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**TEAM LEARNING IN A MATRIX ORGANIZATION:  
Case study of a software development center in Mexico**

Master's thesis

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This thesis conforms to the requirements for a Master's thesis.

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I have written this Master's thesis independently. Any ideas or data taken from other authors or other sources have been fully referenced.

.....(signature of the author and date)

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## **INTRODUCTION**

In the age of globalization and Internet, the organizational and team learning are very important source of competitiveness. This is especially true in software development (SD), as knowledge intensive economy. In these fast changing environments, organizations that are able to learn and not just react can realize benefits in the market. These organizations are called "learning organizations" (LO). D. Garvin has defined LO as “an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insight” (Garvin 1993: 78).

One of the most cited specialists of learning organizations, Peter Senge, in his book “The Fifth Discipline”, singled out five components or disciplines that help organizations to learn. They are: system thinking, personal mastery, mental models, shared vision, and team learning (Senge 1990, 2006).

Learning occurs at three levels: individual, group (team), and organization (Nonaka 1994). As companies work to become learning organizations, they need to transfer the personal knowledge that occurs at an individual level, through the intermediate level of team learning, up to the organizational level. Because team learning is so central to this process, understanding it more fully is the focus of this research paper.

Many authors have previously studied team learning as a very helpful tool for improving team performance. Christopher Chan (2003) has examined the effects of internal and external team learning on team performance. Marianne van Woerkom (2009) has studied the relationship between team learning activities and team performance. Amy Edmondson (1999) has conducted extensive research about psychological safety and learning behavior in work teams.

The author has had a unique opportunity to study team learning processes at a two-year old software development center in Mexico. The company that opened this development center has been a world leader in the telecommunication and information technology sector for more than 30 years. As an international company headquartered in Silicon Valley, it has sales offices all over the world, as well as two development centers in India and Mexico.

The development center in Mexico opened in 2010 and, by March, 2012, it had grown to 270 employees, most of whom are software developers. The author not only observed the processes from inside, but also had the opportunity to interview managers and software developers. Most of employees in the center are Mexicans, (although there are also people from Europe and Latin America). Despite the fact that United States and Mexico are neighbors, there are significant differences in the habits, ethics, and values between the people in each country.

The research for this paper was conducted as a case-study, as by objective reasons it was not possible to get enough data for a good statistical analysis. All the research conditions for a case-study (a good understanding of phenomenon, sensitivity for novel and unexpected issues in data collection, ability to ask good questions, a good listener, and flexibility in the data collection process (Yin 1994)) have been met.

The principal questions addressed by this study are: 1) How has a matrix-structured, two-year old organization been able to achieve a high level of team learning?; 2) How does a matrix management structure affect team learning: does it support or hinder it?; 3) Do Senge's organization learning factors such as shared vision and personal mastery influence team learning as well? and 4) What team learning practices are used at the development center and how quickly do these practices bring about improvements?

The research is a single-case study, because it has concentrated on the team learning processes and their influence on team performance in just one company. Both quantitative and qualitative methods were used: interviews with managers, archival records, direct observations, questionnaires, and participant observations.

The paper includes an introduction, three chapters, conclusion, references, and appendices. In the first chapter, related works and their outputs will be introduced, the learning organization models of Peter Senge and Amy Edmondson compared, hypotheses formulated for team learning in the studied development center, and its cultural background (Mexican culture) described using G. Hofstede's four dimensions: power distance (PDI), individualism (IDV), masculinity (MAS), and uncertainty avoidance (UAI). In the second chapter, the research methodology will be introduced; the questionnaire and its results will be reviewed, the interviews conducted with organization managers will be discussed, and observations about team learning and the psychological atmosphere within the development center in Mexico will be shared. Additionally, the limitations of the study will be identified. In the third chapter, "Discussion", the correspondence between the theories of Peter Senge and Amy Edmondson will be described, the questionnaires and interviews analyzed, using principal component analysis (PCA), t-test and other statistic methods, the model of factors that influence team learning in the development center in Mexico will be introduced, and recommendations will be made for future studies. Finally, in the conclusion, a brief description of the results will be provided as well as recommendations to the development center for future development and methods for future studies will be suggested.

