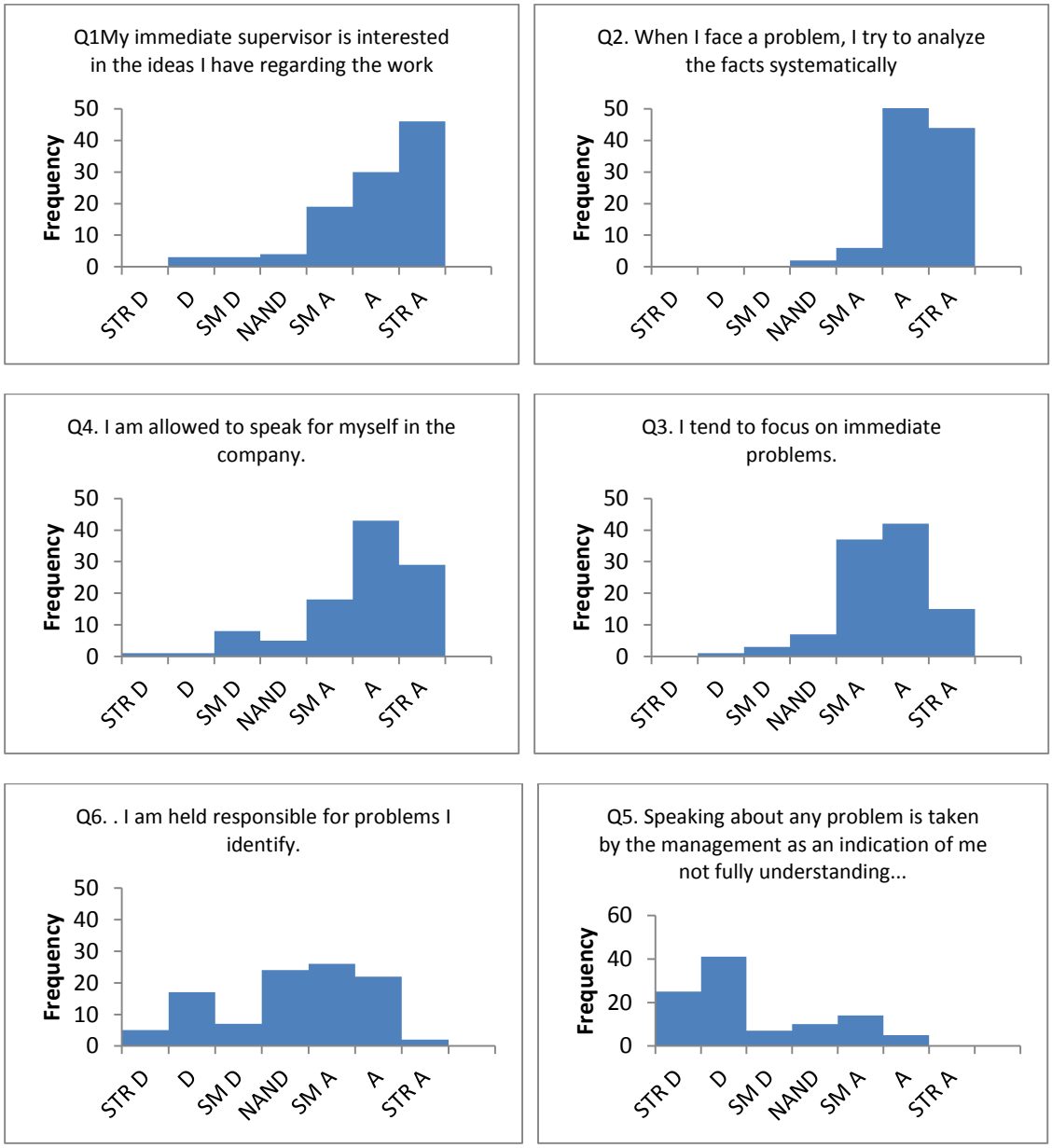


Figure II.1: H10: Response Distribution for Healthcare Industry.

