THESIS

LAST PLANNER® SYSTEM AFFECTS ORGANIZATIONAL LEARNING

Submitted by

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ABSTRACT

LAST PLANNER® AFFECTS ORGANIZATIONAL LEARNING

To better understand organizational learning within the construction industry, this research examines the possible relationship between organizational learning and the Last Planner® System (LPS) of construction planning. The research survey was administered to construction professionals to assess their use of LPS and measure the level of organizational learning within their respective companies. LPS is a planning system that increases value and minimizes waste through focusing on collaborative communication and learning from the past; overlapping well with key factors of learning organization.

Hypothesis one stated that LPS users would score higher on the Learning Organization Capability Score (LOCS). Through the data analysis it was found that the first hypothesis should be rejected due to discovery of an inverse relationship then proposed. The second hypothesis proposed that LPS users would score higher on the effective transfer of knowledge and team and group problem solving sub-scales. This was found to show statistical significance, however in the opposite direction then originally hypothesized. Hypothesis three proposed a positive correlation between an organizations number of lean production planning characteristics utilized and their LOCS, this was found to show no statistical significance.

While a reverse relationship was found between LPS use and the LOCS, the review of literature suggests the opposite and further research should be done before any final conclusions can be made. This research served as a preliminary investigation of the relationship between organizational learning and the Last Planner® System, a more comprehensive and in depth research would greatly benefit the topic area.

ACKNOWLEDGMENTS

I would like to dedicate this thesis to my parents, aunt, and uncle. There is no doubt in my mind that without their continued support and counsel I could not have completed this process.

I would like to acknowledge the instruction and guidance of Dr. Bolivar Senior and the initial impetus to study the Last Planner® System given to me by Dr. Farook Hamzeh. Both of these men have given me a deep appreciation and love for the beauty and detail of this subject.

TABLE OF CONTENTS

LIST OF TABLES

Table # *Page*

LIST OF FIGURES

Figure # *Page*

CHAPTER I: INTRODUCTION

Research Problem

Organizational learning is key to the success of businesses in an ever-changing environment (Bierly & Hämäläinen, 1995; Garvin, 1993; S. Goh & Richards, 1997). The construction industry is an example of such an environment where learning is vital for long-term success. For the purposes of this research, organizational learning is defined as "the processes within an organization to maintain or improve performance based on experience" (DiBella, Nevis, & Gould, 1996) and is understood to be "a collective activity that takes place under certain conditions or circumstance" (S. Goh & Richards, 1997).

The Last Planner® System (LPS) of production control, developed by Glenn Ballard and Greg Howell (Ballard, 2000), is a planning system that increases value and minimizes waste through collaborative effort among 'last planners' (Ballard, Hamzeh, & Iris, 2007; Gonzalez, Alarcon, & Mundaca, 2008; Hamzeh & Bergstrom, 2010; Porwal, Fernandez-Solis, Lavy, & Rybkowski, 2010). LPS emphasizes collaborative and team planning, requiring all project members to communicate with each other, sharing project knowledge and insight along with gaining a deeper understanding of processes.

To better the understanding of organizational learning within the construction industry, this research identifies and examines the possible relationship between learning and LPS.

Previous Studies

Anthony DiBella, George Huber, Mary Crossan, Swee Goh, and David Garvin have all studied organizational learning. Many researchers view organizational learning as a process and learning organizations as those that exhibit key characteristics, including: recognizing and

acquiring knowledge or possibilities, interpretation and understanding of acquired information, knowledge sharing and distribution within the company, and the ability to institutionalize knowledge (Crossan, Lane, & White, 1999; Garvin, 1993; Huber, 1991; Klimecki & Laßleben, 1999).

Over the past several years, numerous construction companies have implemented aspects of lean construction into their operations. Lean construction is a philosophy and methodology of processes to minimize waste and maximize value to all parties (Hamzeh & Bergstrom, 2010). LPS was developed by Glenn Ballard and Greg Howell as a lean construction tool for production control and planning (Kalsas, Skaar, & Thorstensen, 2009). LPS emphasizes reducing waste and increasing successful planning predictability.

Deficiencies in the Literature

Even with the relatively large amount of research conducted on LPS and organizational learning, many areas require further examination. There remains an insufficient amount of research concerning the effects of LPS on organizational learning, being the focus of this research study.

Significance of the Study

This study will benefit the construction industry through illustrating how LPS affects companies' organizational learning behaviors. LPS may assist companies in becoming a learning organization. Learning organizations have a distinct advantage over competitors, enabling them to find and/or develop improved service and work processes, which in turn insure success and growth in an ever-changing environment (Dodgson, 1993; S. Goh & Richards, 1997).

Purpose of the Study and Delimitations

To better understand organizational learning within the construction industry, this research examines the relationship between organizational learning and the LPS of construction planning. Organizational learning is a measure of key underlying conditions and characteristics essential in maintaining and fostering a productive environment. The organizational learning level of construction companies was examined with a survey developed by (S. Goh & Richards, 1997; S. C. Goh, Quon, & Cousins, 2007).

Theoretical Perspective

Learning organizations exhibit key characteristics: clarity of purpose and mission, leadership commitment and empowerment, experimentation and rewards, transfer of knowledge, and teamwork and group problem solving (S. Goh, 2001; S. Goh & Richards, 1997; S. C. Goh, 1998). The acquiring, sharing, and understanding of information is vital to the creation and improvement of organizations.

LPS promotes increased communication amongst all involved parties along with embracing worker involvement and knowledge from past failures and successes, which coincide with Learning Organizations characteristics. Due to the clear overlap between Last Planer® System and learning organizations, a connection is believed to exist. The researcher presumes LPS, the independent variable, will have a positive influence on the level of learning organization capability, the dependent variable.

Research Questions

The following questions served as the guiding roadmap throughout the research project, with the first being the primary overarching question.

- How does the LPS use affect construction companies' general organizational learning?
- How are the characteristics of a learning organization affected by LPS?
- Does a higher level of LPS implementation correlate with an increased level of learning organization capability?

Three research hypotheses were developed from these questions; H1: Use of Last Planner® System will positively correlate with a higher level of learning organization capability score, H2: There is a positive correlation between the effective transfer of knowledge (ETK) and team and group problem solving (TGP) sub-scales and the use of LPS, and H3: There will be a positive correlation between the number of lean production planning characteristics utilized and the learning organization capability score.

With a changing environment and increasing competitiveness, construction companies must improve inefficient practices of the past. Companies wishing to grow will be required to learn new ways and/or improve current practices. Learning organizations experiment with new processes. Such organizations have a distinct advantage over competitors.

The research will provide valuable information to both the construction industry and the organizational learning field, by assessing the current learning organization capability of the industry and areas for potential improvement. Identifying a possible relationship between LPS use and the level of learning organization capability is of particular importance to the lean construction industry.

CHAPTER II: LITERATURE REVIEW

The Last Planner ® System

Over the past several years, numerous construction companies have implemented aspects of lean construction into their operations. Lean construction is a philosophy and methodology designed to minimize waste and maximize value to all parties (Hamzeh & Bergstrom, 2010). Current construction planning is accomplished through a push-style schedule, where planned tasks are determined from what 'should' be done, with little or no consideration of what actually 'can' be done (Gonzalez, Alarcon, Maturana, Mundaca, & Bustamante, 2010). Many construction industry planning and project management strategies and techniques are inefficient, resulting in additional project costs and time requirements (Koskela & Vrijhoef, 2000). With a lean construction framework focusing on the process and end goals; methods of achieving those goals differ from traditional project management. A lean construction framework has clearly defined objectives to ensure value for all parties and the use of production control techniques throughout the project life (Ballard & Howell, 2003; Hamzeh & Bergstrom, 2010; Howell, 1999).

The Last Planner ® System (LPS) was developed by Glenn Ballard and Greg Howell as a lean construction tool for production control and planning (Kalsas et al., 2009). The construction industry deals with many variables, including production rate and labor efficiency (Gonzalez et al., 2008). LPS emphasizes reducing waste and increasing successful planning predictability. Through LPS, companies determine their Percent Planned Complete (PPC) along with other metrics to help them improve upon their planning. PPC is calculated by dividing the number of the completed activities by the total number of planned tasks (Ballard, 2000). Employing LPS,

many companies have reported an increase in workflow reliability, improved project delivery time, and labor productivity (Hamzeh, Ballard, & Tommelein, 2008; Porwal et al., 2010)

LPS leads to reduction of waste, time and variation, work flexibility and transparency, which in turn increases value provided to customers and worker involvement in planning. LPS ensures collaboratively produced plans, identification and removal of constraints early on, reliable promising, and learning from past failures and successes (Ballard, Hammond, & Nickerson, 2009; Hamzeh, 2009; Kalsas et al., 2009).

The Last Planner ® (LP) refers to the individual who is the 'last planner' of the construction workflow. The LP could be the supervisor, foreman, squad boss or any individual or group responsible for work completion in the near-term. They oversee work that results in completed tasks and production, not more plans (Ballard & Howell, 2003).

The figure below illustrates the differences between traditional construction planning process and LPS, with the major difference being the incorporation of 'can' and 'will' into the planning process.

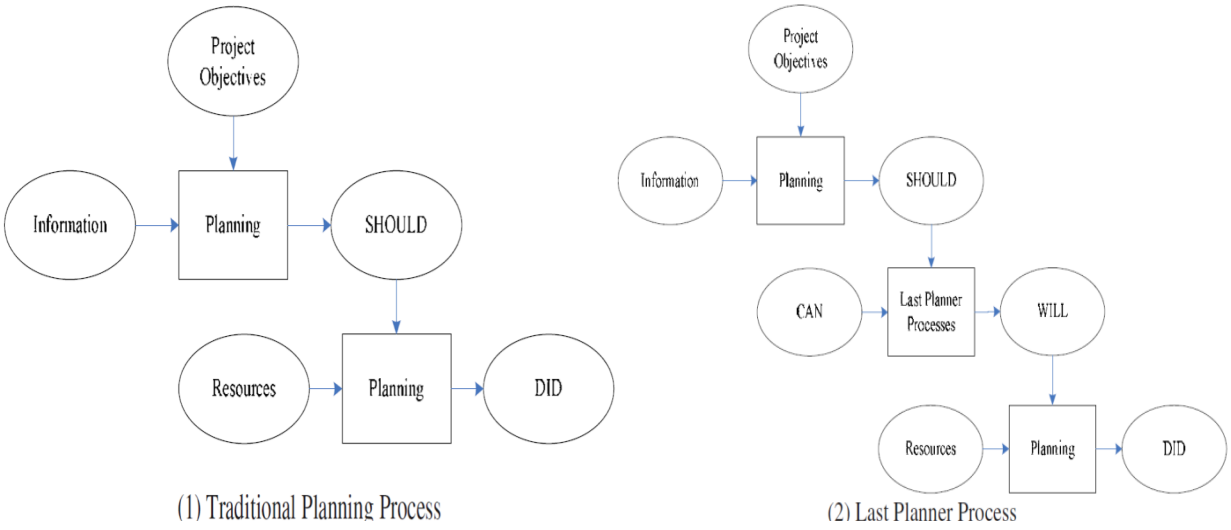

Figure 2.1: Construction Planning Process (Kim & Ballard, 2010)

Ballard describes 'should' tasks as those that must be successfully completed to meet the project schedule and project completion. The ideas of 'can' and 'will' are relatively new to the construction industry as they promote communication between all parties involved and aid in the collaborative agreement of feasible tasks.

To assist in transforming the 'should' tasks into 'can' tasks, Ballard suggests tasks meet the following criteria; definition, soundness, sequence and size. A task is considered well defined when the amount of labor, material, resources required and verification is measured. Sound tasks are those in which all of the required labor, material, resources, etc. are available by the scheduled start of the task. The sequence of a task looks at whether or not the tasks are in the correct order to meet customer expectations and to reduce possible need for rework. Tasks are well sized when they are compatible with the designated crews' production capability based on available crew size and resources. Each of these items aid in determining if a particular task 'can' be done (Ballard, 2000).

The ‘will’ component comes into play when last planners commit to completing a task successfully with an acceptable decision in which to hand over of that area, material, or item to the next required party.

LPS consists of four different stages; (1) master scheduling plan; (2) phase scheduling; (3) lookahead planning; and (4) the weekly work plan. Each of these stages is explained in progression below. These phases help associate the ‘should’, ‘can’, ‘will’, and ‘did’ with tasks involved within the construction process (Hamzeh, 2009).

Master Scheduling Plan

The master scheduling plan consists of major milestones required throughout the duration of the project. This plan is derived from requirements within the contract documents (Hamzeh, 2009). Creating a master plan starts with determining the owners’ needs and values along with project requirements and milestones. From these milestones, a Critical Path Method (CPM) schedule is created with the aid of software programs such as Microsoft Project or Primavera. Once the master schedule is completed, the estimated time line is then compared with the desired overall project completion date. Occasionaly adjustments may be required when the estimated project duration is longer then owner or shareholders requirements (Hamzeh, 2009). This master scheduling process is illustrated in Figure 2.2.

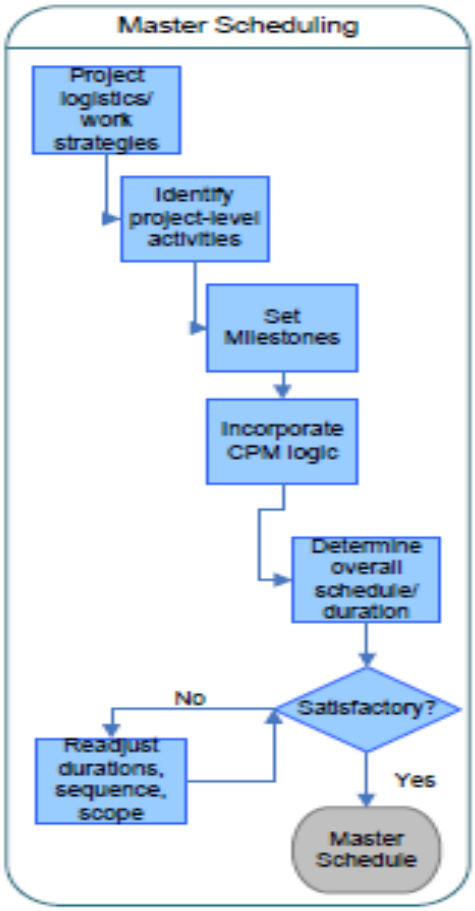

Figure 2.2: Master Scheduling Plan process (Hamzeh 2009)

Phase scheduling

Isolating milestones developed during the master scheduling process into separate phases provides a phase schedule. This process is most often accomplished in a reverse scheduling mode; that is starting with the required final product or date of that phase and working backwards to determine the correct sequencing, timing, and operations required to successfully meet the milestone.

The schedule created from the reverse scheduling process may: (1) take a longer period of time then is available, (2) fit within the allotted time with no buffers or float, or (3) fit within the allotted time with sufficient buffer and float time (Hamzeh, 2009). Depending on the type of

schedule created, adjustments may be required, possibly by performing more tasks simultaneously or through new performance technologies or construction methods. Figure 2.3 shows the steps and processes that go into creating an acceptable phase schedule.