# CHAPTER 1. TEAM LEARNING INFLUENCING FACTORS

## 1.1 Organizational learning

The learning organization concept has captured the interest of academics and enterprise managers for years. A learning organization (LO) is “an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insight” (Garvin 1993: 78).

Peter Senge gives a similar definition to "learning organization". He believes that LO's are "organizations 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 to see the whole together" (Senge 2006: 3).

According to Peter Senge (1990: 16) there are three reasons why many executives are interested in **organizational learning**:

- 1) they want their organizations to be able to adapt to changes quickly;
- 2) they turn to organizational learning when other efforts to enhance strategic planning and management fail; and
- 3) they want to reduce or eliminate the paradigm blindness plaguing their organizations.

For organizational learning in SD companies, some authors (Shepherd *et al* 2006: 197) use the term “organizational technology learning” to reflect that a combination of organizational learning and technical learning occurs in SD projects. In this study the term “organizational learning” will be used, since there are many common features between SD and other organizations in the learning process.



Shimon L. Dolan and Salvador Garcia (2002) contrasted their idea of Managing By Values (MBV) with the widely used concepts of Management By Instructions (MBI) and Management By Objectives (MBO). According to researchers, the latter two methods give inadequate results when companies try to become learning organizations. On the other hand, MBV is emerging as a strategic leadership tool of tremendous potential for practical development, as a result of its great relevance at various levels. Managing By Value as a leadership tool supports the development of learning organization, because it has a triple purpose: to simplify, to guide and to secure commitment. All of these ideas support the importance of shared vision as one of the attributes of a learning organization described by Peter Senge (1990, 2006).



**Figure 1.** Evolution of three ways of managing companies by instruction, objectives and values. (Dolan *et al* 2002: 104)

Shimon L. Dolan and Salvador Garcia (2002: 105) also mention that, with the appearance of new technologies (e.g. process automation, data and telecommunications), organizations strive to increase the professionalism and creativity of their employees. But at the same

time, this process makes employees want to be treated as independent mature individuals with their own performance criteria. In order for managers and employees to both find a way to develop as they wish, employees must become autonomous, flexible, and committed. This is important, because a professional without these characteristics is not a real professional, but merely an employee.

The authors (*ibid*: 105 - 106) state that "an organization that has genuinely accepted shared values will turn out to be much more efficient in tolerating creatively, exploiting complexity and uncertainty, than another which merely receives certain objectives or even simply obeys instructions or follows a manual of procedures“.

Kozlowski *et al* (2000) states that organizational learning is rooted in individual learning, but at the same time it is more than just a simple summation of individual learning. Researchers propose that the conceptual meaning of collective learning should not be focused only on individual learning, but should also included higher-level processes and linkages that capture how learning by individuals is combined, translated, and amplified to emerge as an analogous phenomenon at the collective level.

The key to Kozlowski's concept of organizational learning is "an alignment between formal and informal systems at multiple levels of the organization (within level) and across multiple levels of the organization (between level). Formal organizational systems and informal processes, when aligned, can encourage, enhance, capture, and amplify individual learning, thereby creating an organizational learning system" (Kozlowski *et al* 2009: 10).

In their research the authors (*ibid*) were focused on organizational learning as informal, emergent processes of individual and team learning.

Many researchers, who have tried to build a learning organization model, have reached different results: both in the number of factors (three to five) and in the factors themselves.

Peter Senge's model of five components or disciplines (1990, 2006) has become a classic

among academics and organization managers. It includes:

- 1) Personal mastery
- 2) Mental models
- 3) Team learning
- 4) Building shared vision
- 5) Systems thinking

Personal mastery is an approach that is based on competence, skills and the spiritual unfolding that goes beyond them. It is a continual learning process. Employees with a high level of personal mastery are aware of their ignorance and incompetence, but they remain self-confident and view every situation in which they are not professional as a growth opportunity.

Hypothesis 1: In the development center, personal mastery is positively associated with team learning.

Managing mental models is essential for a company to bring about change. Mental models are everyone's internal images of how the world works; images that can limit people to familiar ways of thinking and acting. Companies should help employees to surface, test and improve their mental models.