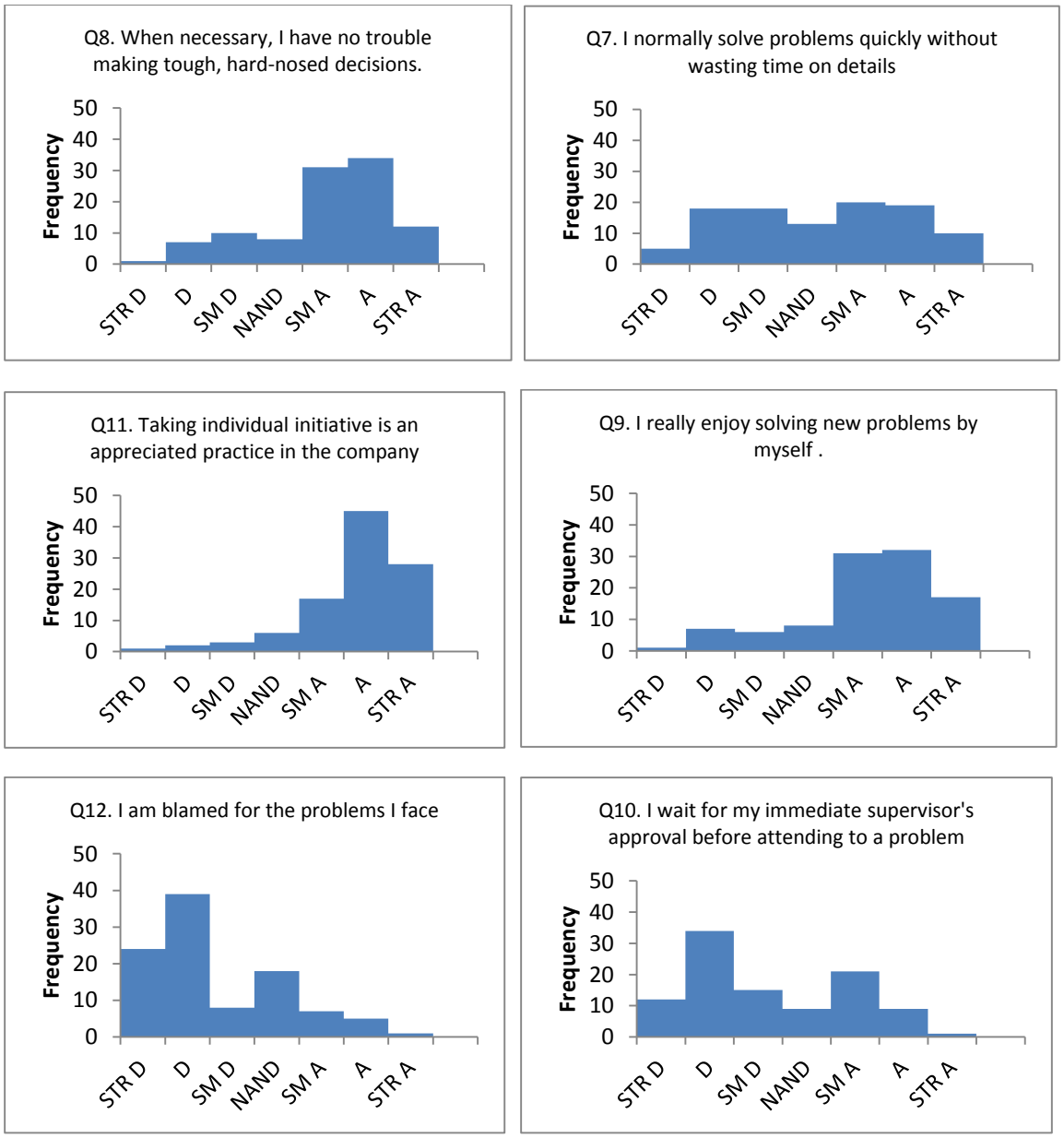


Figure II.2: H20: Response Distribution for Healthcare Industry.

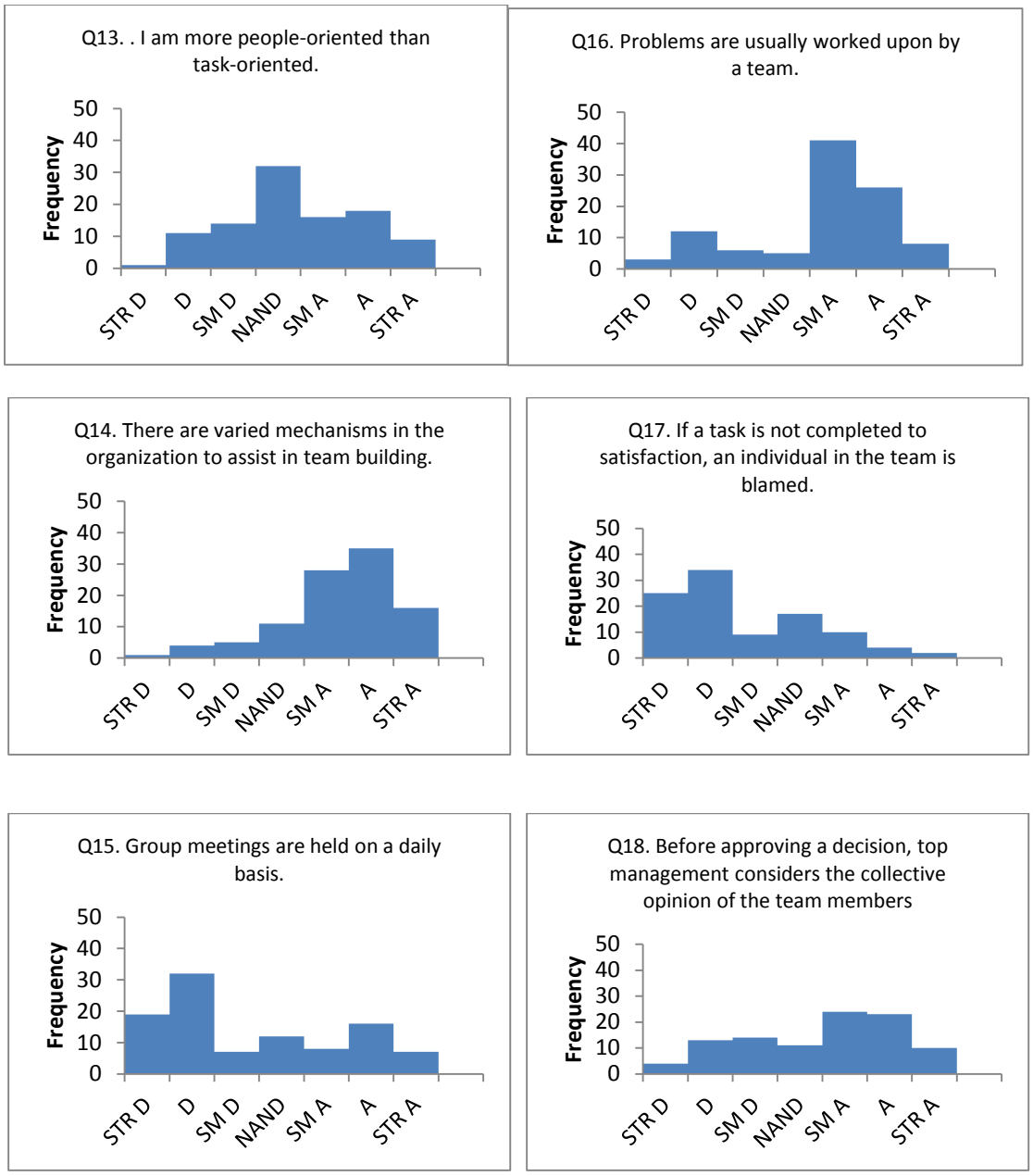


Figure II.3: H30: Response Distribution for Healthcare Industry.