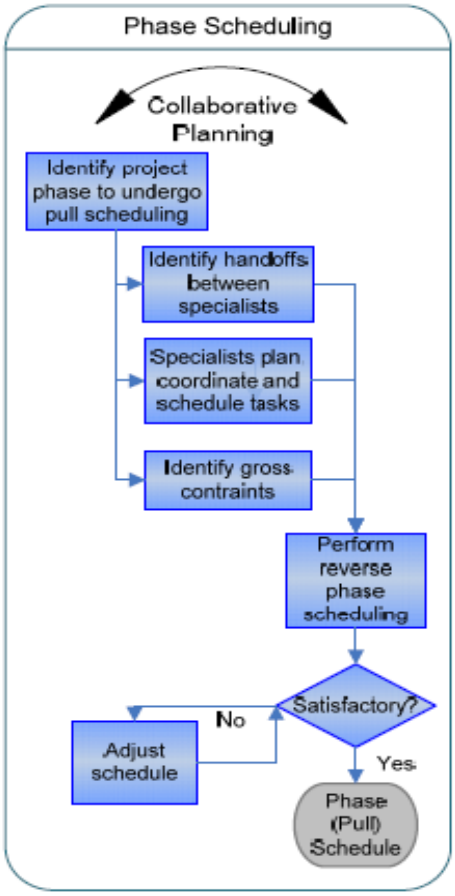

Figure 2.3: Phase Scheduling Process (Hamzeh 2009)

Lookahead planning

The lookahead plan creates a link between the phase schedule or long term commitments and the weekly work plan or short term tasks required to be completed (Hamzeh, 2009). Lookahead planning considers plans 3-6 weeks ahead and breaks tasks down into operations, determines the appropriate workflow sequence and rate, and matches the available workload with the capacity of the individuals or teams performing the work. During the

lookahead process, a backlog of workable tasks is also maintained to allow a selection of ready work if an issue arises during the workweek with a scheduled task or surplus time becomes available (Ballard, 2000; Ballard & Howell, 2003). The lookahead planning process is illustrated below in Figure 2.4.

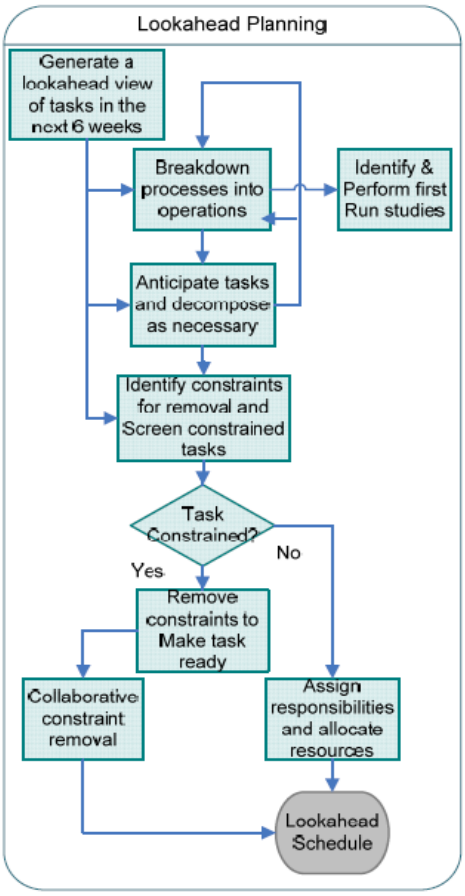

Figure 2.4: Lookahead Planning Process (Hamzeh 2009)

Weekly work plan

From the pool of workable tasks created during the lookahead-planning phase, chosen tasks are then placed on the weekly work plan (WWP). Only those tasks that are defined, sound, properly sequenced and sized should be chosen for the WWP. The WWP is the level at which the last planners make reliable commitments and promises. For each task that is placed on the

WWP, the responsible last planner commits to complete the task(s) by a certain date, often the end of the week and hand that area or product over to the next required sub-contractor or party (Hamzeh, 2009).

Figure 2.5 shows the process and steps involved in creating a weekly work plan along with referencing the aspects of learning that can come from a WWP.

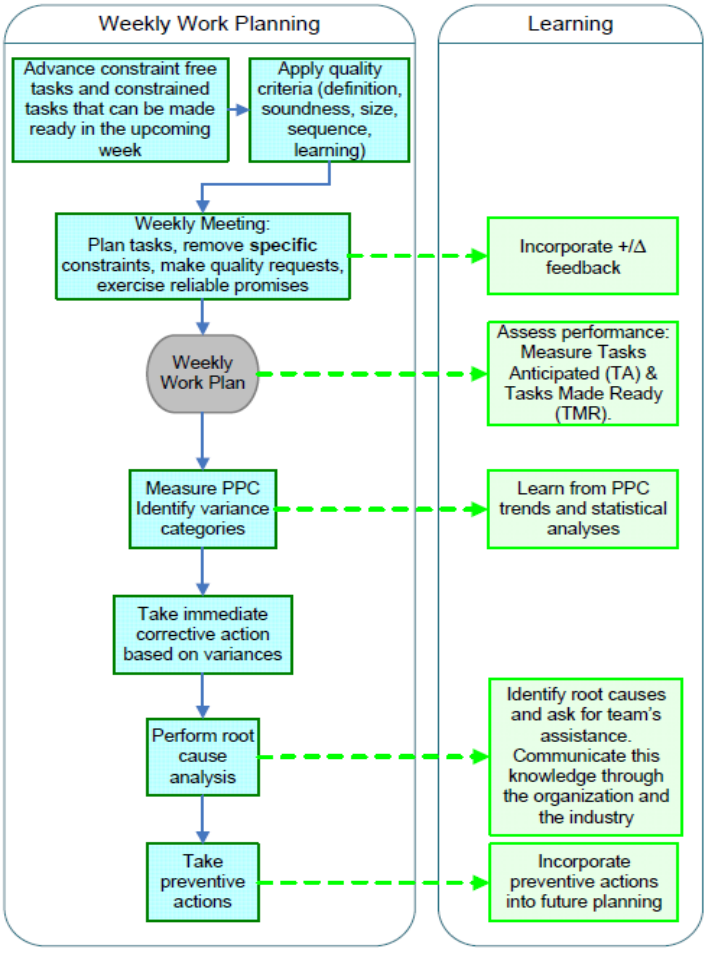

Figure 2.5: Weekly Work Plan Process and Learning (Hamzeh 2009)

Implementation

LPS implementation has been researched by a vast number of industry professionals and academics. This is largely because LPS has faced, and continues to face, challenges preventing

full implementation and use of the system within construction companies, requiring them to reconsider their planning processes (Alarcon & Calderon, 2003). One particular study by (Porwal et al., 2010) identified common challenges faced by the construction industry when implementing LPS. Porwal reviewed all pertinent literature on the topic of LPS implementation dating to 2000. He identified twelve common issues between general user challenges and system implementation challenges. Major problems included a general lack of training, poor management commitment along with organizational attitude or the "we've always done it this way" view. A few of the challenges found at the user level include a lack of individual commitment and the misconception that LPS requires extra time and resources (Porwal et al., 2010).

However challenging its initial implementation, there are significant benefits to organizations utilizing LPS. Luis Alarcon studied LPS use within construction companies in Chile, finding an average increase in PPC of 7% (50 to57%) within the first year of use and 14% (up to 64%) after the second year (Alarcon & Calderon, 2003). For multimillion-dollar or long-term projects, these increases in PPC represent significant benefits, demonstrating that relatively small increases in PPC translate into large benefits towards the overall project. Other companies utilizing LPS are seeing an 86% improvement in overall project success and PPC levels raising 50% (Alarcon & Calderon, 2003).

Learning

Following the completion of the workweek, the Percent Plan Complete (PPC) can be determined, expressing the reliability of the week's planning. A higher value of PPC is correlated with a more reliable scheduling and stable workflow (Gonzalez et al., 2010).

Quite often, not all tasks planned in the weekly work plan will be completed. To increase completion of tasks and increase PPC, the reason(s) why tasks were not completed must be determined. This root cause analysis can be completed through the process of "The 5 Whys". This is a method of asking 'why' several times until the true reason and root cause of non-completion is determined. This root cause is occasionally determined within less than five why questions or possibly more.

An example of the use of "The 5 Whys" analysis, taken from (Adams, 2008) is the scenario of customers being dissatisfied with receiving products that are not to their specifications; (1) Why are customers being shipped incorrect items? Reason being that the warehouse has shipped something different then the customer and sales individual agree on (2) Why is the warehouse shipping the wrong item? Because the sales department is expediting orders, calling to the warehouse and an error in communication is occurring. (3) Why is the sales department calling the warehouse directly instead of following proper procedures? Because the appropriate order form requires extra time to receive the sales manager's approval, slowing down the process. (4) Why is the sales manager's approval required? Because they want to be updated continuously to report to the CEO. (5) Why is the computer system not being used by sales manager to review sales reports? Because they do not trust the generated data? (6) Why do they not trust the data? Because the input of data is sloppy and not always up to date? (7) Why is data entry sloppy and not current? Because employees are not comfortable with entry, correcting, updating, or validating sales information with the system. This example demonstrates how the use of "The 5 Whys", analysis can support the identification of the root cause of non-completed tasks or shortcomings. This also illustrates that the use of "The 5 Whys" may actually involve more or less then 5 questions, the end goal is to identify the root cause.

Identifying the reasons for not accomplishing tasks has proven to be an essential source of information and aids in the determination of which cause(s) have the largest impact on task completion and project progress (Formoso & Moura, 2009). Top reasons for not achieving work often include material shortage, labor shortage, poor craft coordination or planning, and lack of information (Ballard & Howell, 1998; Kalsas et al., 2009).

On projects that are beginning to use LPS, some of the non-completed tasks may be due to the last planners lack of or misunderstanding concerning making reliable commitments or proper assessment of crew capacity, if this is the case then the education of the last planners should be the improvement focus area (Ballard & Howell, 2003).

Figure 2.6 shows how the learning aspects are recycled back into the LPS process and used to improve future planning. Figure 6 also illustrates the continuous learning characteristic of the LPS, as after the completion of each week the PPC, Reasons for Non-Completion, and positive or negative feedback are determined and continuously used to improve the planning process and therefore the overall project progress. This cycle of learning assists in improving efficiency of both the Last Planner® System and the organization as a whole.

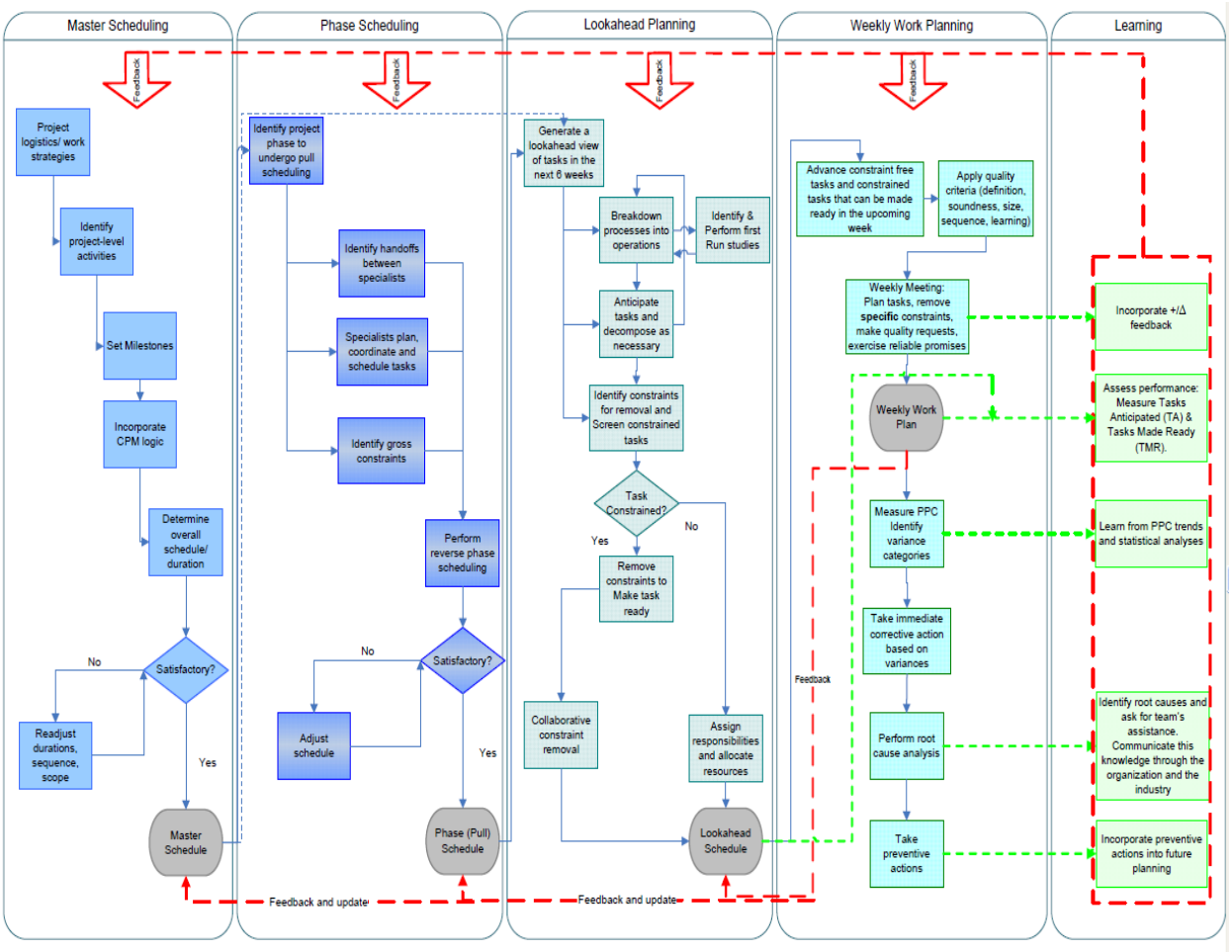

Figure 2.6: Learning within The Last Planner ® System (Hamzeh 2009)

Organizational Learning

What is Organizational Learning

Organizational learning is key to continued success in an ever-changing environment (Bierly & Hämäläinen, 1995; Garvin, 1993; S. Goh & Richards, 1997). The construction industry is an example of an evolving business, therefore organizational learning is vital for the success of construction companies.

Ever since Argyris and Schon researched organizational learning in the 1970's, it has caught the attention of businesses around the globe. A number of individuals including Anthony DiBella, George Huber, Mary Crossan, Swee Goh, and David Garvin have studied organizational learning. Research has continued ever since and as a result there has been a variety of definitions describing organizational learning including those from Huber (1991), Nonaka (1994), and March and Olsen (1975) each approaching organizational learning from a slightly different perspective.

Researchers have taken differing approaches to studying organizational learning, ranging from information processing to product innovation. Dodgson (1993) describes learning as the "purposive quest to retain and improve competitiveness, productivity, and innovativeness in uncertain technological and market circumstances."