A shared vision is a one that many people are truly committed to, because it reflects their personal vision. When people actually share a vision, they are connected by a common aspiration. In companies, managers should explain their company's vision in a way that every employee will have a real desire to achieve it.

Hypothesis 2: In the development center, shared vision is positively associated with team learning.

Team learning is the process of developing the capacity of a team to create the results they truly desire. It is based on both shared vision and personal mastery, because the team should know the direction they are they all put their effort to, and without personal development, team development is impossible. But shared vision and personal mastery are

not enough. Team learning is the discipline that involves dialogue and discussion within teams in order to increase their knowledge sharing.

System thinking, according to Senge (1990), is a fifth discipline that unites the four others to make a learning organization.

Uuno Puus *et al* (Puus 2009) has studied the learning environment in the software industry at enterprises in Estonia. Using questionnaire and factor analysis, he developed a five factor model that is different from Senge's five disciplines model. Puus' five factors are:

- 1) "Values of work/activities". This factor is somewhat similar to Senge's "Systems thinking" and explains the project team's attitude toward the activities in the project;
- 2) "Commitment". This is closest to Senge's "Shared vision". However, Uuno Puus notes that this factor explains the team members' commitment to achieving the project goals;
- 3) "Customer orientation". This factor describes the importance of customer opinion and stakeholder interest in the project development process. While this factor does not directly correspond to Senge's model, it may be considered as a part of the "Mental model" discipline;
- 4) "Team development" fully corresponds to Senge's "Team learning" factor and shows to what extent teams are ready to discuss issues in a useful way in an open, friendly atmosphere;
- 5) "Desire for personal mastery" factor shows to what extent team members lack self confidence and how much they desire to improve their skills. This is closest to Senge's discipline: "Personal mastery".

Tõnis Mets and Made Torokoff (2007: 142) state that organizational learning originates from a company's internal and external environment, business processes, resources, etc. In their study (*ibid*), the researchers consider that new knowledge creation and learning in and by an organization and its members is realized through the interaction of:

- 1) individual and joint learning in different ways, sometimes through training by organization members;
- 2) mental systems, including joint language, shared values, shared patterns, mental

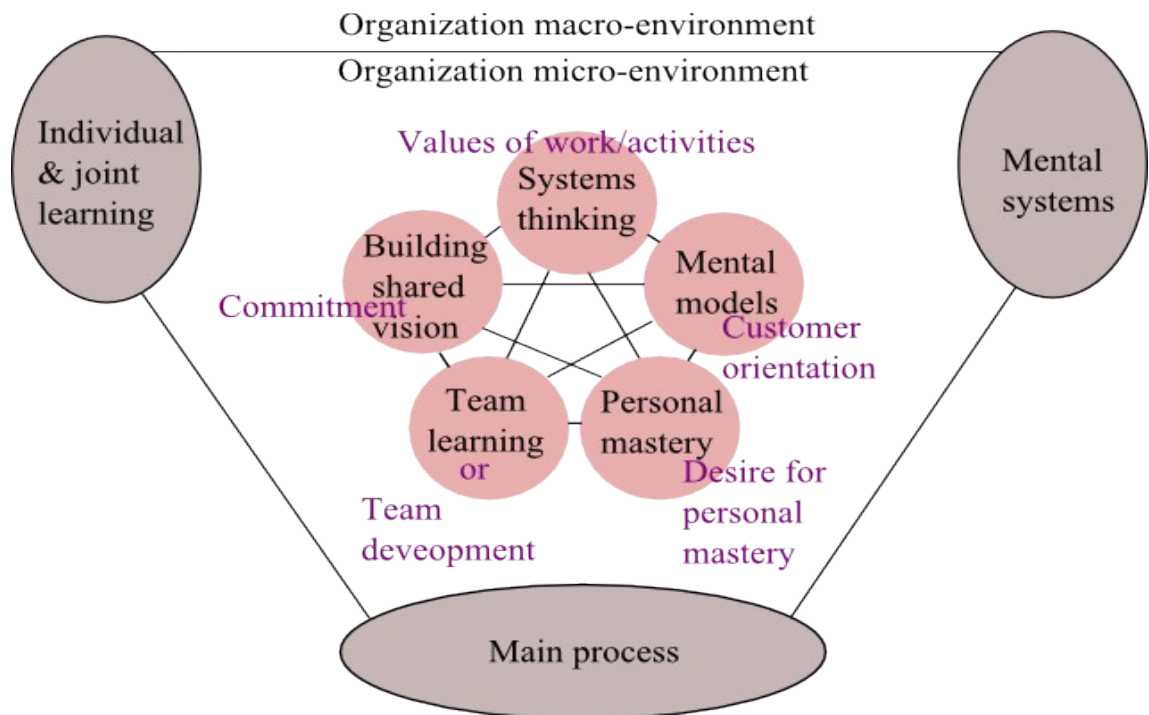
models, cognitive maps, formed or created by and among organizational members; and