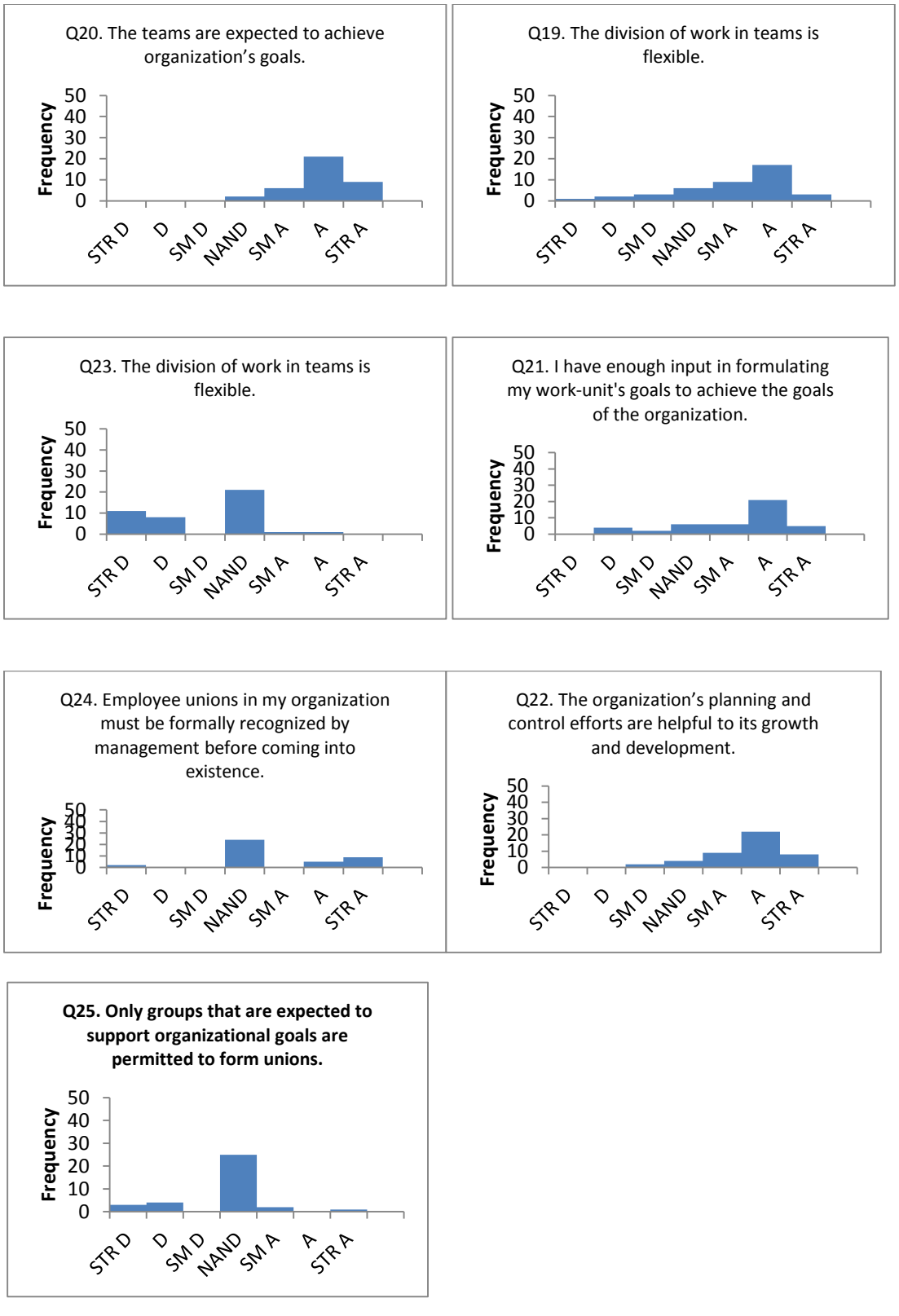


Figure II.4: H40: Response Distribution for Healthcare Industry.