For the purposes of this research, organizational learning is described as "the processes within an organization to maintain or improve performance based on experience" (DiBella et al., 1996) and is understood to be "a collective activity that takes place under certain conditions or circumstance" (S. Goh & Richards, 1997). For an organization to learn and/or create an environment that is conductive to learning, there must be a set of conditions or practices that are satisfied.

Learning within organizations is vital for ones long-term success; in fact Kogut and Zander (1993) claim that the capability to gain new knowledge is one of the few sustainable competitive advantages of a firm.

Some organizations may feel they do not need to learn, as they may currently have a stable customer or niche environment. This is often not the case due to constantly changing and improving internal and external environments, especially within technology-dependent sectors.

No matter the external environment of an organization, one can always improve the internal organizational learning as a way to improve its internal efficiency and effectiveness (Bierly & Hämäläinen, 1995).

While different constructs or frameworks of organizational learning exist, the basic underlying principles are similar. Garvin proposes three broad factors essential for organizational learning: (1) a supportive environment; (2) concrete processes and practices', and (3) leadership that reinforces learning (Garvin, Edmondson, & Gino, 2008). DiBella, Nevis and Gould (1996) describe the process of organizational learning as one that involves knowledge acquisition, sharing, and utilization. Huber (1991) discusses four constructs of knowledge acquisition, information distribution, information interpretation, and organizational memory.

Knowledge acquisition is the process in which information is gained. The process of distributing and sharing information is described as information distribution. The process of determining one or more commonly understood interpretations of the information is information interpretation. The storing and retaining of information for future use is described as organizational memory.

When discussing Information distribution, Huber (1991) notes that when there is a more wide spread circulation of information this allows for more varied sources to access the information, increasing the likelihood and opportunity of more areas and individuals to learn. When a larger number of cross-functional teams and individuals are gathered together to discuss and/or plan options, information is efficiently distributed to a larger group. In short, a wider spread of information sharing leads to a wider spread organizational learning.

Crossan, Lane, and White (1999) developed the 4I Framework of organizational learning, which includes intuiting, interpreting, integrating, and institutionalizing that occur over the individual, group, and organizational levels.

Intuiting is the recognition of patterns or possibilities and is divided into expert and entrepreneurial intuition. Expert intuition deals with exploration through the reorganization of patterns and situations based on experience. Entrepreneurial intuition supports exploration through the ability to identify possibilities and general connections, as no two situations are exactly the same although may contain similar patterns. Intuition is the beginning of new learning however overall success is dependent on effective learning across all levels.

Interpreting is the explaining and giving of meaning to the information in words or actions to oneself and others. The process of interpreting includes developing cognitive maps based on gained information, through the use of language and metaphors, words and names begin to be added to the once simple feelings or intuitions. The use of metaphors and "visions" are often utilized to aid in the explanation of the intuition to oneself and the communication to others. Metaphors indicate the initiation of the interpreting process. The development of cognitive maps will likely be different for different people as everyone interprets feelings or stimuli differently; this difference in interpretation is not necessarily due to uncertainty about the feeling or stimuli.

As individuals discuss, a shared understanding is developed and integrated. As continuous conversation takes place and an understanding and meaning moves beyond the individual into the group, integrating occurs.

Institutionalizing is the taking of successful learned behaviors and turning them into routines of the organization. This typically takes a longer time then the previous three I's as it

takes time for understanding to move from the individual through the group and into the organization. The idea/routine becomes institutionalized generally only after a degree of agreement on the understanding and importance is gained among the influential organization members.

Institutionalized learning does have the risk of becoming irrelevant due to the typically longer time to change, this irrelevancy may obstruct new discovery, and therefore a process of unlearning must take place.

Organizational learning is more then just the sum of the individual learning of its members. The process of institutionalizing does have the ability to create a lens in which events and experiences are viewed and interpreted; this can both enhance and impede future responses and learning. With a consistently changing environment, the challenge is to maintain a balance of the tension between the institutionalized learning of the past while allowing for new learning.

Table 2.1: Organizational Learning Frameworks

(DiBella et al., 1996)	(Huber, 1991)	(Crossan et al., 1999)
Knowledge acquisition	Knowledge Acquisition	Intuiting
Knowledge sharing	Information Distribution	Interpreting
Knowledge utilization	Information Interpretation	Integrating
	Organizational Memory	Institutionalizing

An organization is not easily able to directly force learning to occur or even to observe the process of it; only the results and outcomes of learning can be seen as evident in a change in behavior or knowledge of an organization (Klimecki & Laßleben, 1999). As organizational learning cannot be directed, management must focus on creating environments and conditions in which learning is encouraged and likely to occur. The implementation and use of the LPS within construction companies is believed to aid in the creation of such an environment.

To create a learning environment, certain conditions and practices must be present. Fortunately, these conditions can be taught and learned (S. C. Goh, 1998). While all organizations can learn, there may be some that learn easier and quicker than others (S. Goh, 2001). These organizations will likely survive longer and be more successful than those who do not learn or only do so naturally. All organizations are more susceptible to learning in an environment that encourages it, increasing their learning capability.

Learning Organizations

Learning occurs at various levels throughout the organization, often beginning at the individual level. All learning begins primarily at the individual level and progresses through the overall organization (Dodgson, 1993). Thus, it is also important to consider an individuals' ability to learn and openness when bringing new employees into the organization and progressing through the human resources hiring process. While individual learning is necessary for the overall organization to learn and change, individual learning alone is not sufficient to sustain organizational learning (Marsick & Watkins, 2003). An organizational culture must be in place that encourages, supports, and rewards learning across all levels from the individual to the overall organization.

Organizational learning is gained through the development of internal conditions fostering discovery (S. C. Goh, 1998). Organizations such as Honda, GE, FIAT Auto, and Chaparral Steel have commonly been recognized as learning organizations and manage their learning so that it occurs by design and not just by occasional chance (DiBella et al., 1996; Garvin, 1993; S. C. Goh, 1998).

There are a number of varying definitions of a learning organization, ranging from those focused on behavioral change, information processing, development of common and shared understandings, to development of a wider range of behavioral responses (Dodgson, 1993; Garvin, 1993; Huber, 1991; Klimecki & Laßleben, 1999). Garvin proposes the following definition that will be utilized for the purposes of this research, "A learning organization is an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behaviors to reflect new knowledge and insights" (Garvin, 1993, p. 80). In order to effectively create, acquire, and transfer information and knowledge one must purposefully adopt structures and practices that will foster an environment conducive to learning (Dodgson, 1993). Goh defines this as Learning Capability or the ability of the organization to implement the appropriate management practices, structures and procedures that facilitate and encourage learning (S. C. Goh, 2003).

Peter Senge, author of the popular book 'The Fifth Discipline' describes learning organizations as "where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together" (Senge, 1990a). Senges' definition may seem to be a utopia of sorts and only achievable in an ideal and perfect world, yet having an end goal in mind to strive and work towards is always beneficial. There is little doubt that an organization culture that encourages learning has a greater tendency to result in improved performance (Marsick & Watkins, 2003).

Characteristics of Learning Organizations

Learning Organizations can be described as a particular type of organization exhibiting the characteristics of organizational learning (S. Goh, 2001). Therefore to adequately understand learning organizations, one must first understand their characteristics.

Various researchers have examined learning organizations and have found similar attributes, these may vary in terminology, but basic underlying principles are similar. In Peter Senge's book "The Fifth Discipline" he describes five disciplines that a learning organization must illustrate: personal mastery, mental models, shared vision, team learning, and systems thinking (Senge, 1990a).

Garvin identifies five key areas, which he refers to as building blocks, that an organization must be skilled at for learning to occur. These include systematic problem solving, experimentation with new approaches, learning from their own experiences and past history, learning from the experiences and best practices of others, and transferring knowledge quickly and efficiently throughout the organization (Garvin, 1993).

Goh and Richards found five underlying characteristics and practices of an organization that aid in allowing and fostering learning to take place. These include; clarity of purpose and mission, leadership commitment and empowerment, experimentation and rewards, transfer of knowledge, and teamwork and group problem solving (S. Goh & Richards, 1997).

Various individuals have researched characteristics of a Learning Organization; Table 2.2 is a listing of these characteristics and their researchers.

Table 2.2: Learning Organization Characteristics

(Senge, 1990a)	(Garvin, 1993)	(S. Goh & Richards, 1997)	(Shaw & Perkins, 1991)	(McGill & Slocum, 1993)
Personal Mastery	Systematic problem solving	Clarity of Purpose and Mission	Involving external people to challenge employee assumptions	Openness to experiences
Mental Models	Experimentation with new approaches	Leadership Commitment and Empowerment	Making funds and time available for employee experimentation	Willingness to acknowledge failures
Shard Vision	Learning from their own experience and past history	Experimentation and Rewards		Continuous experimentation
Team Learning	Learning from the experiences and best practices of others	Transfer of Knowledge		
Systems Thinking	Transferring knowledge quickly and efficiently throughout the organization	Teamwork and Group Problem Solving		

Upon comparison of the characteristics of learning organizations as discussed by various researchers, it was found that those characteristics described by Goh and Richards effectively address and include all others. For this reason and the purposes of this research the terminology associated with learning organization characteristics as described by Goh and Richards (1997) will be utilized. These terms are therefore described in more detail below.

1) Mission and vision consists of ensuring there is a shared understanding among all employees of the organizations values. A clear understanding consists of actions that are aligned with organizational goals and mission. Employees who have clear information about the mission of the organization feel more capable and confident in taking initiative. Clarity of mission and purpose is achieved when all employees share a common belief and support in the organizations direction and understanding in how it relates in their daily work activities. Time for reflection and analysis should be allowed to review and assess needs, work systems, and products (Garvin, 1993). This most appropriately fits into the clarity of purpose and mission characteristics along with the transfer of knowledge. Senge (1990b) believes that with a common understanding of mission and vision, a tension is created that allows learning to occur. This tension can be described as the difference between the organizational current state and the desired state.

2) The leadership characteristic focuses on maintaining a shared leadership and involvement of all members. Managers are not regarded as controllers as in the traditional sense; they are viewed more like coaches. In addition, the status or rank of members is not as crucial as their ability to contribute to organizational goals. 'Open-door' and 'leave your ego at the door' policies are among those important to this building block if all employees are to be engaged in decision-making. Managers and employees alike provide feedback and are willing to accept constructive criticism without jumping into defensive mode. Creating an attitude and structure that is non-hierarchical and in which involves employees in the decision making process is also represented under this attribute.

3) Experimentation involves encouraging employees to try new ideas. There are some companies that have instilled a sort of forced experimentation and innovation culture by way of requiring new product development that reaches the marketplace every number of years.

4) Transfer of Knowledge. A sole individual with an abundance of knowledge can be essentially useless unless they are able to effectively and efficiently share and transfer that information and experience to the job and with other organization members.

5) Teamwork and Group Problem Solving, through working in teams employees can more successfully bring their skills and knowledge together to address problems and create innovate solutions (S. C. Goh, 1998). Teams assist in breaking boundaries and capitalizing on the synergy available among members to develop innovative problem solutions.

Table 2.3: Learning Organization Characteristics (S. Goh & Richards, 1997)

Clarity of purpose and mission
The degree to which employees have a clear vision/mission of the organization and understand how they can contribute to its success and achievement
Leadership commitment and empowerment
The role of leaders in the organization with respect to helping employees learn and elicit behaviors that are consistent with an experimenting and changing culture
Experimentation and rewards
The degree of freedom employees enjoy in the pursuit of new ways of getting the job done and freedom to take risks
Transfer of knowledge
The systems that enable employees to learn from others, from past failures and from other organizations
Teamwork and group problem solving
The degree of teamwork possible in the organization to solve problems and generate new and innovative ideas

Importance to Industry

Organizational Learning is not a simple, short-term task; it is a lengthy process requiring commitment from all levels of an organization (S. C. Goh, 1998). Successful organizational learning can assist in building a competitive advantage within the industry. Having the ability to gain and acquire new knowledge and/or develop a deeper understanding of existing knowledge is critical to the transformation process of becoming a learning organization. However, simply

having this new or deeper knowledge or insight is not enough; one must act on it otherwise only the potential for improvement exists (Garvin, 1993). Discarding obsolete and/or misleading knowledge, termed unlearning, is as important as understanding new knowledge (Dodgson, 1993). Slow unlearning is viewed as a weakness and hampers an organizations quest towards becoming an effective learning organization. Certain management and internal practices can either help or hinder the learning process.

There are a variety of reasons why working towards becoming a learning organization is important, these include the desire to avoid decline, increased ability to manage change, reduced likelihood of repeated mistakes, and/or increased organizational performance and competitive advantage. The most common of these reasons being the desire for continuous adaptation and to increase organization efficiency (Dodgson, 1993).

The continuous learning is of great importance to all businesses and companies within all environments (Bierly & Hämäläinen, 1995), possibly even more so to those in the current construction industry as budgets tighten and competition for projects increases. Even organizations with a stable market place and exterior environment must continue to improve in order to increase internal efficiency (Bierly & Hämäläinen, 1995).

Learning organizations develop a significant advantage over their competitors including the ability to improve work processes along with developing and/or recognizing organizational improvements before their slower learning competitors (S. Goh & Richards, 1997). Establishing a high level of learning capability is even more important within industries that are in constant change and rely on knowledge heavily (S. C. Goh, 1998). With the construction industry being a prime example of an evolving industry with companies continuously looking to improve their efficiency and competitive advantage, learning organizations present themselves well.

Last Planner® System and Learning Organizations

While no direct literature relating to learning organizations and the Last Planner® System was found, through a review and analysis of the two research areas a possible connection was discovered. Last Planner® System fosters and increases communication amongst all involved parties, potentially serving as a tool to also aid in the development of a learning organization. The Last Planner® System also embodies practices such as enhancing worker involvement and learning from past failures and successes, which overlap well with Learning Organizations characteristics.

Learning from past failures and successes is an important part of the learning and feedback process within LPS, this connects very well with Garvin's (1993) building block 'Learning from their own experiences and past history' for learning organizations along with tying into the importance of transfer of knowledge as mentioned by Goh and Richards (1997).

Table 2.4: LPS & Learning Organizations Connections

Last Planner® System Goals	Learning Organization Characteristics
Increase communication	Transfer of Knowledge
Improve worker involvement	Teamwork and Group Problem Solving
Learn from past failures	Transfer of Knowledge
Learn from past success	Transfer of Knowledge

CHAPTER III: METHODOLOGY

To further understand organizational learning within the construction industry, this research will identify and examine the possible relationship between organizational learning and the Last Planner® System of construction planning. Data collection for this research was accomplished using an on-line web-based quantitative survey over a period of several months.

Population and Sample

The study population included construction companies within the US, both those companies currently using traditional planning means and these using lean construction methods. Participants were selected based on a convenience sample. They were identified through their relationship and involvement with construction professional organizations such as the Lean Construction Institute (LCI) and Associated General Contractors of America (AGC). Other professional organizations that supported this research through the listing and advertising of the survey within their member newsletters included the American Subcontractors Association and the Colorado Contractors Association. Research participation was indirectly solicited via professional organizations, as the researcher did not personally contact companies to participate.