- 3) the main processes, usually related to the business process in the interaction of the company and the client, and their environment in a wider sense.

Altogether these describe the three dimensional organizational learning framework (OLF) that Mets introduced in his previous work (Mets 2002).

In their work Mets and Torokoff (2002, 2007) compare OLF to Peter Senge’s five discipline model and suggest that Senge’s model is specific to organizations that are more intelligent and more knowledge-business oriented than those that they have studied. Since the case study in this thesis investigates the learning processes at a world leading SD company, it was decided to rely primarily on Peter Senge’s model.

In the Figure 2, the Mets model is shown in gray, the Senge model in pink, and the Puus model of learning organizations is shown in purple.



**Figure 2.** Relationship between Senge (1990), Mets (2002) and Puus (2009) models (Mets 2007: 110, with author additions)

Despite the fact that Uuno Puus' five factor model has been tested at SD companies, in the academic literature Peter Senge's model has been widely used. In addition, Mets and Torokoff (*ibid*) recommend using Senge's model for studying intelligent companies, so the case study uses Senge as one of its main sources.

In SD companies employees have a very high level of personal development which should be transferred to organizational learning through team learning. Since team learning may support team performance and is one of the influencing factors to organizational learning, it was chosen to be the object of this study.

## **1.2 Team learning, its operational methods and team performance measurement methods in Software Development companies**

Two important characteristics of teams are boundedness and stability of membership (Wageman *et al* 2005). Real teams have clear boundaries that distinguish team members from nonmembers. They also have at least moderate stability in their membership, giving team members the time and opportunity to learn how to work together effectively.

According to Entekin and Court (2001), there are two main advantages to working in teams. First, teamwork has the capacity to empower people to use their abilities, which is relevant to motivation. Second, working in teams allows managers to focus their attention on strategic issues, rather than supervising each individual separately.

In his book "Fifth discipline" Peter Senge (2006: 217) describes successful team work as a summary of personal powers aligned into one direction. He states that in most teams, the energies of individual members work at cross purposes and the team wastes its energy. Individuals may work hard, but their effort is not efficiently translated to the team effort. There are many practical cases where individual team members have a high IQ, but the team IQ is very low. This happens when people don't share their knowledge, experience, findings, and mistakes.

As team members interact with each other, the knowledge and skills of each team member can be transferred to the other team members, improving the efficiency and effectiveness of

the team's collective learning process (Ellis *et al* 2003).

The positive effect of team learning on team performance has also been reported by other researchers including: Flood *et al* (2001), Edmondson (1996, 1999), van Woerkom (2009), and Chan(2003). Other academics have investigated different aspects of team learning and its effect on performance.

Marianne van Woerkom (2009) was the first to investigate how different team learning activities relate to different types of team performance, as rated by team members and managers. She found that stable teams outperform other teams in terms of effectiveness and efficiency. Team members need time to develop productive relationships, resulting in more effectiveness and efficiency.

In her paper, van Woerkom (2009) distinguishes three types of the team learning activities:

- 1) information acquisition;
- 2) information processing; and
- 3) information storage and retrieval.

According to Argote (1999), group learning involves the processes through which members share, generate, evaluate, and combine knowledge. Christopher Chan (2003) concluded that knowledge sharing across teams has great potential for improving performance. The use of reflective learning, where team members reflect on their work processes, also has big potential for improving team performance.