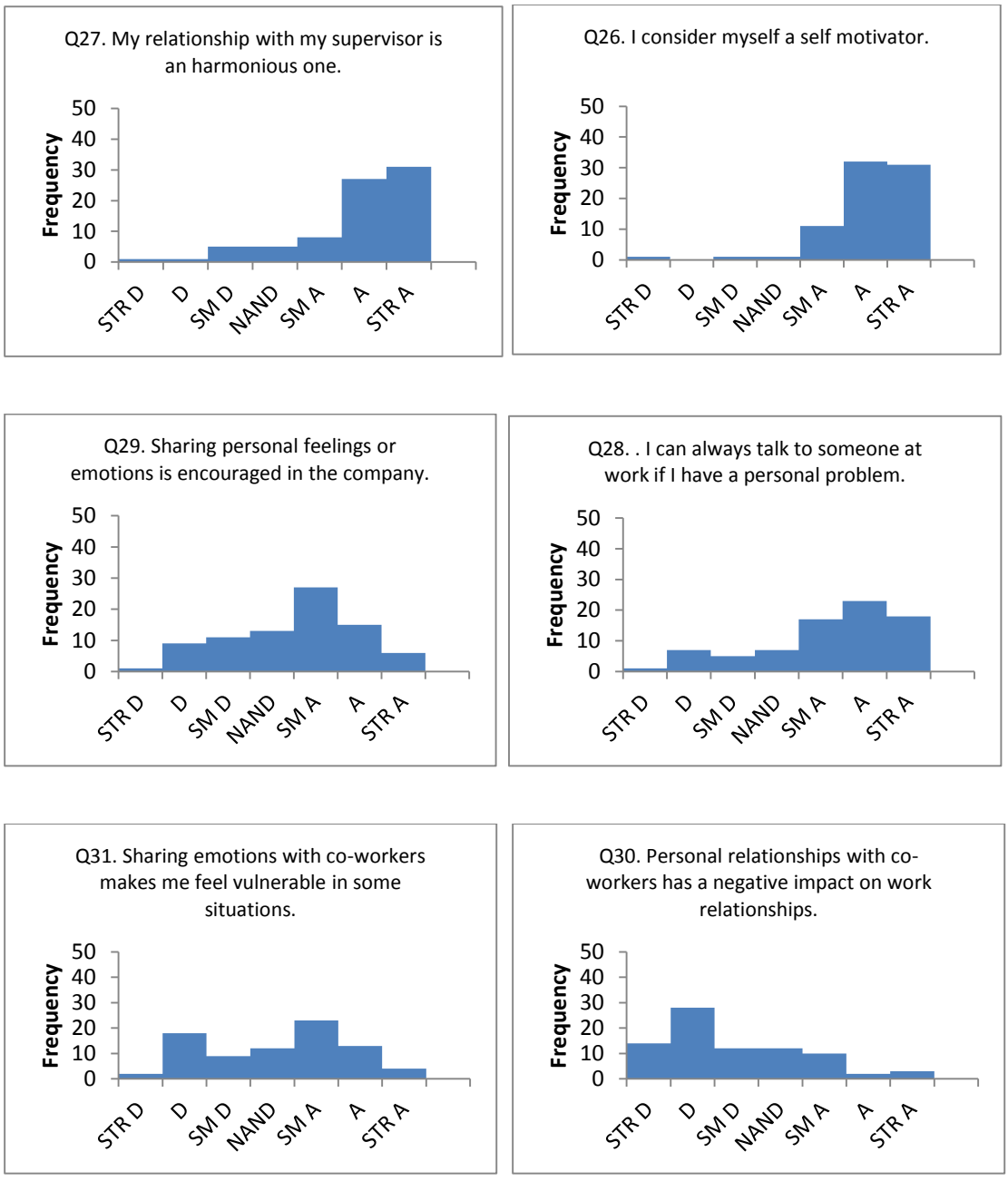


Figure II.5: H50: Response Distribution for Healthcare Industry.

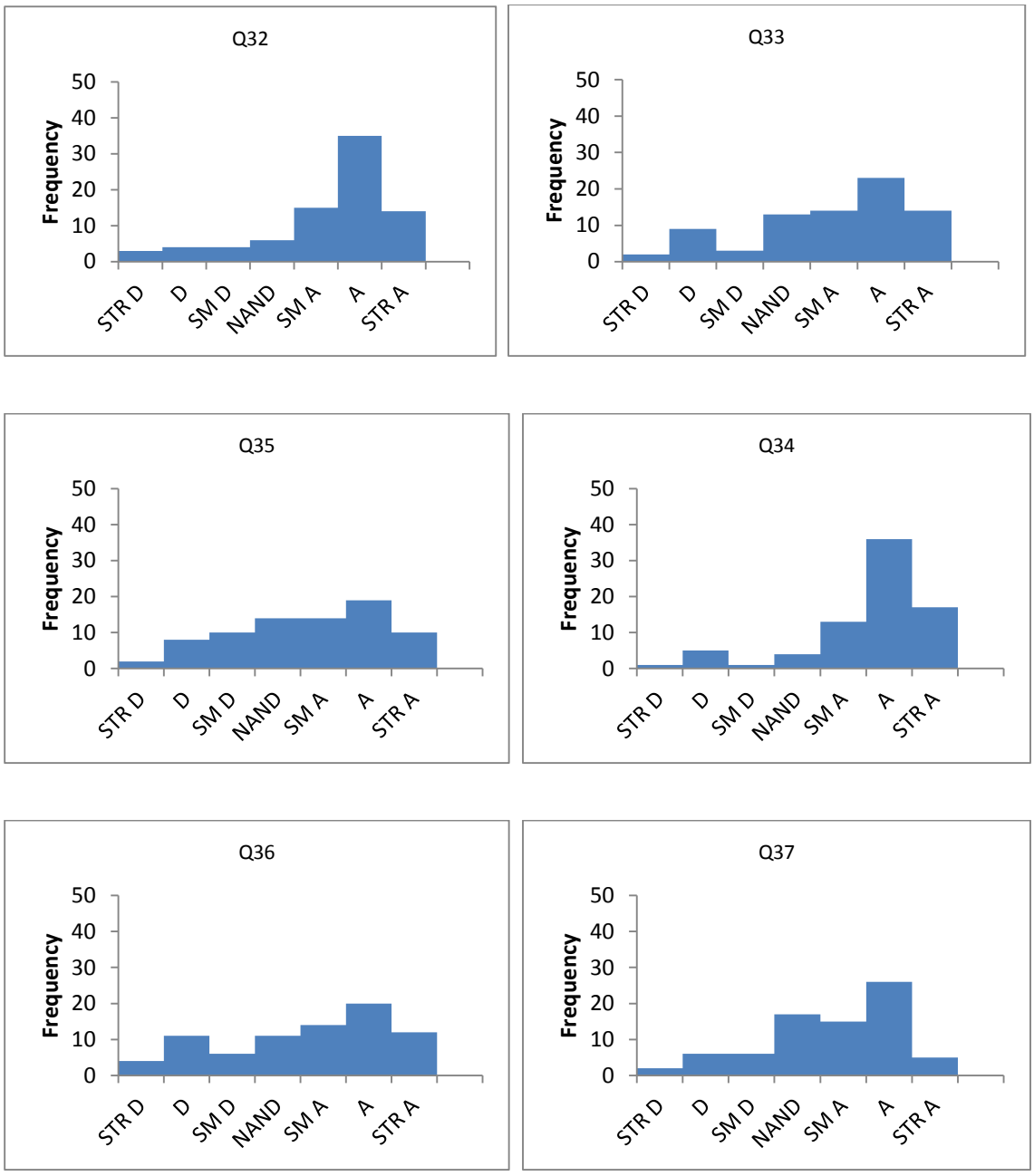


Figure II.6: H60: Response Distribution for Healthcare Industry.