Data Collection

Data collection utilized "Survey Gizmo", a web-based survey software company, and was conducted over a period of seven months. An online survey was found to be the preferred method of data collection due to the ability to reach numerous construction company participants in a short time frame, no mass mailings were required and it allowed for a faster turnaround in data collection and analysis all with a low cost.

Survey Instrumentation

The survey consisted of 44 items covering three primary sections: Last Planner® System use, Organizational Learning, and general demographics. The majority of these questions were based on a 7 point Likert scale, ranging from 1 representing strongly disagree to 7 representing strongly agree. Throughout the survey some questions were reverse worded to increase the participant's careful reading of the questions.

Development of the survey involved an extensive literature review pertaining to both Organizational Learning and the Last Planner® System (Ballard et al., 2009; S. Goh & Richards, 1997; Hamzeh, 2009). Questions addressing a company's experience with the Last Planner® System and level of implementation were developed through review of previous research on the topic including Ballard (2000), Alarcon and Calderon (2003) and with the assistance of Dr. Farook Hamzeh.

Care was taken during survey development to ensure a balance of positively and negatively worded questions to minimize potential bias. This was also done as a measure to ensure correct and truthful responses to the survey. An example of this is shown in the questions below, both addressing the topic of Leadership Commitment and Empowerment.

- Senior managers and employees share a common vision of what our work should accomplish
- Employees and senior management have differing goals and visions for the organization

Of the 44 questions, 5 are general demographic questions, 11 are related to the Last Planner® System, and 28 to Learning Organizations. Questions pertaining to LPS ranged from simple questions of 'Do you utilize the Last Planner® System?' to those describing the elements of LPS. Through research and literature review the researcher found eight common key aspects

of LPS; master scheduling, phase scheduling, look-ahead planning, workable backlog, weekly work planning, percent plan complete measurement, first run studies, and root cause analysis.

Two major surveys have previously been developed to measure the learning of an organization, The Organizational Learning Survey (S. Goh & Richards, 1997) and the Learning Organization Survey (Garvin et al., 2008). The Organizational Learning Survey (OLS) was developed in order to measure the practices and characteristics that enable learning (S. Goh & Richards, 1997). The survey consists of 21 questions focusing on five major underlying organization characteristics. These characteristics are clarity of purpose and mission, leadership commitment and empowerment, experimentation and rewards, transfer of knowledge, and teamwork and group problem solving. Measuring these characteristics adds to an organizations' knowledge, allowing them to utilize the information to modify and improve its behavior overtime, creating a benchmark of learning for them.

The Learning Organizational Survey (LOS) was developed by David Garvin, Amy Edmondson, and Francesca Gino (2008). The LOS is significantly longer then the OLS, containing 77 questions categorized into three different building blocks, in which Garvin (2008) refer to as the building blocks of the learning organization. The first building block, supportive learning environment, includes psychological safety, appreciation of differences, openness to new ideas, and time for reflection. Building block two, concrete learning processes and practices, is the largest category made up of experimentation, information collection, analysis, education and training, and information transfer. The last of the three blocks is leadership that reinforces learning.

Although both the LOS and OLS are designed to determine how well a company functions as a learning organization, for the purposes of this research it was decided to focus on

the OLS due to the availability of additional research pertaining its use along with having a smaller questionnaire size. The Organizational Learning Survey has been administered in a variety of organizations, reporting a cronbach alpha reliability rating of 0.91 (S. C. Goh et al., 2007). With contact and prior approval from Dr. Goh, questions from the OLS were incorporated into the survey for this research.

The OLS provides organizations a tool to determine their current state of learning capability and aid in the identifying of areas in need of improvement. It essentially takes a snapshot of an organizations learning capability, creating a benchmark in time. By taking these snapshots at various times one is able to identify trends and changes. These benchmarks and snapshots can then be used to provide feedback to managers and employees to identify areas of strengths and weaknesses relevant to organizational learning. Because results of the survey are based on perceptions, the best use of the data is to initiate conversation rather than be the sole factor for decision-making.

Two additional characteristics were found important to a learning organization, Human resource practices and Leaders' mandate. Human resource practices, as described by Michael McGill and John Slocum (1993), addresses the issue that organizations should consist of quality employees and as a step to ensure this, organizations should select individuals not just for their knowledge of the industry but also based on their ability to learn. The Leaders' mandate characteristic addresses the idea that leaders should not remain stagnant but instead be constantly regenerating and approaching new environments and problems differently (McGill & Slocum, 1993). It was felt by the researcher that the term Leaders' mandate is unclear and was therefore reworded to the Leader Regenerative Role.

Figure 3.1 shows the various categories in which the present survey questions address.

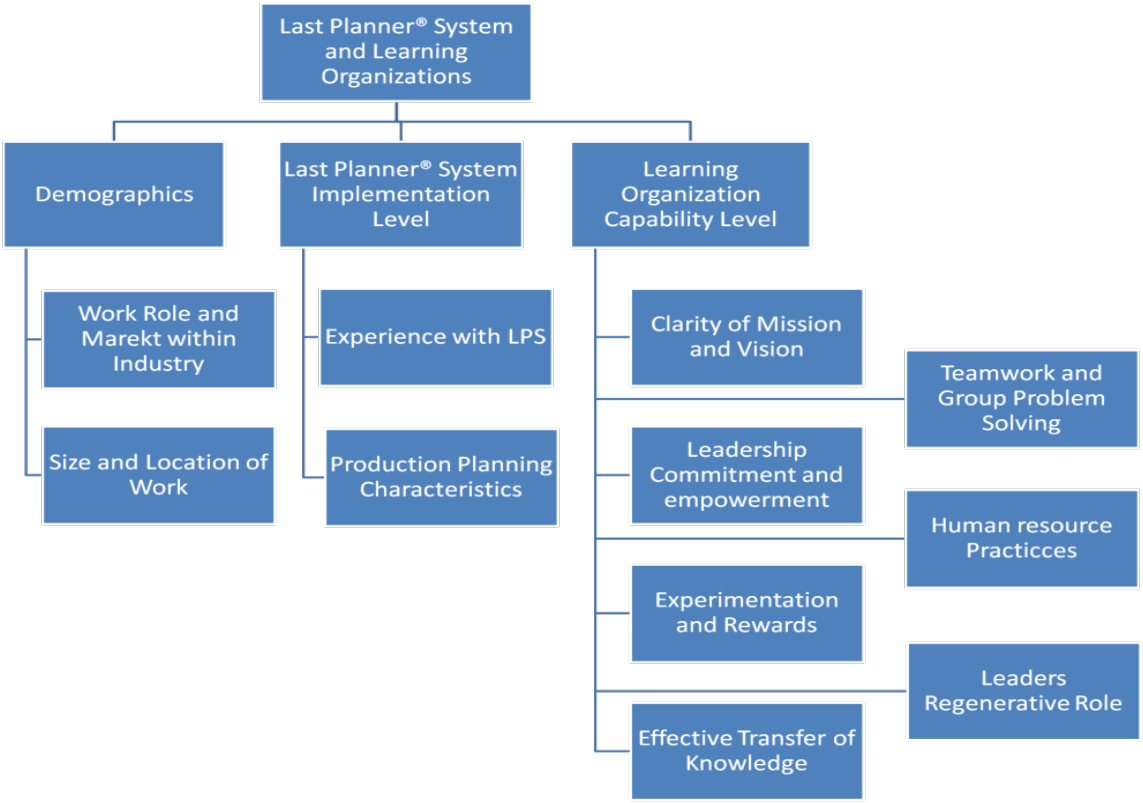

Figure 3.1: Present Survey Categories

A full listing of the research survey and all questions used in the present study can be found in Appendix A: Research Survey.

Research Variables

Variables in the study include the use of the Last Planner® System (independent variable) and the learning organization capability (dependent variable). Table 3.1 relates the study variables to the associated survey questions. The research hypotheses state that: H1: Use of Last Planner® System will positively correlate with a higher level of learning organization capability score, H2: There is a positive correlation between the effective transfer of knowledge (ETK) and team and group problem solving (TGP) sub-scales and the use of LPS, and H3: There

will be a positive correlation between the number of lean production planning characteristics.

The research hypotheses and relevant survey questions are illustrated in Table 3.2.

Table 3.1: Present Survey Question Categorization

		Survey Items
	Demographics	#1-5
Last Planner® System	Production/Planning Schedule Characteristics	#6-16
Learning Organization Characteristics	Clarity of Mission and Vision (CMV)	#17-20
	Leadership Commitment and Empowerment (LCE)	#21-26
	Experimentation and Rewards (EandR)	#27-34
	Effective Transfer of Knowledge (ETK)	#35-39
	Teamwork and Group Problem Solving (TGP)	#40, 42, 44
	Human Resource Practices (HRP)	#41
	Leaders Regenerative Role (LRR)	#43

Table 3.2: Research Hypotheses and Relevant Items on Present Survey Instrument

Hypothesis	Survey Items
H1: Use of Last Planner® System will positively correlate with a higher level of learning organization capability score	#1, 17-44
H2: There is a positive correlation between the effective transfer of knowledge (ETK) and team and group problem solving (TGP) sub-scales and the use of LPS	#1, 35-39, 40, 42, 44
H3: There will be a positive correlation between the number of lean production planning characteristics utilized and the learning organization capability score.	#8-16, 17-44

Variable creation

Examination of H1 and H2 involved grouping survey responses into two categories based on their use of the Last Planner® System. LPS1 group consists of survey responses that indicated 'Yes' to their use of LPS as determined through response to survey question 1. LPS2 group consists of survey responses that indicated 'No' to their use of LPS as determined through response to survey question 1

The feedback and learning loop of the Last Planner® system incorporate both the transfer or knowledge and team and group problem solving characteristics well through integrating positive and negative feedback, assessing performance, and identifying root causes and most importantly communicating this knowledge throughout the organization.

An additive scale variable entitled 'LeanScale' was created to examine H3. The scale ranged from 0 to 9 depending on the number of yes responses, represented with a 1, to questions 8 through 16. A higher LeanScale value indicates a larger number of lean production planning characteristics used.

The 21 questions incorporated from the OLS can be separated into five sub-scales; clarity of mission and vision, leadership commitment and empowerment, experimentation and rewards, effective transfer of knowledge, and teamwork and group problem solving. The human resource practices and leaders regenerative role variables, incorporated by the researcher as a result of the literature review, were combined with the five previous sub-scales. The average of the seven sub-scales were then calculated to obtain an overall Learning Organization Capability score (LOCS).

Data Analysis

Upon completion of data collection phase, a summary and descriptive analysis was performed on the data including standard deviations and range of scores. Research hypotheses were then analyzed using regression analysis and statistical computer software, SPSS 20. The SPSS syntax code is included in Appendix C: SPSS Syntax Results from the regression analysis were reported using R and R^2 values, t-test, effect size, and significance levels.

To address H1 the LOCS, both combined and sub-scales were then calculated for each LPS1 and LPS2 groups, a t-test was then completed to assess whether the means of the two groups are statistically different from each other. Regression analysis was performed to examine the possible relationship between the use of LPS and the sub-scales ETK and TGP to address H2. Regression analysis of LeanScale and LOCS was performed to address H3. Research path models for each hypothesis are illustrated below.

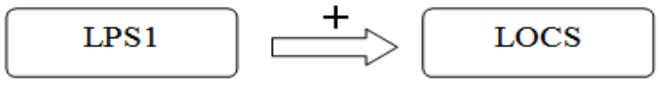

Figure 3.2: H1 Path Model

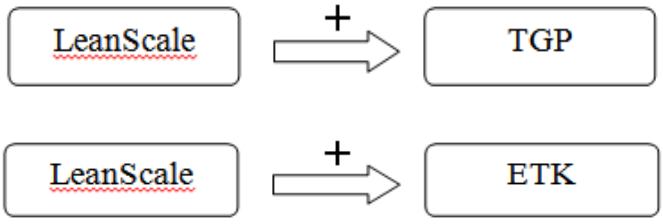

Figure 3.3: H2 Path Model

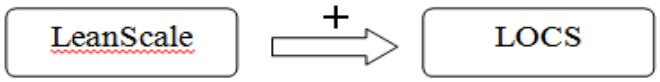

Figure 3.4: H3 Path Model

Research Ethics

The researcher has followed all guidelines set forth by Colorado State University (CSU) regarding federal requirements relating to use of human subjects. Approval has been received from the CSU Research Integrity and Compliance Review office, documents pertaining to this approval and exemption are provided in Appendix B: Research Integrity and Compliance Review.

CHAPTER IV: FINDINGS AND DATA ANALYSIS

Presentation of Data

With a total of 122 individuals accessing the research survey, 82 initiated the survey with 54 respondents completing 100 percent of the survey. Tables 4.1 and 4.2 outline the general demographics of survey participants.

Table 4.1: Demographic Characteristics of Total Survey Participants

Characteristic	N	%
Use of Last Planer® System		
No	70	85.4
Yes	12	14.6
Construction Market		
Commercial	44	54.3
Residential	9	11.1
Highway/Heavy Industrial	12	14.8
Municipal Utility	3	3.7
Public	3	3.7
Other	10	12.3
Construction Role		
General Contractor	54	66.7
Subcontractor	12	14.8
Designer	1	1.2
Consultant	5	6.2
Other	9	11.1
Company Annual Revenue		
< $1 Million	7	8.6
$1-5 Million	9	11.1
$5-50 Million	19	23.4
$50-100 Million	4	4.9
> $100 Million	42	51.8
US Geographical Location* **		
California	4	4.9
Colorado	13	16
Michigan	10	12.3
Texas	4	4.9
Not Indicated	20	24.7
Other	30	37.0

*81 valid responses

** Only top 5 responses shown

Table 4.2: Demographic Characteristics Dependent on Last Planner® System Use

	LPS User (LPS1) N=12		LPS Non-User (LPS2) N=70	
Characteristic	N	%	N	%
Length of Last Planner® System use				
0-1 Year	5	41.7		
1-3 Years	3	25		
3-6 Years	2	16.7		
6-10 Years	2	16.7		
10 + Years				
Project Experience with Last Planner® System				
1-5 Projects	8	66.7		
5-10 Projects	1	8.3		
10-15 Projects				
15 + Projects	3	25		
Construction Market				
Commercial	8	66.7	36	52.2
Residential	1	8.3	8	11.6
Highway/Heavy Industrial	1	8.3	11	15.9
Municipal Utility			3	4.3
Public			3	4.3
Other	2	16.7	8	11.6
Construction Role				
General Contractor	9	75	45	65.2
Subcontractor	1	8.3	11	15.9
Designer			1	1.4
Consultant			5	7.2
Other	2	16.7	7	10.1
Company Annual Revenue				
< $1 Million	2	16.7	5	7.2
$1-5 Million			9	13
$5-50 Million	2	16.7	17	24.6
$50-100 Million			4	5.8
> $100 Million	8	66.7	34	49.3
US Geographical Location*				
Colorado	3	25	10	14.5
California	1	8.3	3	4.3
Michigan	1	8.3	9	13
Texas			4	5.8
Minnesota			3	4.3
Other	3	24.9	25	35.4
Not Indicated	4	33.3	16	23.2

Note. LPS1 includes 'Yes' respondents of Q01; LPS2 includes 'No' respondents of Q01
*Only top responses shown

Tables 4.3 – 4.9 present the reliability analysis and means for each learning organization sub-scale for all survey participants.