In the context of individual and team learning, Guns (1995) identifies nine types of learning in the learning organization:

- 1) technical/task learning;
- 2) systemic learning;
- 3) cultural learning;
- 4) group/team development learning;
- 5) leadership/management learning;
- 6) business learning;
- 7) strategic learning;

- 8) reflective learning; and
- 9) transformational learning.

DeShon *et al* (2004) state that team learning is fundamentally rooted in individual cognition, motivation, and behavior, but shaped and deepened by interaction over time to appear at the collective level. In other words, trying to treat team learning as a solely collective concept is not meaningful, because such an approach neglects the underpinnings of the process. Thus, according to the authors, it is necessary to understand team learning as a process covering multiple levels.

Amy Edmondson (1996, 1999) has investigated whether team learning correlates positively with team performance. She used two different models:

In her first study (Edmondson 1996), two constructs were used to study team learning-oriented behavior and its influence on team performance: internal learning (within the team) and external learning (outside of the team). Edmondson defined internal learning as “the extent to which team members engage in behaviors to monitor performance against goals, obtain new information, test assumptions, and create new possibilities.” (*ibid*: 164). External learning was described as “an assessment by several of the team’s customers and/or managers about the extent to which the team engages in behaviors such as seeking new information or asking those who receive or use its work for feedback”. In this research, Edmondson introduced the Team Learning Survey which has been used by other academics (for example, Christopher Chan *et al* 2003).

In 1999, Edmondson used a different model to study team learning. She tested the following components: supportiveness of the organization context, task design, clear direction, team composition, team efficacy, team psychological safety, team leader coaching, team learning behavior, team performance, and internal motivation. (Edmondson 1999).

Team psychological safety is defined as the tacit belief that the team is safe from interpersonal risk. This term suggests neither a careless sense of permissiveness nor an unrelentingly positive affect, but rather a sense of confidence that the team will not



embarrass, reject, or punish someone for speaking up (*ibid*).

The literature also indicates that team member diversity and the use of managerial reviews have a direct impact on team learning (Wang *et al* 2006).

Taking into account all of the above and the unique case of the development center in Mexico, two additional hypotheses are proposed:

Hypothesis 3: Learning behavior in teams is positively associated with team performance.

Hypothesis 4: Team psychological safety is positively associated with learning behavior in organizational work teams.

Both Senge and Edmondson have studied group learning. However, while Edmondson described the factors that influence team learning, Senge has identified the disciplines that influence organizational learning, one of which is team learning. Since shared vision can occur at any group level it can be used as organization level factor as well as team level factor. Also personal mastery can enrich both team learning and organizational learning.

One of the principal questions for this thesis is whether Senge's organization learning factors, like shared vision and personal mastery, also influence team learning. To address this question, it is necessary to look at the correspondence between Senge and Edmondson factors (Table 1).

**Table 1.** Correspondence between Senge and Edmondson theories

<b>Edmondson component</b>	<b>Senge dimension</b>
Task design	Shared vision
Clear direction	Shared vision
Team efficacy	Shared vision
Internal motivation	Personal mastery
Job involvement	Personal mastery

Source: compiled by the author

Senge's Shared Vision factor relates to three factors in Edmondson's (1999) theory: Task Design, Clear Direction, and Team Efficacy. Senge (2006) states that when people share a vision, they are connected by a common aspiration, and managers should explain their company's or team's vision in a way that every employee will have a real desire to achieve it. In the Task Design factor, Edmondson (1999) considers whether the team feels that its work makes a difference to its clients and whether they know what their customers think about the team's output (product). In the Clear Direction factor, the researcher aims to determine whether all team members understand what the team is supposed to accomplish and the team objectives. Edmondson uses the Team Efficacy factor to test to what extent the team members believe that they can achieve all of the goals set by their manager.

Personal mastery, as described by Senge, includes skills and competence, and the spiritual unfolding that goes beyond them. In addition, it includes the employee's motivation to participate in a continual learning process and to become a better performer. In Edmondson's factor, Internal Motivation, she learns the importance to employees of self-development and performance improvement. In the Job Involvement factor, she concentrates on the significance of the job to the employee's life.