APPENDIX III: APPAREL SECTOR – RESPONSE DISTRIBUTION

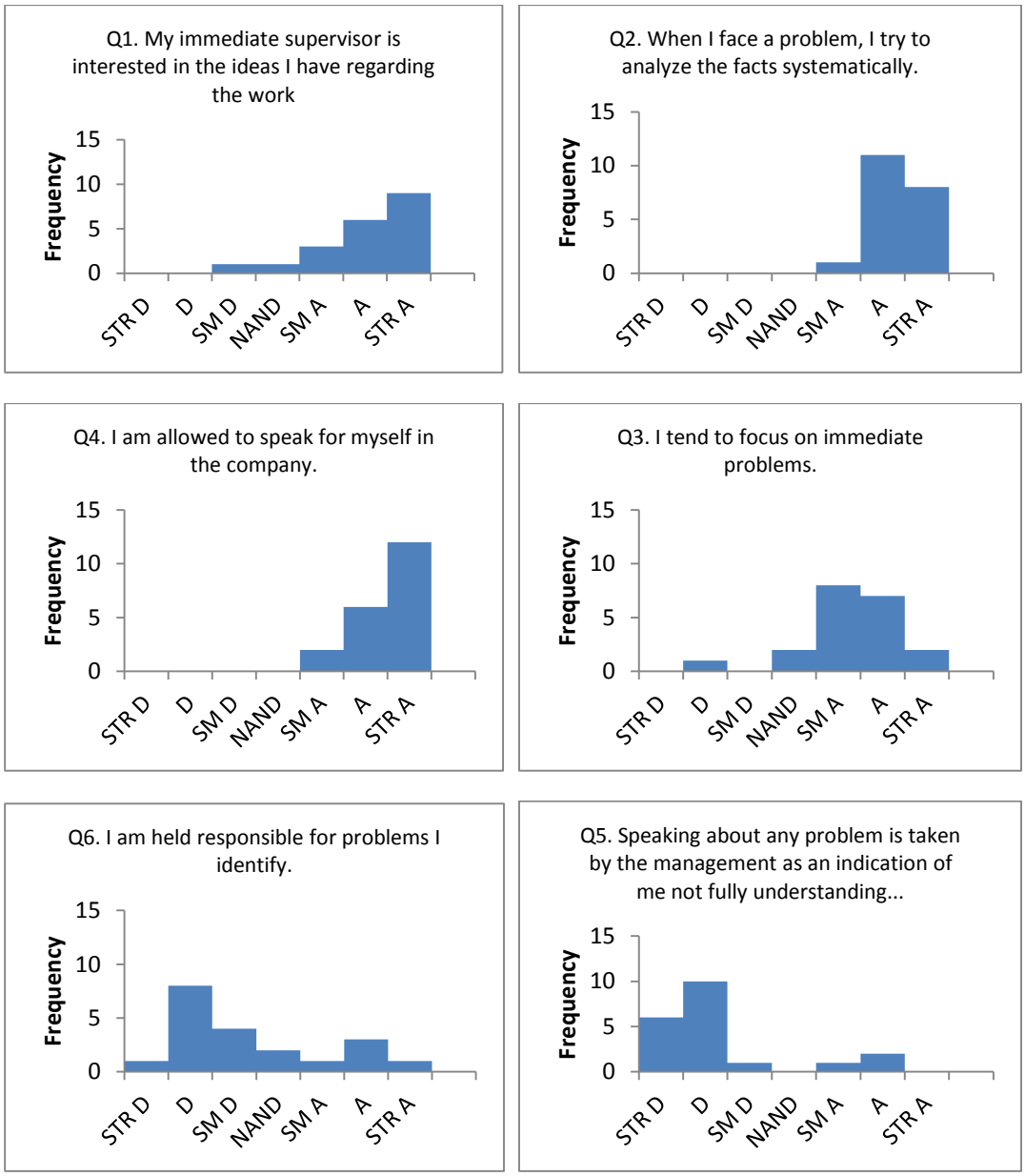


Figure III.1: H10: Response Distribution for Apparel Industry.