Table 4.3: Reliability and Means of Clarity of Mission and Vision (CMV) sub-scale (*N*=63)

Question	Mean	SD	Cronbach Alpha if removed
Q17 There is widespread support and acceptance of our organization's mission statement	5.60	1.432	.686
Q18 Our organization's mission statement identifies values which all employees must conform	5.70	1.488	.662
Q19 We have opportunities for self-assessment with respect to organizational goal attainment	5.43	1.729	.693
Q20 I do not understand how the mission of our organization is to be achieved*	5.52	1.703	.882
CMV Aggregate	5.56	1.249	.791

Note. Questions based on 7 point Likert scale, 7 equals Strongly Agree
*For this question the scale is reversed, 7 equals Strongly Disagree

Table 4.4: Reliability and Means of Leadership Commitment and Empowerment (LCE) sub-scale (*N*=59)

Question	Mean	SD	Cronbach Alpha if removed
Q21 When new ideas are brought to the table, managers oppose the ideas or make it difficult to implement them*	4.59	1.886	.779
Q22 Senior managers and employees share a common vision of what our work should accomplish	5.34	1.646	.795
Q23 When discussing company/project issues or problems with company manager, the managers do not accept suggestions as constructive criticism*	5.12	1.630	.753
Q24 Managers is our organization often provide useful feedback which adds in the identification of both potential problems and potential opportunities	5.63	1.541	.787
Q25 Mangers in our organization frequently involve employees in important decisions	5.17	1.588	.793
Q26 Employees and senior management have differing goals and visions for the organization*	4.83	2.001	.775
LCE Aggregate	5.11	1.235	.810

Note. Questions based on 7 point Likert scale, 7 equals Strongly Agree
*For this question the scale is reversed, 7 equals Strongly Disagree

Table 4.5: Reliability and Means of Experimentation and Rewards (EandR) sub-scale (*N*=57)

Question	Mean	SD	Cronbach Alpha if removed
Q27 I feel comfortable bringing new ideas into our organization	5.82	1.428	.858
Q28Managers in our organization discourage experimentation among team members looking to improve work processes*	5.33	1.715	.830
Q29 Employees that suggest non-successful ideas do face disciplinary action by management or the company	5.67	1.562	.843
Q30 Successful innovative ideas are often rewarded by management	5.11	1.666	.847
Q31 In my experience, new ideas from employees are not treated seriously by management *	4.67	1.746	.846
Q32 From my experience, new employees in our organization are encourage to question the way things are done	4.39	1.868	.843
Q33 Disciplinary action is brought upon those whose suggested improvement or experimentations fail*	5.82	1.525	.838
Q34 Experimentation and new ideas are encouraged by management	5.49	1.548	.815
EandR Aggregate	5.29	1.158	.857

Note. Questions based on 7 point Likert scale, 7 equals Strongly Agree
*For this question the scale is reversed, 7 equals Strongly Disagree

Table 4.6: Reliability and Means of Effective Transfer of Knowledge (ETK) sub-scale (*N*=56)

Question	Mean	SD	Cronbach Alpha if removed
Q35 Within our organization, unsuccessful projects/work activities are seldom identified*	5.39	1.485	.738
Q36 New work processes that may be useful to the organization as a whole are usually shared with all employees across all departments and projects	4.73	1.784	.723
Q37 I often have an opportunity to talk with other staff about successful programs or work activities in order to understand why the programs/work activities succeeded	5.52	1.452	.683
Q38 We have a benchmarking system that allows us to learn successful practices from outside organizations	3.96	1.954	.726
Q39 Within our organization, solutions for unsuccessful projects/work activities are regularly recommended	4.66	1.871	.786
ETK Aggregate	4.85	1.247	.773

Note. Questions based on 7 point Likert scale, 7 equals Strongly Agree
*For this question the scale is reversed, 7 equals Strongly Disagree

Table 4.7: Reliability and Means of Teamwork and Group Problem Solving (TGP) sub-scale (*N*=54)

Question	Mean	SD	Cronbach Alpha if removed
Q40 Current organizational practices encourage employees to solve problems together before discussing them with a manager	4.94	1.535	.536
Q42 Within our company, employees are discouraged from forming groups to solve organizational problems*	5.28	1.595	.526
Q44 Most problem, solving groups in this organization feature employees from a variety of functional areas	5.44	1.562	.299
TGP Aggregate	5.22	1.142	.562

Note. Questions based on 7 point Likert scale, 7 equals Strongly Agree
*For this question the scale is reversed, 7 equals Strongly Disagree

Table 4.8: Reliability and Means of Human Resource Practices (HRP) sub-scale (*N*=59)

Question	Mean	SD	Cronbach Alpha if removed
Q41 New employees are hired not just on experience but also the ability to learn and improve	5.18	1.759	
HRP Aggregate**	5.18	1.759	

Note. Questions based on 7 point Likert scale, 7 equals Strongly Agree
**Due to HRP sub-scale encompassing only one question, no reliability or Cronbach Alpha was calculated

Table 4.9: Reliability and Means of Leaders Regenerative Role (LRR) sub-scale (*N*=54)

Question	Mean	SD	Cronbach Alpha if removed
Q43 Work activity procedures and processes in our company have remained unchanged since their inception	5.37	1.762	
LRR Aggregate**	5.37	1.762	

*For this question the scale is reversed, 7 equals Strongly Disagree
**Due to LRR sub-scale encompassing only one question, no reliability or Cronbach Alpha was calculated

Table 4.10 presents the reliability analysis of the Learning Organizational Capability Score (LOCS) scale.

Table 4.10: Reliability of Learning Organization Capability Score (LOCS) scale (*N*=54)

Sub-Scale	Mean	SD	Cronbach Alpha if removed
Clarity of Mission and Vision (CMV)	5.56	1.249	.867
Leadership Commitment and Empowerment (LCE)	5.11	1.235	.854
Experimentation and Rewards (EandR)	5.29	1.158	.852
Effective Transfer of Knowledge (ETK)	4.85	1.247	.857
Teamwork and Group Problem Solving (TGP)	5.22	1.142	.871
Human Resource Practices (HRP)	5.18	1.759	.862
Leadership Regenerative Role (LRR)	5.37	1.762	.889
LOCS Aggregate	5.23	1.052	.882

With the reliability analysis of LOCS indicating a Cronbach Alpha of .882, a good level of internal consistency has been achieved indicating that the questions measure the same underlying construct.

Table 4.11 provides the reliability analysis of the LeanScale variable encompassing questions 8 to 16. A higher LeanScale value indicates a larger number of lean production planning characteristics used.

Table 4.11: Reliability analysis of LeanScale (N=63)

Question	N	Cronbach Alpha if removed
Q08 Does your company develop a schedule consisting of all major milestones required for project completion?	58	.781
Q09 Does your company develop a schedule specific to each milestone, through working backwards from the required milestone completion date?	36	.767
Q10 Does your company develop a schedule for future weeks containing appropriate work-flow sequencing and matching of resource capacity with availability?	52	.755
Q11 Does your company maintain a list of ready to begin work activities in the event an issue arises during the workweek with a scheduled task or excess time becomes available?	31	.753
Q12 Does your company create a weekly schedule in which responsible parties commit to the completion of work after the required information, previous work, resources, space, and materials etc. for each task has been considered?	40	.743
Q13 Does your company compare the number of completed activities to the total number of planned activities at least once a week	33	.729
Q14 Does your company perform fist run studies for new work tasks and processes?	19	.757
Q15 Does your company identify the reasons for non-completed tasks on the Weekly Work Plan?	64	.731
Q16 Is the root cause of non-completed tasks from the Weekly Work Plan determined?	64	.731
LeanScale		.772

With the reliability analysis of LeanScale indicating a Cronbach Alpha of .772, an acceptable level of internal consistency has been achieved indicating that the questions measure the same underlying construct.

The learning organization characteristics mean and standard deviation values along with those of the LeanScale for both Last Planner® System users and non-users is shown in table 4.12.

Table 4.12: Learning Organization characteristic means of LPS users and non-users

Variable	LPS1	LPS2
Clarity of Mission and Vision (CMV)		
Mean	5.02	5.68
SD	1.845	1.074
N	11	52
Leadership Commitment and Empowerment (LCE)		
Mean	4.94	5.15
SD	.978	1.292
N	11	48
Experimentation and Rewards (EandR)		
Mean	4.89	5.37
SD	.964	1.188
N	10	47
Effective Transfer of Knowledge (ETK)		
Mean	3.92	5.06
SD	1.092	1.194
N	10	46
Teamwork and Group Problem Solving (TGP)		
Mean	4.47	5.39
SD	1.020	1.107
N	10	44
Human Resource Practices (HRP)		
Mean	4.50	5.45
SD	1.779	1.748
N	10	44
Leaders Regenerative Role (LRR)		
Mean	5.30	5.39
SD	1.703	1.794
N	10	44

Note. LPS1 includes ‘Yes’ respondents of Q01; LPS2 includes ‘No’ respondents of Q01

Analysis of the Data

Three separate hypotheses were tested; each comparing the responses of LPS users and non-users. H1 proposed a significant difference between LPS users and non-users, with a positive direction, in regards to their LOCS. H2 proposed a significant difference between LPS users and non-users, with a positive direction, in regards to their ETK and TGP. H3 stated that there would be a positive correlation between the number of lean production planning characteristics (LeanScale) utilized and the learning organization capability score (LOCS).

To address H1 the LOCS was calculated for each LPS1 and LPS2 groups, a t-test was then completed to assess whether the means of the two groups were statistically different from each other. A one tailed t-test was used because H1 is a directional hypothesis suggesting a positive relationship; LPS users would report a higher LOCS than non-users.

Comparison of LOCS for LPS users and non-users revealed a significant difference between the groups $t(52) = -1.573$, $p=0.061$. However, LPS users scored lower on the LOCS ($M = 4.77$, $SD = 0.971$) than LPS non-users ($M = 5.34$, $SD = 1.052$). This suggests that the relationship between these variables is not positive but negative, therefore H1 is rejected.

Table 4.13: Learning Organization Capability Score of LPS users and non-users

	LPS1	LPS2
Learning Organization Capability Score (LOCS) Aggregate		
Mean	4.77	5.34
SD	.971	1.052
N	10	44

Note. LPS1 includes 'Yes' respondents to use of LPS; LPS2 includes responses of 'No'

To address H2 the ETK and TGP was calculated for each LPS1 and LPS2 groups, a t-test was then completed to assess whether the means of the two groups were statistically different

from each other. A one tailed t-test was used because H2 is a directional hypothesis suggesting a positive relationship; LPS users would report a higher ETK and TGP than non-users.

Comparison of ETK for LPS users and non-users revealed a significant difference between the groups $t(54) = -2.766$, $p=0.004$. However, LPS users scored lower on the ETK ($M = 3.92$, $SD = 1.092$) than LPS non-users ($M = 5.06$, $SD = 1.194$). This suggests that the relationship between these variables is not positive but negative.

Comparison of TGP for LPS users and non-users revealed a significant difference between the groups $t(52) = -2.422$, $p=0.009$. However, LPS users scored lower on the TGP ($M = 4.47$, $SD = 1.020$) than LPS non-users ($M = 5.39$, $SD = 1.107$). This suggests that the relationship between these variables is not positive but negative therefore H2 is rejected.

Table 4.14: ETK and TGP scores of LPS users and non-users

	LPS1	LPS2
Effective Transfer of Knowledge (ETK)		
Mean	3.92	5.06
SD	1.092	1.194
N	10	46
Teamwork and Group Problem Solving (TGP)		
Mean	4.47	5.39
SD	1.020	1.107
N	10	44

Note. LPS1 includes 'Yes' respondents to use of LPS; LPS2 includes responses of 'No'

To address H3 regression analysis was performed to determine a possible significant relationship between the number of lean production planning characteristics (LeanScale) and the level of LOCS. A regression analysis, predicting LOCS scores from LeanScale scores, was found to show no statistical significance, $F(1,51) = .194$, $p = .662$. Summary statistics identified

R=.062 and R^2 =.004, indicating a correlation of .062 with an effect of .004 showing that .4% of the variance in LOCS is accounted for by the LeanScale score.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

Summary of Findings

Three separate hypotheses were tested; each compared the responses of Last Planner® System (LPS) users and non-users. The first hypothesis proposed a significant difference between LPS users and non-users, with a positive direction, in regards to their Learning Organization Capability Score (LOCS). The second hypothesis proposed a significant difference between LPS users and non-users, with a positive direction, in regards to their Effective Transfer of Knowledge (ETK) and Teamwork and Group Problem solving (TGP). Hypothesis three proposed that there would be a positive correlation between the number of lean production planning characteristics (LeanScale) utilized and their LOCS.

Through the analysis it was determined that H1 should be rejected due to discovery of an opposite relationship then expected. H2 was found to show statistical significance, however in the opposite direction then hypothesized. While a reverse relationship was found between LPS use and the Learning Organization Capability the literature review suggests the opposite and further research should be done before any final conclusions are made. H3 showed no statistical significant resulting in its rejection.

Conclusions

While significance was found between the relationship of LPS users and the perception of learning, knowledge transfer, and teamwork and group problem solving within their organizations, further research and analysis should be conducted. Numerous survey questions are in the form of a 7-point Likert scale. Likert scales measure a respondents' level of agreement or disagreement with a statement, while this can be very beneficial in that it often provides a

range of perceptions, a certain level of error may also occur due the differing views of what each scale level means. In the current study LPS users may view aspects of learning at a higher standard than non-users. While two different organizations may have identical processes and procedures in terms of their knowledge transfer and from a objective standpoint both be on the same level, individuals within one organization may view/rank themselves lower due to having a higher expectations and standards. This might explain why, while the literature suggests that LPS users should score higher in terms of Effective Transfer of Knowledge and other areas yet the current survey found LPS users scoring lower than non-users.

While the original research hypotheses were rejected based on a potentially reversed relationship found for H1 and H2 and H3 showing no significance, additional data analysis was completed to further explore the data collected and examined for additional potential relationships. These additional analyses include a review of the LeanScale scores of LPS users and non-users, an examination to see if there is a possible difference based on years of LPS usage, and an analysis test if the construction market, role, or revenue significantly correlate with LOCS.

Analysis looking into whether the LeanScale scores were statistically different from the LPS1 and LPS2 group was conducted using a t-test. A one tailed t-test was used because of this expected relationship being positive; LPS users (LPS1) were expected to indicate a higher LeanScale score than non-users (LPS2).

Comparison of LeanScale scores for LPS users and non-users revealed a significant difference between the groups $t(61) = 2.170$, $p=0.017$. LPS users scored higher on the LeanScale ($M = 6.91$, $SD = 2.023$) than LPS non-users ($M = 5.17$, $SD = 2.479$).