With respect to operational methods, George Huber (1996: 827) gives some advice on how organizations can become better as learning organizations. His first advice is to learn from experience: systematically capture, store, process, and distribute relevant experience gathered from projects (for example, through postmortem reviews). His second advice is to use computer-based organizational memory to capture knowledge obtained from experts and share it with everyone in the organization.

Most companies that develop software manage their work in projects, or, if they develop the product, they manage it in releases. Some development processes may take only a few weeks, while long-term projects may take up to five years. But there is always a point when the development process has completed an iteration. It is very useful to share the knowledge and experience obtained from each iteration within the team and to introduce it to the entire organization. One common method for transferring knowledge from one

person to others is called "postmortem review". It is also called "project retrospectives", "postmortem analysis", "project analysis review", "post-project review", "quality improvement review", "lessons learned", etc. Torgeir Dingsoyr (2004: 295) describes postmortem review as a collective learning activity which can be easily organized for projects, either when they end a phase or are terminated. The primary goal of the review is to reflect on what happened in the project, to describe what errors were made and how to avoid them in the future, and to consider what lessons were learned, and how to use the received knowledge in subsequent projects. The physical output of these meetings is a postmortem report.

According to Peter Senge (2006), there are two primary types of knowledge transfer within a team: dialogue and discussion. Both are important for team learning development, but their real power is in their synergy.

The word "dialog" comes from Greek where "dia" (through) and "logos" (word, thought, meaning), which means that dialog is a stream of ideas that flows from one person to another. In a dialog people access more ideas that can be accessed individually. Senge (*ibid*) states that the purpose of dialogue is to go beyond any one individual's understanding.

Discussion is the necessary counterpart of a dialogue. During discussion different views and opinions are presented and defended. The outcome of a discussion is making a decision.

Since one of outputs of team learning is team performance, **performance measurement methods** should be described. Measurement methods are needed to evaluate performance improvement or decline, or to compare results for different teams or periods. In some fields, performance may be expressed in pieces done per hour, in hours completed by one person, etc. In SD companies it can be difficult to measure individual, team, or project performance; nonetheless it is very important.

Rini van Solingen and Egon Berghout (2001: 247) have studied different performance measurement methods in SD companies and concluded that measuring results can:

- 1) increase understanding of software development processes;
- 2) increase control of the software development process;
- 3) increase capacity to improve the software development process;
- 4) improve accuracy of estimates for software project costs and schedules;
- 5) provide more objective evaluations of the effect of changes in techniques, tools, or methods;
- 6) provide more accurate estimates of the effects of changes on project cost and schedule;
- 7) decrease development costs due to increased productivity and efficiency;
- 8) decrease project cycle time due to increased productivity and efficiency;
- 9) improve customer satisfaction and confidence due to higher product quality.

However, it is complicated to get objective numerical results that are not based on the opinions of team members, complexity of the code used to develop the product, etc. Rini van Solingen and Egon Berghout (*ibid*) support the idea that, while successful software measurement is possible, it is very difficult and is mostly used for cost/benefit analysis.

There are few business models of SD companies and two of them will be reviewed in this paper. In the first business model, Time and Materials, companies have clients who order a custom software development and pay on a time and materials basis. In this model, a cost/benefit analysis is essential. Development team representatives and the client meet to discuss the scope of the project and estimate how many resources will be required. Traditionally, SD companies use a 20% buffer to account for inaccuracies in this process. But, if for any reason, it is impossible to meet the client's expectations on time, the SD team may work without payment (which means their effort will cost less), negotiate with the client for additional payment (which may affect the client's future trust), or even pay a penalty.

In the other model of SD companies, people work on proprietary products/projects which are then sold to one/many clients. In this case, is very difficult to predict how much the product will earn, because if it becomes successful the company can cover expenditures, and teams will work to improve the product, adding new features etc. Sometimes, if there

are large clients who want to adapt the product to their own requirements, there may be additional revenue or the modifications might be done “for free”, if the customer has already bought many copies of the product and SD organization wants to keep the client satisfied.

### **1.3 Matrix organization**

According to Edmondson (1999) organization and team structure explain most of the variance in team effectiveness.