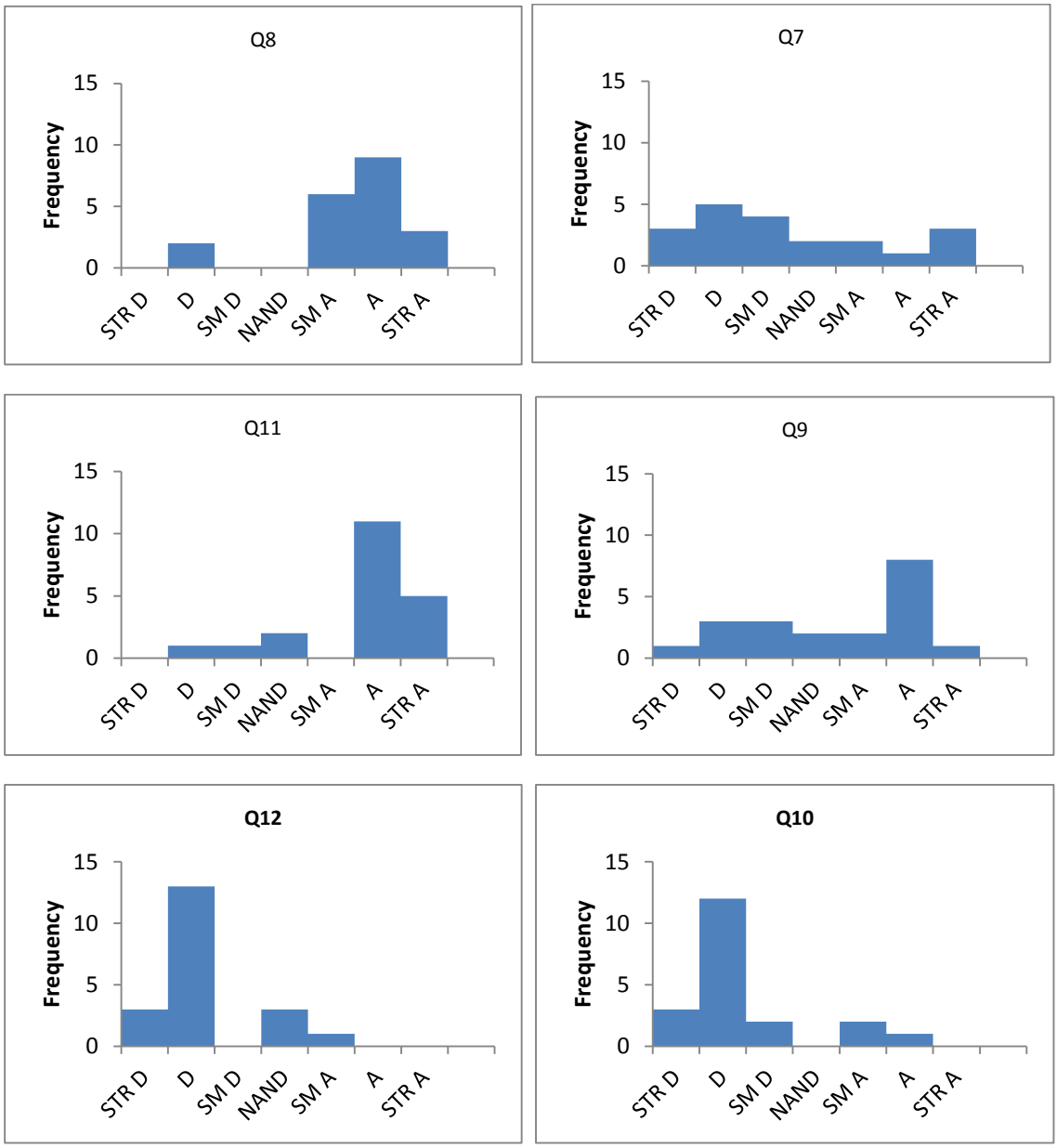


Figure III.2: H20: Response Distribution for Apparel Industry.

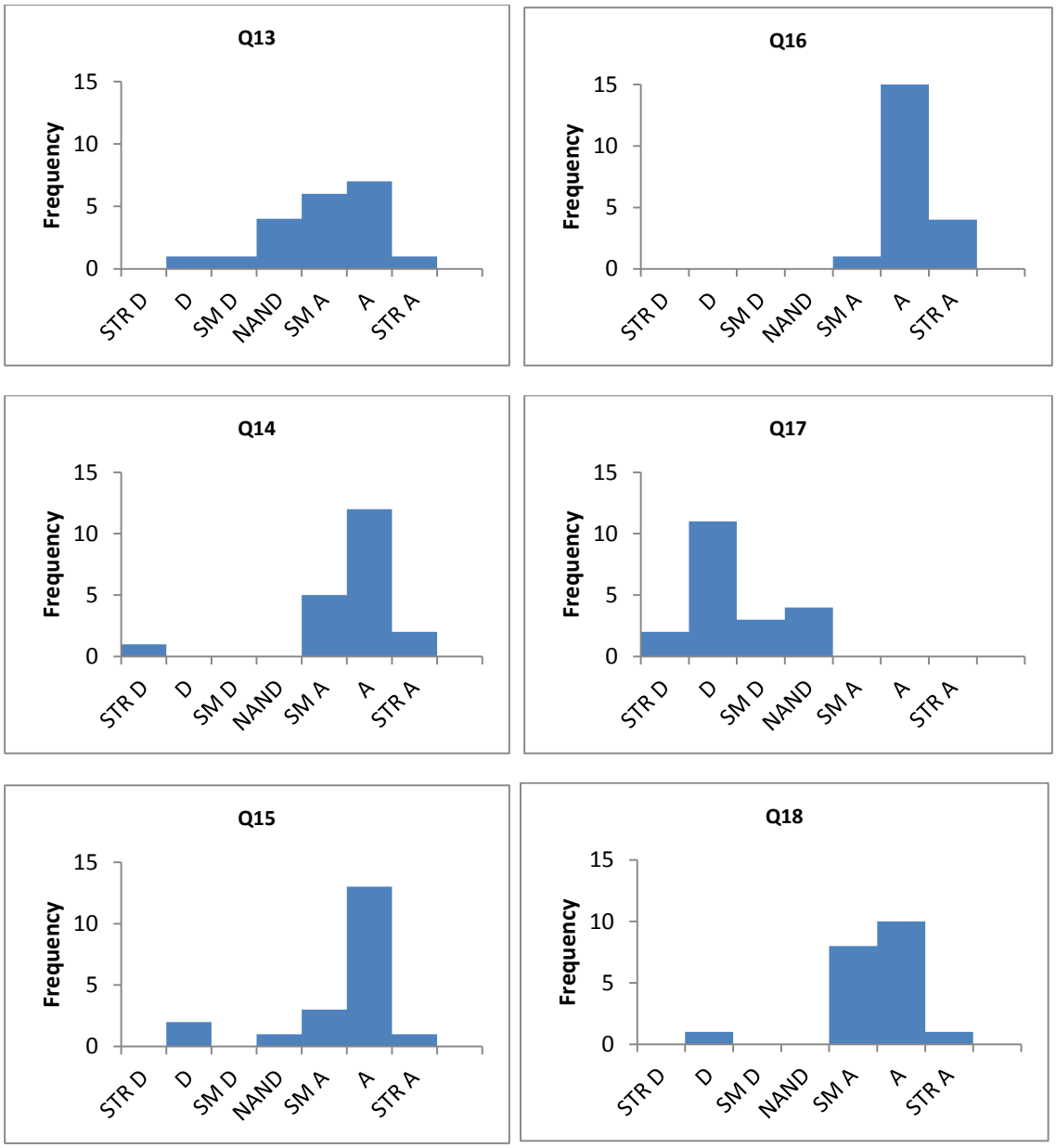


Figure III.3 H30: Response Distribution for Apparel Industry.