Table 5.1: LeanScale scores for LPS users and non-users

	LPS1	LPS2
LeanScale		
Mean	6.91	5.17
SD	2.023	2.479
N	11	52

Note. LPS1 includes 'Yes' respondents to use of LPS; LPS2 includes responses of 'No'

Focusing within the LPS users group, data was analyzed as to the difference of scale means and grouping responses according to the number of years experience with LPS. The LPS users data set was relatively small with only10 respondents completing enough of the survey to receive a score on the learning and lean scale.

Table 5.2: Length of LPS use and scale means

Variable	0-3 Years *N*=6	3-10 Years *N*=4
Clarity of Mission and Vision (CMV)		
Mean	5.29	5.25
SD	1.56	1.76
Leadership Commitment and Empowerment (LCE)		
Mean	4.89	5.25
SD	.98	.79
Experimentation and Rewards (EandR)		
Mean	4.86	4.94
SD	.56	1.27
Effective Transfer of Knowledge (ETK)		
Mean	3.67	4.30
SD	1.13	.73
Teamwork and Group Problem Solving (TGP)		
Mean	4.50	4.42
SD	1.14	.64
Human Resource Practices (HRP)		
Mean	4.33	4.75
SD	2.05	.83
Leaders Regenerative Role (LRR)		
Mean	5.33	5.25
SD	1.49	1.79
Learning Organization Capability Score (LOCS)		
Mean	4.70	4.88
SD	.98	.81
LeanScale		
Mean	6.17	7.50
SD	1.57	2.06

The data within table 5.2 illustrate that organizations employing LPS for longer then three years show an increased level of Learning Organization Capability. Data within table 5.3 suggests that the Learning Organization Capability does not increase or change dramatically with increased project use.

Table 5.3: LPS project use and scale means

Variable	1-5 Projects *N*=6	5+ Projects *N*=4
Clarity of Mission and Vision (CMV)		
Mean	5.08	5.38
SD	1.55	1.77
Leadership Commitment and Empowerment (LCE)		
Mean	5.14	4.64
SD	.95	.86
Experimentation and Rewards (EandR)		
Mean	5.09	4.65
SD	.68	1.23
Effective Transfer of Knowledge (ETK)		
Mean	3.83	3.83
SD	1.08	.84
Teamwork and Group Problem Solving (TGP)		
Mean	4.56	4.33
SD	1.05	.72
Human Resource Practices (HRP)		
Mean	4.67	3.83
SD	1.92	.94
Leaders Regenerative Role (LRR)		
Mean	5.00	5.50
SD	1.60	1.41
Learning Organization Capability Score (LOCS)		
Mean	4.77	4.60
SD	.91	.93
LeanScale		
Mean	5.50	8.33
SD	1.64	.47

To test if the construction market, role, or revenue significantly correlated with the LOCS score, the new variables of ConstMrkt, ConstRole, and ConstRevenue were created. Tables 5.4 – 5.6 provide the LOCS means and standard deviations of the new variables.

Table 5.4: LOCS according to Construction Market

	LOCS
Commercial	
Mean	5.46
SD	.970
N	33
Residential	
Mean	5.90
SD	1.151
N	4
Highway/Heavy Industrial	
Mean	4.52
SD	.714
N	9
All Others	
Mean	4.76
SD	1.233
N	8

Note. Construction market responses of 'Municipal Utility', 'Public', and 'Other' were grouped into 'All Others' due to their low *N* values

A One-Way ANOVA was completed, because the one independent variable (ConstMrkt) consisted of four levels, to assess whether the means of the construction market groups were statistically different from each other, this revealed a significant difference between the groups $f(3,50)=3.373$, $p=.026$. Respondents within the Residential market scored the highest on the LOCS ($M = 5.90$, $SD = 1.151$) with those in the Commercial market ($M = 5.46$, $SD = 0.970$), All Others ($M = 4.76$, $SD = 1.233$), and Highway/Heavy Industrial ($M = 4.52$, $SD = .714$) markets following respectively.

Finding that LOCS values are significantly different depending on the particular market a construction organization is in, suggesting a construction company's market may be a better predicator of LOCS scores rather then the use of LPS.

Table 5.5: LOCS according to Construction Role

	LOCS
General Contractor	
Mean	5.32
SD	.944
N	37
Sub-Contractor	
Mean	4.88
SD	.845
N	7
All Others	
Mean	5.16
SD	1.534
N	10

Note. Construction role responses of 'Designer', 'Consultant', and 'Other' were grouped into 'All Others' due to their low *N* values

A One-Way ANOVA was completed, because the one independent variable (ConstRole) consisted of three levels, to assess whether the means of the construction role groups were statistically different from each other. This did not reveal a significant difference between the groups $f(2,51)=.532$, $p=.591$. Respondents within the General Contractor role scored the highest on the LOCS ($M = 5.32$, $SD = .944$) with All Others ($M = 5.16$, $SD = 1.534$), and Sub-Contractor ($M = 4.88$, $SD = .845$) roles following respectively.

Table 5.6: LOCS according to Construction Revenue

Construction Revenue	LOCS
<$5 Million	
Mean	5.65
SD	.995
N	10
$5-100 Million	
Mean	4.81
SD	.984
N	15
>$100 Million	
Mean	5.31
SD	1.063
N	29

Note. Construction revenue responses of '<$1 Million' and '$1-5 Million' were grouped into '<$5 Million' and '$5-50 Million' and '$50-100 Million' were grouped into '$5-100 Million' to more equally distribute *N* values

A One-Way ANOVA was completed because the one independent variable (ConstRevenue) consisted of three levels, to assess whether the means of the construction revenue groups were statistically different from each other. A significant difference was not identified between the groups $f(2,51)=2.191$, $p=.122$. Respondents with less then $5 Million revenue scored the highest on the LOCS ($M = 5.65$, $SD = .995$), those with over $100 Million ($M = 5.31$, $SD = 1.063$), and between $5-100 Million ($M = 4.81$, $SD = .984$) revenue following respectively.

Areas of potential improvement

Increasing response rate

With a total of 122 individuals accessing the survey, 82 initiated the survey with only 52 respondents completing 100 percent of the survey. Low completion rate may be attributable to a

variety of reasons, including survey structure, length and ease of completion. As a potential method to increase survey response rate and completion, a mixed approach of a web-based survey telephone or survey response options could be utilized. Personally contacting individuals within companies via e-mail and/or phone to request survey participation with a follow-up reminder would also have been done. However to accomplish this a listing of company and individual contact information would be required, being a difficult task to accomplish and potentially resulting in survey respondents being able to be identified therefore losing anonymity.

Survey design

The structure of the survey could also be revised such as the moving of demographic questions to the end of the survey. An example of this would be relocating the question of 'do you utilize the Last Planner® System' towards the end of the survey as it may be possible that with potential respondents seeing this question first they may think that the survey relates only to users of LPS and therefore complete no further questions.

Survey design improvement might include removal of the 'other' option within some of the questions, particularly within the questions of construction market, role, and US state. This item could also be addressed by requiring survey respondents to enter a typed response when selecting the 'other' option.

Additional questions related to Human Resource Practices (HRP) and Leaders Regenerative Role (LRR) would also be added to more accurately measure these scales. The current research survey consisted of only yes/no or multiple-choice questions. The addition of a few open-ended questions, either relating to specific items or allowing for optional open-ended

responses upon survey completion may provide additional information and/or reasoning for survey responses.

Recommendations

With this research serving more as a preliminary investigation of the relationship between organizational learning and the Last Planner® System, it is clear that more comprehensive and in depth research would benefit the topic area, taking into consideration the items under areas for potential improvements.

In further research, it is recommended that expert opinions (such as through focus groups) be utilized to achieve a better-rounded research method through the incorporation of both qualitative and quantitative methods. Focus groups could be utilized to provide input to aid in survey development along with providing additional insight and explanations to data received following survey completion.

Research may also examine whether the length of use of LPS, both in terms of years and project experience, affects the level of learning organization capability. It was discovered within the current research that companies using LPS for more than three years showed a higher level of LOCS than those with less than three years experience. However, it was also found that companies that have utilized LPS on more than five projects showed a lower level of LOCS than those with less than five LPS projects. Further research may provide a more holistic view and possible understanding of this.

Additional data analysis found a statistically significant difference in LOCS between construction markets, possibly suggesting that a construction company's market may be a better predicator of LOCS scores rather then their use of LPS. Further research to examine this

relationship would be beneficial, along with looking into the possible effects a company's role within construction and revenue may have on organizational learning.

Future work could include case study research in which the survey would be administered three separate times to a company considering Last Planner® System implementation. Initial survey administration would take place before LPS implementation, following this the survey would then be administered again and a final time a few months following implementation. With a case study structured in this manner the research variables, both known and unknown, could be better accounted for allowing the survey differences to be attributable to LPS.

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APPENDIX A: RESEARCH SURVEY

Last Planner® System and Learning Organizations

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1) Do you utilize the Last Planner® System within your company?
( ) Yes
( ) No

How long have you been using the Last Planner® System?
[ ] 0-1 Year
[ ] 1-3 Years
[ ] 3-6 Years
[ ] 6-10 Years
[ ] 10+ Years

How many projects have/are you using the Last Planner® System on?
[ ] 1-5
[ ] 5-10
[ ] 10-15
[ ] 15+

2) Which construction market does your company primarily work in?
[ ] Commercial
[ ] Residential
[ ] Highway/Heavy Industrial
[ ] Municipal Utility
[ ] Public
[ ] Other

3) What role does your company primarily perform within the construction industry?
[ ] General Contractor
[ ] Subcontractor
[ ] Designer
[ ] Consultant
[ ] Other

4) In which category does your company's annual revenue for 2010 best fit?
[ ]
[ ] $1-5 Million
[ ] $5-50 Million
[ ] $50-100 Million
[ ] $100+ Million

5) In which US state does your company primarily work in?

6) Does your company utilize an outside scheduling consulting firm?
( ) Yes
( ) No

7) Which of the following are part of your planning process?
Select all that apply
[ ] Master Scheduling
[ ] Phase Scheduling
[ ] Look-ahead Planning
[ ] Workable Backlog
[ ] Weekly Work Planning
[ ] Percent Plan Complete Measurement
[ ] First Run Studies
[ ] Root Cause Analysis/Reasons for Non-completion

8) Does your company develop a schedule consisting of all major milestones required for project completion?
( ) Yes
( ) No

9) Does your company develop a schedule specific to each milestone, through working backwards from the required milestone completion date?
( ) Yes
( ) No

10) Does your company develop a schedule for future weeks containing appropriate work-flow sequencing and matching of resource capacity with availability?
( ) Yes
( ) No

11) Does your company maintain a list of "ready to begin work" activities in the event an issue arises during the workweek with a scheduled task or excess time becomes available?
( ) Yes
( ) No

12) Does your company create a weekly schedule in which responsible parties COMMIT to the completion of work after the required information, previous work, resources, space, and materials etc. for each task has been considered?
( ) Yes
( ) No

13) Does your company compare the number of the completed activities to the total number of planned activities at least once a weekly.
( ) Yes
( ) No

14) Does your company perform first run studies for new work tasks and processes? Performing the new task in the field on a small scale a few weeks ahead of the scheduled execution to determine the best means, methods, sequencing, etc. in which to perform the task.
( ) Yes
( ) No

15) Does your company identify the reasons for non-completed tasks on the Weekly Work Plan.
( ) Yes
( ) No

16) Is the root cause of non-completed tasks from the Weekly Work Plan determined?
( ) Yes
( ) No

Please answer the following questions in terms of how the questions or statements apply to those projects in which you have been a part of.
17) There is widespread support and acceptance of our organization's mission statement.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

18) Our organization's mission statement identifies values which all employees must conform.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

19) We have opportunities for self-assessment with respect to organizational goal attainment. (Ex: regular reviews/evaluations)
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

20) I do not understand how the mission of our organization is to be achieved.

( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

21) When new ideas are brought to the table, managers oppose the ideas or make it difficult to implement them.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

22) Senior managers and employees share a common vision of what our work should accomplish.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

23) When discussing company/project issues or problems with company managers, the managers do not accept suggestions as constructive criticism.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

24) Managers in our organization often provide useful feedback which adds in the identification of both potential problems and potential opportunities.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

25) Managers in our organization frequently involve employees in important decisions.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

26) Employees and senior management have differing goals and visions for the organization.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

27) I feel comfortable bringing new ideas into our organization.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

28) Managers in our organization discourage experimentation among team members looking to improve work processes.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

29) Employees that suggest non-successful ideas do not face disciplinary action by management or the company.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree

( ) Strongly agree

30) Successful innovative ideas are often rewarded by management.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

31) In my experience, new ideas from employees are not treated seriously by management.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

32) From my experience, new employees in our organization are encouraged to question the way things are done.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

33) Disciplinary action is brought upon those whose suggested improvements or experimentations fail.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

34) Experimentation and new ideas are encouraged by management.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree

( ) Moderately agree
( ) Strongly agree

35) Within our organization, unsuccessful projects/work activities are seldom identified.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

36) New work processes that may be useful to the organization as a whole are usually shared with all employees across all departments and projects.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

37) I often have an opportunity to talk with other staff about successful programs or work activities in order to understand why the programs/work activities succeeded.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

38) We have a benchmarking system that allows us to learn successful practices from outside organizations.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

39) Within our organization, solutions for unsuccessful projects/work activities are regularly recommended.
( ) Strongly disagree
( ) Moderately disagree

( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

40) Current organizational practices encourage employees to solve problems together before discussing them with a manager.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

41) New employees are hired not just on experience but also the ability to learn and improve.*
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

42) Within our company, employees are discouraged from forming groups to solve organizational problems.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

43) Work activity procedures and processes in our company have remained unchanged since their inception.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

44) Most problem solving groups in this organization feature employees from a variety of functional areas.
( ) Strongly disagree
( ) Moderately disagree
( ) Slightly disagree
( ) Neutral
( ) Slightly agree
( ) Moderately agree
( ) Strongly agree

Thank You!
Thank you for taking part in the survey. Your time and responses are greatly appreciated. You may now close this window.

APPENDIX B: RESEARCH INTEGRITY AND COMPLIANCE REVIEW

Colorado State University

Research Integrity & Compliance Review Office
Office of Vice President for Research
Fort Collins, CO 80523-2011
(970) 491-1553
FAX (970) 491-2293

DATE: May 12, 2011

TO: Dr. Farook Hamzeh, Construction Management
Brandon Langerud, Construction Management

FROM: Janell Barker, IRB Administrator
Research Integrity & Compliance Review Office

TITLE: Last Planner® System and Learning Organizations

IRB ID: 059-12H **Review Date:** May 12, 2011

The Institutional Review Board (IRB) Administrator has reviewed this project and has declared the study exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b)(2): Research involving the use of educational tests,….survey procedures, interview procedures or observation of public behavior, unless: a) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects.