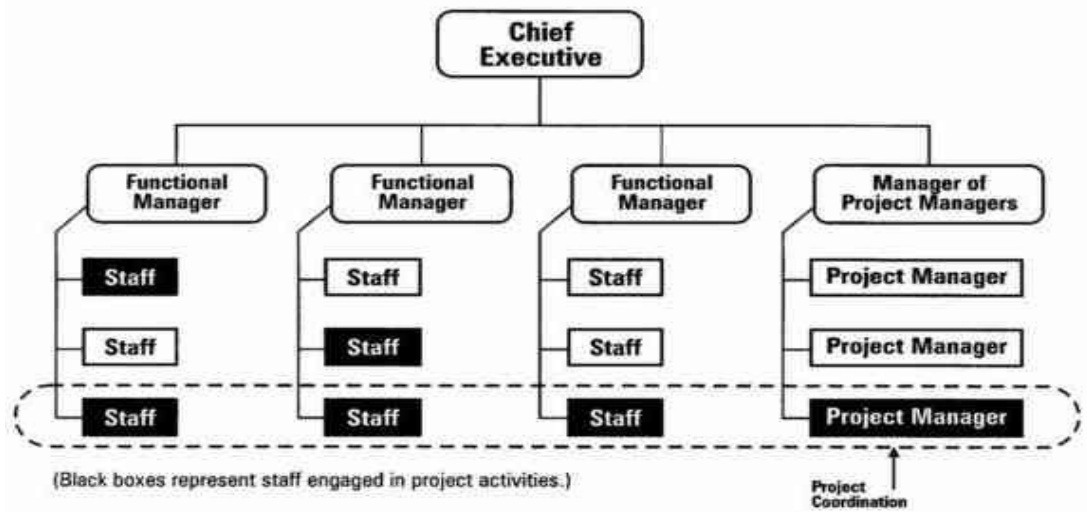
An organization can be structured in different ways, depending on its objectives. Organizational structure defines which individuals will participate in which decision-making processes and who will be their managers and peers.

According to W.D. Hendry (1993) matrix organizations have the following features:

- 1) There is dual authority: each employee reports to two different managers, and each divisional manager shares the responsibility for supervising the work of his staff with the relevant project manager.
- 2) A team of specialists from the same functional divisions may be formed to work in cooperation on a specific project.

Kenneth Knight (1976: 113) has defined matrix organization as a “mixed organizational form in which the normal vertical hierarchy is overlaid by some form of lateral authority, influence, or communication”. Thus a matrix organization contains roles which are subject to dual influence, and it emphasizes coordination through lateral relationships which cross departmental boundaries.

Figure 3 shows that each member of the team has a functional manager and colleagues as well as a project manager and colleagues.



**Figure 3.** Matrix structured organization scheme (Matrix organization and project management: 16.04.2012)

Companies may apply matrix structure in a variety of different ways. Some organizations use a matrix only for specific projects, while others use it permanently. Researchers define **three types of matrix organizations** that differ from each other according to whose role is more important: the project manager or functional manager.

According to Larson *et al* (1987), the three types of matrix organizations form a continuum, from an organization with only functional managers on one extreme to organizations with only project managers at the other extreme. In between are the true matrix organizations which have both functional and project managers. A functional matrix exists when the project manager's role is limited to coordinating the efforts of the functional group. Functional managers are responsible for the design and completion of requirements (Sy 2005). In contrast, in a project matrix, the project manager has more power and responsibility in achieving goals, while the functional manager's involvement is limited to providing services and advisory support to personnel. Finally, the third type is a balanced matrix, where the project manager defines what needs to be accomplished and the functional manager establishes the overall plan of how it will be accomplished. In this case, employees are officially members of two organizing dimensions (*ibid*). The functional manager is responsible for assigning project tasks according to the standards and schedules

that were set by project manager.

Larson *et al* (1987) states that when a matrix organization lies between functional and project organization, it is more flexible than first, but not as flexible as pure project organization. At the same time, it is more efficient than a project team, but has additional administrative cost that are unnecessary in functional teams.

Among the strengths of matrix organizations, authors single out better distribution of resources (both human and physical), improved motivation and commitment through shared decision making process etc. Weaknesses include conflicts caused by employees not understanding how authority is distributed and who to report to. Table 2 provides a more detailed list of the **strengths and weaknesses** of a matrix structure.