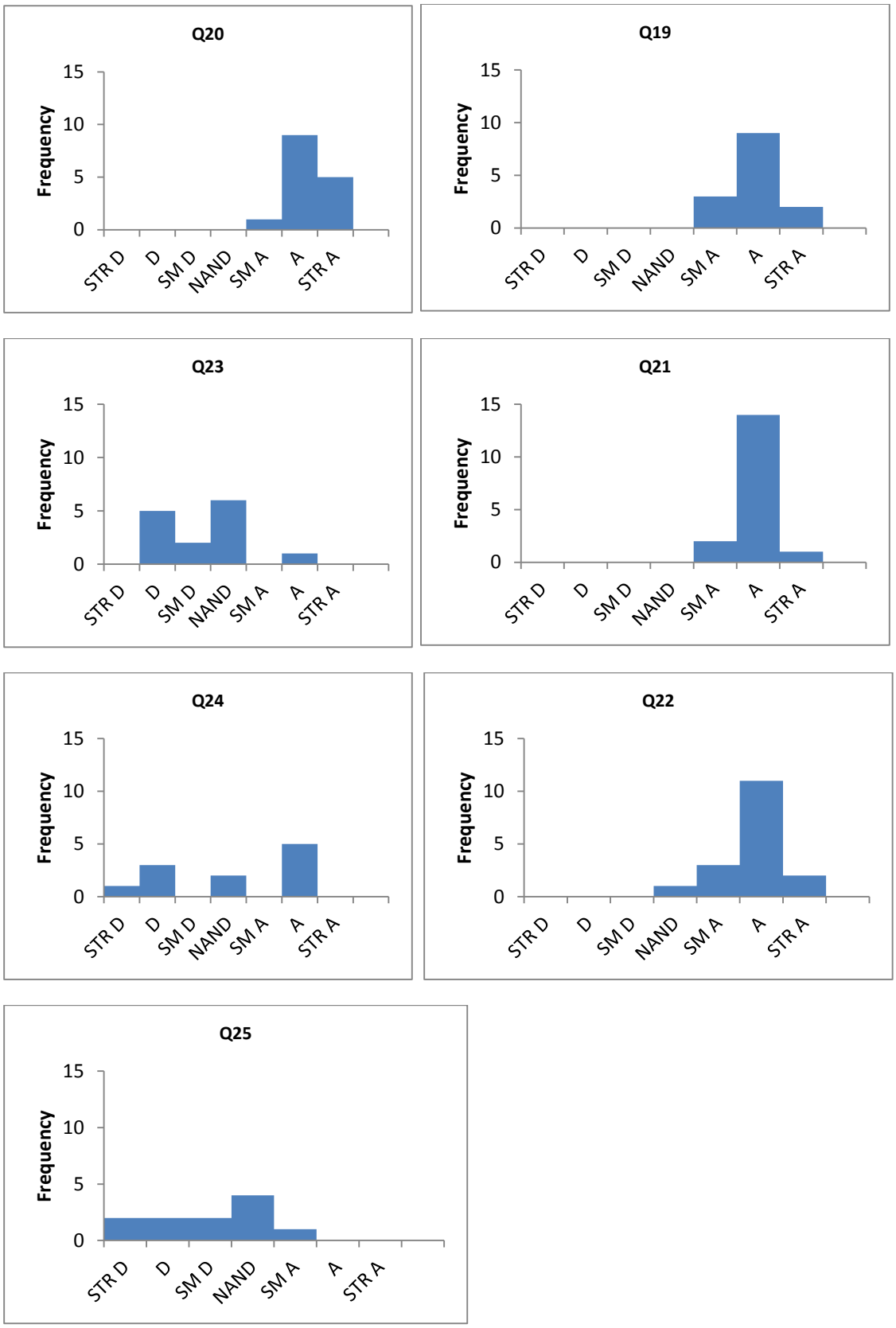


Figure III.4: H40: Response Distribution for Apparel Industry.