The IRB determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as proposed in the Exempt application**, including obtaining and documenting (signed) informed consent if stated in your application or if required by the IRB.
- **Any modification of this research should be submitted to the IRB through an email to the IRB Administrator, prior to implementing any changes**, to determine if the project still meets the Federal criteria for exemption. If it is determined that exemption is no longer warranted, then an IRB proposal will need to be submitted and approved before proceeding with data collection.
- **Please notify the IRB if any problems or complaints of the research occur.**

Please note that you must submit all research involving human participants for review by the IRB. **Only the IRB may make the determination of exemption**, even if you conduct a similar study in the future.

Colorado State University

Research Integrity & Compliance Review Office
Office of Vice President for Research
Fort Collins, CO 80523-2011
(970) 491-1553
FAX (970) 491-2293

DATE: November 8, 2011

TO: Bolivar Senior, Construction Management
Brandon Langerud, Construction Management

FROM: Janell Barker, IRB Coordinator
Research Integrity & Compliance Review Office

TITLE: Last Planner System & Learning Organizations

IRB ID: 059-12H **Review Date:** November 8, 2011

The Institutional Review Board (IRB) Administrator has reviewed the modification of this project (to change the PI from Dr. Hamzeh to Dr. Senior) and has declared the study remains exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b)(2). The IRB determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as proposed in the IRB application**, including obtaining and documenting (signed) informed consent if stated in your application or if required by the IRB.
- **Any modification of this research should be submitted to the IRB through an email to the IRB Administrator, prior to making any changes**, to determine if the project still meets the Federal criteria for exemption. If it is determined that exemption is no longer warranted, then an IRB proposal will need to be submitted and approved before proceeding with data collection.
- **Please notify the IRB if any problems or complaints of the research occur.**

Please note that you must submit all research involving human participants for review by the IRB. **Only the IRB may make the determination of exemption**, even if you conduct a similar study in the future.

APPENDIX C: SPSS SYNTAX

```
    ***Variable Creation***
*Reliability Test of CMV.
RELIABILITY
  /VARIABLES=Q17 Q18 Q19 Q20
  /SCALE('Cronbachs Alpha for CMV') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS VARIANCE COV CORR.

*Create CMV Variable (Clarity of Mission and Vission).
COMPUTE CMV=mean.3(Q17,Q18,Q19,Q20).
EXECUTE.

*Frequencies of CMV.
FREQUENCIES VARIABLES=CMV
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.

*Reliability Test of LCE.
RELIABILITY
  /VARIABLES=Q21, Q22, Q23, Q24, Q25, Q26
  /SCALE('Cronbachs Alpha for LCE') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS VARIANCE COV CORR.

*Create LCE Variable (Leadership Commitment and Empowerment).
COMPUTE LCE=mean.5(Q21, Q22, Q23, Q24, Q25, Q26).
EXECUTE.

*Frequencies of LCE.
FREQUENCIES VARIABLES=LCE
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.


*Reliability Test of EandR.
RELIABILITY
  /VARIABLES=Q27, Q28, Q29, Q30, Q31, Q32, Q33, Q34
  /SCALE('Cronbachs Alpha for EandR') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS VARIANCE COV CORR.

*Create EandR Variable (Experimentation and Rewards).
COMPUTE EandR=mean.6(Q27, Q28, Q29, Q30, Q31, Q32, Q33, Q34).
EXECUTE.

*Frequencies of EndR.
FREQUENCIES VARIABLES=EandR
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
```

```
  /ORDER=ANALYSIS.


*Reliability Test of ETK.
RELIABILITY
  /VARIABLES=Q35,Q36, Q37, Q38, Q39
  /SCALE('Cronbachs Alpha for ETK') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS VARIANCE COV CORR.
*Create ETK Variable (Effective Transfer of Knowledge).
COMPUTE ETK=mean.4(Q35, Q36, Q37, Q38, Q39).
EXECUTE.
*Frequencies of ETK.
FREQUENCIES VARIABLES=ETK
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.


*Reliability Test of TGP.
RELIABILITY
  /VARIABLES=Q40, Q42, Q44
  /SCALE('Cronbachs Alpha for TGP') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS VARIANCE COV CORR.
*Create TGP Variable (Teamwork and Group Problem Solving).
COMPUTE TGP=mean.2(Q40, Q42, Q44).
EXECUTE.
*Frequencies of TGP.
FREQUENCIES VARIABLES=TGP
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.


*Reliability Test of HRP.
RELIABILITY
  /VARIABLES=Q41
  /SCALE('Cronbachs Alpha for HRP') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS VARIANCE COV CORR.
*Create HRP Variable (Human Resource Practices).
COMPUTE HRP=mean.1(Q41).
EXECUTE.
* Define Variable Properties.
*HRP.
VARIABLE LEVEL  HRP(SCALE).
EXECUTE.
*Frequencies of HRP.
FREQUENCIES VARIABLES=HRP
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.


*Reliability Test of LRR.
```

```
RELIABILITY
  /VARIABLES=Q43
  /SCALE('Cronbachs Alpha for LRR') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS VARIANCE COV CORR.
*Create LRR Variable (Leaders Regenerative Role).
COMPUTE LRR=mean.1(Q43).
EXECUTE.
* Define Variable Properties.
*LRR.
VARIABLE LEVEL  LRR(SCALE).
EXECUTE.
*Frequencies of LRR.
FREQUENCIES VARIABLES=LRR
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.


*Reliability Test of LOCS.
RELIABILITY
  /VARIABLES=CMV, LCE, EandR, ETK, TGP, HRP, LRR
  /SCALE('Cronbachs Alpha for LOCS') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS VARIANCE COV CORR.
*Create LOCS Variable (Learning Organization Capability Score).
COMPUTE LOCS=mean.7(CMV, LCE, EandR, ETK, TGP, HRP, LRR).
EXECUTE.
*Frequencies of LOCS.
FREQUENCIES VARIABLES=LOCS
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.

*Reliability Test of LeanScale.
RELIABILITY
  /VARIABLES=Q08, Q09, Q10, Q11, Q12, Q13, Q14, Q15, Q16
  /SCALE('Cronbachs Alpha for TGP') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS VARIANCE COV CORR.
*Create LeanScale from Q08-Q16.
DATASET ACTIVATE DataSet1.
COMPUTE LeanScale=Q08 + Q09 + Q10 + Q11 + Q12 + Q13 + Q14 + Q15 + Q16.
EXECUTE.
* Define Variable Properties.
*LeanScale.
VARIABLE LEVEL  LeanScale(SCALE).
EXECUTE.
FREQUENCIES VARIABLES= LeanScale
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.


*Create LPS1 group, those that responded Yes to Q01:Use of LPS.
COMPUTE LPS1=Q01=1.
```

```
EXECUTE.
*Frequencies of LPS1.
FREQUENCIES VARIABLES=LPS1
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
USE ALL.
COMPUTE filter_$=(Q01 = 1).
VARIABLE LABELS filter_$ 'Q01 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.


*Create LPS2 group, those that responded No to Q01:Use of LPS.
COMPUTE LPS2=Q01=2.
EXECUTE.
*Frequencies of LPS2.
FREQUENCIES VARIABLES=LPS2
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
USE ALL.
COMPUTE filter_$=(Q01 = 2).
VARIABLE LABELS filter_$ 'Q01 = 2 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.


*Frequencies of all Survey Questions.
DATASET ACTIVATE DataSet1.
FREQUENCIES VARIABLES=Q01 Q01.A.1 Q01.A.2 Q01.A.3 Q01.A.4 Q01.A.5 Q01.B.1 Q01.B.2 Q01.B.3 Q01.B.4
    Q02.1 Q02.2 Q02.3 Q02.4 Q02.5 Q02.6 Q03.1 Q03.2 Q03.3 Q03.4 Q03.5 Q04 Q04.1 Q04.2 Q04.3 Q04.4 Q05
    Q06 Q07.1 Q07.2 Q07.3 Q07.4 Q07.5 Q07.6 Q07.7 Q07.8 Q08 Q09 Q10 Q11 Q12 Q13 Q14 Q15 Q16
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /BARCHART FREQ
  /ORDER=ANALYSIS.

FREQUENCIES VARIABLES=Q17 Q18 Q19 Q20 Q21 Q22 Q23 Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32 Q33 Q34
 Q35 Q36 Q37 Q38 Q39 Q40 Q41 Q42 Q43 Q44
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.


   ***Regression Analysis***,
     *H1*.
*Regression Analysis of LOCS and Q01:Use of LPS.
REGRESSION
```

```
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q01.
T-TEST GROUPS=Q01(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=LOCS
  /CRITERIA=CI(.90).
* Chart Builder LOCS and Q01.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=Q01 LOCS MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: Q01=col(source(s), name("Q01"))
  DATA: LOCS=col(source(s), name("LOCS"))
  GUIDE: axis(dim(1), label("Do you utilize the Last PlannerÂ® System within your company?"))
  GUIDE: axis(dim(2), label("LOCS"))
  ELEMENT: interval(position(Q01*LOCS), shape.interior(shape.square))
END GPL.

     *H2*
*Regression Analysis of ETK and Q01: Use of LPS.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q01.
T-TEST GROUPS=Q01(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=ETK
  /CRITERIA=CI(.90).
* Chart Builder ETK and Q01.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=Q01 ETK MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: Q01=col(source(s), name("Q01"))
  DATA: ETK=col(source(s), name("ETK"))
  GUIDE: axis(dim(1), label("Do you utilize the Last PlannerÂ® System within your company?"))
  GUIDE: axis(dim(2), label("ETK"))
  ELEMENT: interval(position(Q01*ETK), shape.interior(shape.square))
END GPL.

*Regression Analysis of TGP and Q01: Use of LPS.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q01.
T-TEST GROUPS=Q01(1 2)
  /MISSING=ANALYSIS
```

```
  /VARIABLES=TGP
  /CRITERIA=CI(.90).
* Chart Builder TGP and Q01.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=Q01 TGP MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: Q01=col(source(s), name("Q01"))
  DATA: TGP=col(source(s), name("TGP"))
  GUIDE: axis(dim(1), label("Do you utilize the Last PlannerÂ® System within your company?"))
  GUIDE: axis(dim(2), label("TGP"))
  ELEMENT: interval(position(Q01*TGP), shape.interior(shape.square))
END GPL.


     *H3*
*Regression Analysis of LeanScale and LOCS.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER LOCS.
* Chart Builder LeanScale & LOCS.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScale LOCS MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  DATA: LOCS=col(source(s), name("LOCS"))
  GUIDE: axis(dim(1), label("LeanScale"))
  GUIDE: axis(dim(2), label("LOCS"))
  ELEMENT: point(position(LeanScale*LOCS))
END GPL.



*Regression Analysis of LeanScale and CMV.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER CMV.
* Chart Builder LeanScale and CMV.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScale CMV MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  DATA: CMV=col(source(s), name("CMV"))
  GUIDE: axis(dim(1), label("LeanScale"))
  GUIDE: axis(dim(2), label("CMV"))
  ELEMENT: point(position(LeanScale*CMV))
END GPL.
```

```
*Regression Analysis of LeanScale and LCE.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER LCE.
* Chart Builder LeanScale and LCE.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScale LCE MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  DATA: LCE=col(source(s), name("LCE"))
  GUIDE: axis(dim(1), label("LeanScale"))
  GUIDE: axis(dim(2), label("LCE"))
  ELEMENT: point(position(LeanScale*LCE))
END GPL.

*Regression Analysis of LeanScale and EandR.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER EandR.
* Chart Builder LeanScale and EandR.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScale EandR MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  DATA: EandR=col(source(s), name("EandR"))
  GUIDE: axis(dim(1), label("LeanScale"))
  GUIDE: axis(dim(2), label("EandR"))
  ELEMENT: point(position(LeanScale*EandR))
END GPL.

*Regression Analysis of LeanScale and ETK.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER ETK.
* Chart Builder LeanScale and ETK.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScale ETK MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  DATA: ETK=col(source(s), name("ETK"))
```

```
  GUIDE: axis(dim(1), label("LeanScale"))
  GUIDE: axis(dim(2), label("ETK"))
  ELEMENT: point(position(LeanScale*ETK))
END GPL.

*Regression Analysis of LeanScale and TGP.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER TGP.
* Chart Builder LeanScale and TGP.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScale TGP MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  DATA: TGP=col(source(s), name("TGP"))
  GUIDE: axis(dim(1), label("LeanScale"))
  GUIDE: axis(dim(2), label("TGP"))
  ELEMENT: point(position(LeanScale*TGP))
END GPL.

*Regression Analysis of LeanScale and HRP.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER HRP.
* Chart Builder LeanScale and HRP.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScale HRP MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  DATA: HRP=col(source(s), name("HRP"))
  GUIDE: axis(dim(1), label("LeanScale"))
  GUIDE: axis(dim(2), label("HRP"))
  ELEMENT: point(position(LeanScale*HRP))
END GPL.

*Regression Analysis of LeanScale and LRR.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER LRR.
* Chart Builder LeanScale and LRR.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScale LRR MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
```

```
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  DATA: LRR=col(source(s), name("LRR"))
  GUIDE: axis(dim(1), label("LeanScale"))
  GUIDE: axis(dim(2), label("LRR"))
  ELEMENT: point(position(LeanScale*LRR))
END GPL.


**Commercial Market Frequencies and Regression between learning scales and Commercial Market**
USE ALL.
COMPUTE filter_$=(Q02.1 = 1).
VARIABLE LABELS filter_$ 'Q02.1 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q02.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q02.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q02.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q02.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q02.1.
REGRESSION
```

```
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q02.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q02.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q02.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q02.1.

**Residential Frequencies and Regression between learning scales and Residential Market**
USE ALL.
COMPUTE filter_$=(Q02.2 = 1).
VARIABLE LABELS filter_$ 'Q02.2 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q02.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q02.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
```

```
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q02.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q02.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q02.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q02.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q02.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q02.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q02.2.

**Highway/Heavy Industrial Frequencies and Regression between learning scales and Highway/Heavy Industrial Market**
USE ALL.
COMPUTE filter_$=(Q02.3 = 1).
VARIABLE LABELS filter_$ 'Q02.3 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
```

```
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q02.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q02.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q02.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q02.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q02.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q02.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q02.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q02.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
```

```
  /METHOD=ENTER Q02.3.

**Muncipal Utility Frequencies and Regression between learning scales and Muncipal Utility Market**
USE ALL.
COMPUTE filter_$=(Q02.4 = 1).
VARIABLE LABELS filter_$ 'Q02.4 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q02.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q02.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q02.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q02.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q02.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q02.4.
REGRESSION
  /MISSING LISTWISE
```

```
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q02.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q02.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q02.4.

**Public Frequencies and Regression between learning scales and Public Market**
USE ALL.
COMPUTE filter_$=(Q02.5 = 1).
VARIABLE LABELS filter_$ 'Q02.5 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q02.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q02.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q02.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
```

```
  /DEPENDENT EandR
  /METHOD=ENTER Q02.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q02.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q02.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q02.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q02.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q02.5.


**Other Mrkt Frequencies and Regression between learning scales and Other Market**
USE ALL.
COMPUTE filter_$=(Q02.6 = 1).
VARIABLE LABELS filter_$ 'Q02.6 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q02.6.
```

```
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q02.6.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q02.6.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q02.6.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q02.6.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q02.6.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q02.6.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q02.6.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q02.6.


**General Contractor Frequencies and Regression between learning scales and GC Role**
USE ALL.
COMPUTE filter_$=(Q03.1 = 1).
VARIABLE LABELS filter_$ 'Q03.1 = 1 (FILTER)'.
```

```
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q03.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q03.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q03.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q03.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q03.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q03.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q03.1.
REGRESSION
```

```
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q03.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q03.1.


**Subcontractor Frequencies and Regression between learning scales and SubContractor Role**
USE ALL.
COMPUTE filter_$=(Q03.2 = 1).
VARIABLE LABELS filter_$ 'Q03.2 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q03.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q03.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q03.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q03.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
```

```
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q03.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q03.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q03.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q03.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q03.2.

**Designer Frequencies and Regression between learning scales and Dsigner Role**
USE ALL.
COMPUTE filter_$=(Q03.3 = 1).
VARIABLE LABELS filter_$ 'Q03.3 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.


**Consultant Frequencies and Regression between learning scales and Consultant Role**
USE ALL.
COMPUTE filter_$=(Q03.4 = 1).
VARIABLE LABELS filter_$ 'Q03.4 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
```

```
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q03.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q03.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q03.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q03.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q03.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q03.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q03.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q03.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
```

```
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q03.4.

**Other Frequencies and Regression between learning scales and Other Role**
USE ALL.
COMPUTE filter_$=(Q03.5 = 1).
VARIABLE LABELS filter_$ 'Q03.5 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q03.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q03.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q03.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q03.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q03.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
```

```
  /METHOD=ENTER Q03.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q03.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q03.5.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q03.5.


**<1Million revenue Frequencies and Regression between learning scales**
USE ALL.
COMPUTE filter_$=(Q04 = 1).
VARIABLE LABELS filter_$ 'Q04 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q04.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q04.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q04.
REGRESSION
```

```
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q04.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q04.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q04.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q04.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q04.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q04.


**1-5 Million revenue Frequencies and Regression between learning scales**
USE ALL.
COMPUTE filter_$=(Q04.1 = 1).
VARIABLE LABELS filter_$ 'Q04.1 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
```

```
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q04.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q04.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q04.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q04.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q04.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q04.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q04.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q04.1.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q04.1.
```

```
**5-50 Million revenue Frequencies and Regression between learning scales**
USE ALL.
COMPUTE filter_$=(Q04.2 = 1).
VARIABLE LABELS filter_$ 'Q04.2 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q04.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q04.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q04.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q04.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q04.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q04.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
```

```
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q04.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q04.2.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q04.2.


**50-100 Million revenue Frequencies and Regression between learning scales**
USE ALL.
COMPUTE filter_$=(Q04.3 = 1).
VARIABLE LABELS filter_$ 'Q04.3 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q04.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q04.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q04.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
```

```
  /METHOD=ENTER Q04.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q04.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q04.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q04.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q04.3.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q04.3.


**100+ Million revenue Frequencies and Regression between learning scales**
USE ALL.
COMPUTE filter_$=(Q04.4 = 1).
VARIABLE LABELS filter_$ 'Q04.4 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LOCS CMV LCE EandR ETK TGP HRP LRR LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER Q04.4.
REGRESSION
```

```
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT CMV
  /METHOD=ENTER Q04.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LCE
  /METHOD=ENTER Q04.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EandR
  /METHOD=ENTER Q04.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT ETK
  /METHOD=ENTER Q04.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT TGP
  /METHOD=ENTER Q04.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT HRP
  /METHOD=ENTER Q04.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LRR
  /METHOD=ENTER Q04.4.
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q04.4.


**LeanScale and Q01**.
*LPS1 LeanScale Frequencies and Descriptives*
USE ALL.
COMPUTE filter_$=(Q01=1).
VARIABLE LABELS filter_$ 'Q01=1 (FILTER)'.
```

```
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=Q01 LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN
  /BARCHART FREQ
  /ORDER=ANALYSIS.
DESCRIPTIVES VARIABLES=Q01 LeanScale
  /STATISTICS=MEAN STDDEV MIN MAX.
FREQUENCIES VARIABLES=Q01 Q07.1 Q07.2 Q07.3 Q07.4 Q07.5 Q07.6 Q07.7 Q07.8 Q08 Q09 Q10 Q11 Q12 Q13
    Q14 Q15 Q16
  /NTILES=4
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN
  /BARCHART FREQ
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
*LPS2 LeanScale Frequencies and Descriptives*
USE ALL.
COMPUTE filter_$=(Q01=2).
VARIABLE LABELS filter_$ 'Q01=2 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=Q01 LeanScale
  /NTILES=4
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN
  /BARCHART FREQ
  /ORDER=ANALYSIS.
DESCRIPTIVES VARIABLES=Q01 LeanScale
  /STATISTICS=MEAN STDDEV MIN MAX.
FREQUENCIES VARIABLES=Q01 Q07.1 Q07.2 Q07.3 Q07.4 Q07.5 Q07.6 Q07.7 Q07.8 Q08 Q09 Q10 Q11 Q12 Q13
    Q14 Q15 Q16
  /NTILES=4
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN
  /BARCHART FREQ
  /ORDER=ANALYSIS.
FILTER OFF.
USE ALL.
EXECUTE.
*Regression & T-test between Q01 and LeanScale*.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LeanScale
  /METHOD=ENTER Q01.
T-TEST GROUPS=Q01(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=LeanScale
  /CRITERIA=CI(.90).
* Chart Builder Q01 and LeanScale.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=Q01 LeanScale MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
```

```
  SOURCE: s=userSource(id("graphdataset"))
  DATA: Q01=col(source(s), name("Q01"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  GUIDE: axis(dim(1), label("Do you utilize the Last PlannerÂ® System within your company?"))
  GUIDE: axis(dim(2), label("LeanScale"))
  ELEMENT: point(position(Q01*LeanScale))
END GPL.


**WWP and PPC Use and LOCS**.
*Neither WWP or PPC*.
USE ALL.
COMPUTE filter_$=(Q12 = 0 and Q13 = 0).
VARIABLE LABELS filter_$ 'Q12 = 0 and Q13 = 0 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
DATASET ACTIVATE DataSet1.
COMPUTE LeanScaleWWPPPC=Q08 + Q09 + Q10 + Q11 + Q14 + Q15 + Q16.
EXECUTE.
* Define Variable Properties.
*LeanScaleWWPPPC.
VARIABLE LEVEL  LeanScaleWWPPPC(SCALE).
EXECUTE.
FREQUENCIES VARIABLES=LeanScaleWWPPPC LOCS
  /NTILES=4
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN
  /BARCHART FREQ
  /ORDER=ANALYSIS.
DESCRIPTIVES VARIABLES=LeanScaleWWPPPC LOCS
  /STATISTICS=MEAN STDDEV MIN MAX.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER LeanScaleWWPPPC.
* Chart Builder LeanScaleWWPPPC and LOCS.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScaleWWPPPC LOCS MISSING=LISTWISE
REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScaleWWPPPC=col(source(s), name("LeanScaleWWPPPC"))
  DATA: LOCS=col(source(s), name("LOCS"))
  GUIDE: axis(dim(1), label("LeanScaleWWPPPC"))
  GUIDE: axis(dim(2), label("LOCS"))
  ELEMENT: point(position(LeanScaleWWPPPC*LOCS))
END GPL.
FILTER OFF.
USE ALL.
EXECUTE.
*WWP use but not PPC*.
USE ALL.
COMPUTE filter_$=(Q12 = 1 and Q13 = 0).
VARIABLE LABELS filter_$ 'Q12 = 1 and Q13 = 0 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
```

```
FILTER BY filter_$.
EXECUTE.
DATASET ACTIVATE DataSet1.
COMPUTE LeanScalePPC=Q08 + Q09 + Q10 + Q11 + Q12 + Q14 + Q15 + Q16.
EXECUTE.
* Define Variable Properties.
*LeanScalePPC.
VARIABLE LEVEL  LeanScalePPC(SCALE).
EXECUTE.
FREQUENCIES VARIABLES=LeanScalePPC LOCS
  /NTILES=4
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN
  /BARCHART FREQ
  /ORDER=ANALYSIS.
DESCRIPTIVES VARIABLES=LeanScalePPC LOCS
  /STATISTICS=MEAN STDDEV MIN MAX.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
  /METHOD=ENTER LeanScalePPC.
* Chart Builder LeanScalePPC and LOCS.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScalePPC LOCS MISSING=LISTWISE
REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScalePPC=col(source(s), name("LeanScalePPC"))
  DATA: LOCS=col(source(s), name("LOCS"))
  GUIDE: axis(dim(1), label("LeanScalePPC"))
  GUIDE: axis(dim(2), label("LOCS"))
  ELEMENT: point(position(LeanScalePPC*LOCS))
END GPL.
FILTER OFF.
USE ALL.
EXECUTE.
*WWP and PPC Use*.
USE ALL.
COMPUTE filter_$=(Q12 = 1 and Q13 = 1).
VARIABLE LABELS filter_$ 'Q12 = 1 and Q13 = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=LeanScale LOCS
  /NTILES=4
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN
  /BARCHART FREQ
  /ORDER=ANALYSIS.
DESCRIPTIVES VARIABLES=LeanScale LOCS
  /STATISTICS=MEAN STDDEV MIN MAX.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(90) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT LOCS
```

```
  /METHOD=ENTER LeanScale.
* Chart Builder LeanScale and LOCS.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=LeanScale LOCS MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: LeanScale=col(source(s), name("LeanScale"))
  DATA: LOCS=col(source(s), name("LOCS"))
  GUIDE: axis(dim(1), label("LeanScale"))
  GUIDE: axis(dim(2), label("LOCS"))
  ELEMENT: point(position(LeanScale*LOCS))
END GPL.
FILTER OFF.
USE ALL.
EXECUTE.



*Recoding of Construction Market Variables*.
DATASET ACTIVATE DataSet1.
DO IF  (LOCS > 1).
RECODE Q02.1 (1=1) (0=0) INTO Commercial.
END IF.
VARIABLE LABELS  Commercial 'Commercial'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q02.2 (0=0) (1=2) INTO Residential.
END IF.
VARIABLE LABELS  Residential 'Residential'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q02.3 (0=0) (1=3) INTO HeavyHighway.
END IF.
VARIABLE LABELS  HeavyHighway 'HeavyHighway'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q02.4 (0=0) (1=4) INTO Muncipial.
END IF.
VARIABLE LABELS  Muncipial 'Other'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q02.5 (0=0) (1=4) INTO Public.
END IF.
VARIABLE LABELS  Public 'Other'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q02.6 (0=0) (1=4) INTO Other.
END IF.
VARIABLE LABELS  Other 'Other'.
EXECUTE.
*Creations of ConstMrkt variable*.
COMPUTE ConstMrkt=SUM(Commercial+Residential+HeavyHighway+Muncipial+Public+Other).
EXECUTE.
*Frequencies and Desrciptives of ConstMrkt*.
DATASET ACTIVATE DataSet1.
FREQUENCIES VARIABLES=ConstMrkt
  /ORDER=ANALYSIS.
DESCRIPTIVES VARIABLES=ConstMrkt
  /STATISTICS=MEAN STDDEV MIN MAX.
MEANS TABLES=LOCS BY ConstMrkt
  /CELLS MEAN COUNT STDDEV.
```

```
*Oneway ANOVA of ConstMrkt and LOCS*.
DATASET ACTIVATE DataSet1.
ONEWAY LOCS BY ConstMrkt
  /STATISTICS DESCRIPTIVES HOMOGENEITY
  /PLOT MEANS
  /MISSING ANALYSIS.

*Recoding of Consruction Role Variables*.
DATASET ACTIVATE DataSet1.
DO IF  (LOCS > 1).
RECODE Q03.1 (1=1) (0=0) INTO GeneralContractor.
END IF.
VARIABLE LABELS  GeneralContractor 'GC'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q03.2 (0=0) (1=2) INTO SubContractor.
END IF.
VARIABLE LABELS  SubContractor 'SubContractor'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q03.3 (0=0) (1=3) INTO Designer.
END IF.
VARIABLE LABELS  Designer 'Other'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q03.4 (0=0) (1=3) INTO Consultant.
END IF.
VARIABLE LABELS  Consultant 'Other'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q03.5 (0=0) (1=3) INTO OtherRole.
END IF.
VARIABLE LABELS  OtherRole 'Other'.
EXECUTE.
*Compute ConstRole Variable*.
COMPUTE ConstRole=SUM(GeneralContractor+SubContractor+Designer+Consultant+OtherRole).
EXECUTE.
*Frequenceis and Descriptives of ConstRole*.
FREQUENCIES VARIABLES=ConstRole
  /ORDER=ANALYSIS.
DESCRIPTIVES VARIABLES=ConstRole
  /STATISTICS=MEAN STDDEV MIN MAX.
MEANS TABLES=LOCS BY ConstRole
  /CELLS MEAN COUNT STDDEV.
*Oneway ANOVA of ConstRole and LOCS*.
DATASET ACTIVATE DataSet1.
ONEWAY LOCS BY ConstRole
  /STATISTICS DESCRIPTIVES HOMOGENEITY
  /PLOT MEANS
  /MISSING ANALYSIS.


*Recoding of Construction Revenue Variables*.
DO IF  (LOCS > 1).
RECODE Q04 (0=0) (1=1) INTO RevenueLess$1.
END IF.
VARIABLE LABELS  RevenueLess$1 'RevenueLess$1'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q04.1 (0=0) (1=1) INTO Revenue$1.5.
END IF.
VARIABLE LABELS  Revenue$1.5 'Revenue$1.5'.
```

```
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q04.2 (0=0) (1=2) INTO Revenue$5.50.
END IF.
VARIABLE LABELS  Revenue$5.50 'Revenue$5.50'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q04.3 (0=0) (1=2) INTO Revenue$50.100.
END IF.
VARIABLE LABELS  Revenue$50.100 'Revenue$50.100'.
EXECUTE.
DO IF  (LOCS > 1).
RECODE Q04.4 (0=0) (1=3) INTO RevenueGreater$100.
END IF.
VARIABLE LABELS  RevenueGreater$100 'RevenueGreater$100'.
EXECUTE.
*Compute ConstRevenue Variable*.
COMPUTE ConstRevenue=SUM(RevenueLess$1+Revenue$1.5+Revenue$5.50+Revenue$50.100+RevenueGreater$100).
EXECUTE.
*Frequencies and Descriptives of ConstRole*.
FREQUENCIES VARIABLES=ConstRevenue
  /ORDER=ANALYSIS.
DESCRIPTIVES VARIABLES=ConstRole
  /STATISTICS=MEAN STDDEV MIN MAX.
MEANS TABLES=LOCS BY ConstRevenue
  /CELLS MEAN COUNT STDDEV.
*Oneway ANOVA of ConstRevenue and LOCS*.
DATASET ACTIVATE DataSet1.
ONEWAY LOCS BY ConstRevenue
  /STATISTICS DESCRIPTIVES HOMOGENEITY
  /PLOT MEANS
  /MISSING ANALYSIS.
```