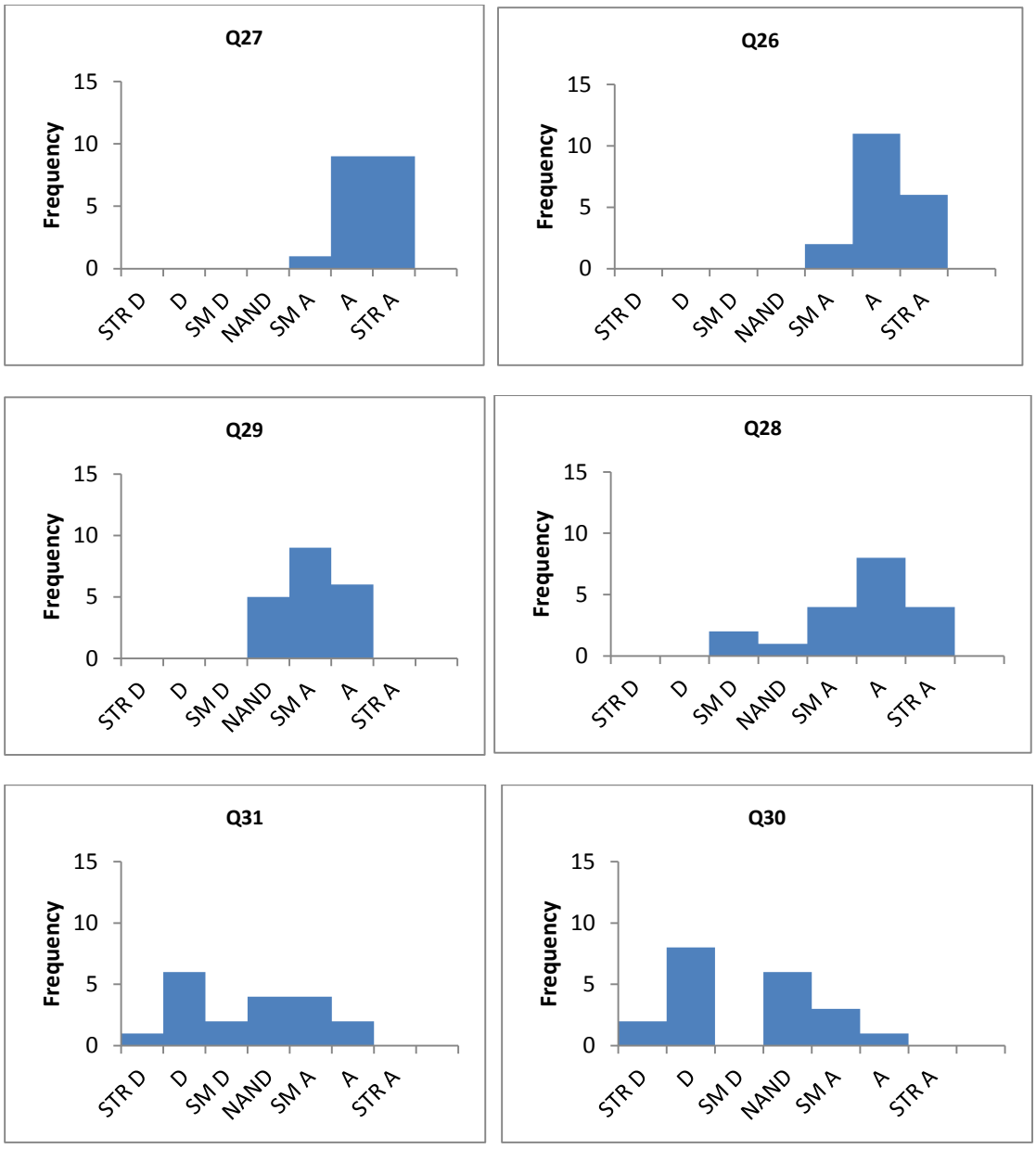


Figure III.5: H50: Response Distribution for Apparel Industry.

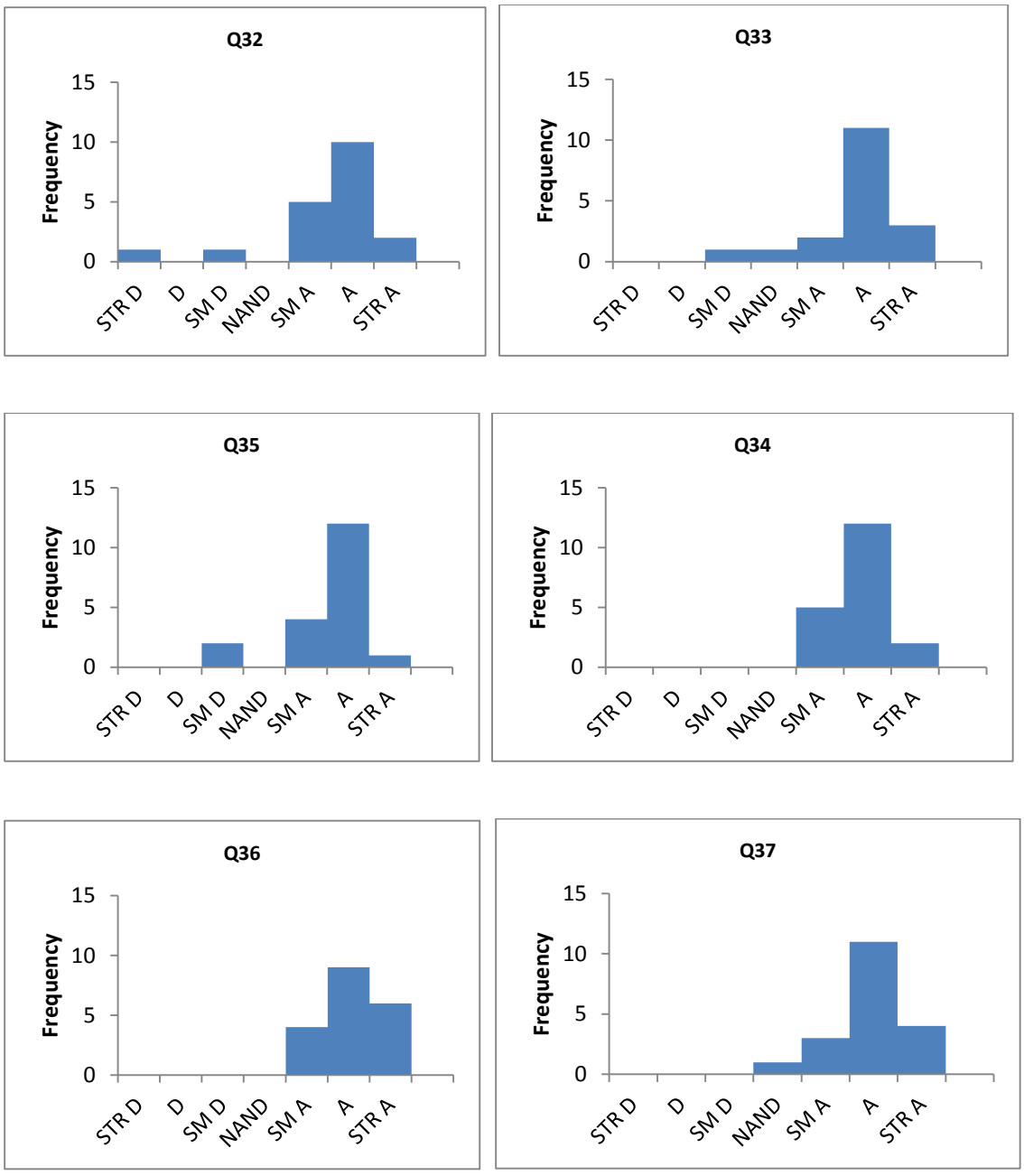


Figure III.6: H60: Response Distribution for Apparel Industry.

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