**Table 2.** Strengths and weaknesses of matrix organizations according to various researchers

Author/ parameter	Strengths	Weaknesses
<b>Sy <i>et al</i> (2005)</b>	<ul style="list-style-type: none"> <li>• Leverages functional economies of scale while remaining small and task-focused;</li> <li>• Focuses employees on multiple business goals;</li> <li>• Facilitates innovative solutions to complex, technical problems;</li> <li>• Improves employees' companywide focus through increased responsibility and decision-making;</li> <li>• Allows for quick and easy transfer of resources;</li> <li>• Increases information flow through the creation of lateral communication channels;</li> <li>• Enhances personal communication skills</li> </ul>	<ul style="list-style-type: none"> <li>• Violates the principle that authority should equal responsibility;</li> <li>• Violates the principle that every subordinate should report to a single boss;               <ul style="list-style-type: none"> <li>• Can create ambiguity and conflict;</li> <li>• Increases costs resulting from the need for additional management and administration;</li> <li>• Increases the likelihood of resistance to change as employees may attribute the matrix with loss of status, authority, and control over traditional domains</li> </ul> </li> </ul>
<b>Larson <i>et al</i> (1987)</b>	<ul style="list-style-type: none"> <li>• Efficient use of resources – specialists and equipment can be shared across projects;</li> </ul>	<ul style="list-style-type: none"> <li>• Power struggles – conflict occurs since authority and responsibilities overlap;</li> </ul>

	<ul style="list-style-type: none"> <li>• Project integration – clear mechanisms for coordinating work across functional lines;</li> <li>• Improved information flow – communication is enhanced both laterally and vertically;</li> <li>• Flexibility – contact between departments expedites decision making and adaptive responses;</li> <li>• Discipline retention – functional experts and specialists are kept together even when projects come and go;</li> <li>• Improved motivation and commitment –increased by involving team members in decision making</li> </ul>	<ul style="list-style-type: none"> <li>• Heightened conflict – competition over resources occurs when personnel are shared across projects;</li> <li>• Slow reaction time – shared decision making;</li> <li>• Difficulty in monitoring and controlling – multidiscipline involvement heightens information demands and makes it difficult to evaluate responsibility;</li> <li>• Excessive overhead – management duplication between project and functional manager;</li> <li>• Stress – dual reporting relationship contributes to ambiguity and role conflict</li> </ul>
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Source: Sy *et al* (2005), Larson *et al* (1987), compiled by the author

As three different types of matrix organization were described, it is necessary to reveal advantages and disadvantages each of them.

**Table 3.** Comparative strengths of three types of matrix structure

<b>Strengths (advantages)</b>	<b>Functional matrix</b>	<b>Balanced matrix</b>	<b>Project matrix</b>
Resource efficiency	High	High	High
Project integration	Weak	Moderate	Strong
Improved information flow	High	Moderate	Low
Flexibility	Moderate	High	Moderate
Discipline retention	Moderate	High	Moderate
Improved motivation and commitment	Uncertain	Uncertain	Uncertain

Source: Larson *et al* (1987:131)

Table 3 shows that all types of matrix organizations have a high level of resource efficiency. However, depending on the type, project integration and improved information flow can be dramatically different. Project integration is strongest in a project matrix, and information



flow is highest in a functional matrix. Flexibility and discipline retention is highest in a balanced matrix, while in both project and functional matrices, these advantages are moderate. With regard to improved motivation and commitment, it is not clear to what extent they are affected by matrix type.

**Table 4.** Comparative weaknesses of three types of matrix structure

<b>Weaknesses (disadvantages)</b>	<b>Functional matrix</b>	<b>Balanced matrix</b>	<b>Project matrix</b>
Power struggles	Moderate	High	Moderate
Heightened conflict	Low	Moderate	Moderate
Slow reaction time	Moderate	Slow	Fast
Difficulty in monitoring and controlling	Moderate	High	Low
Excessive overhead	Moderate	High	High
Experienced stress	Moderate	High	Moderate

Source: Larson *et al* (1987:131)

Table 4 shows that power struggles are moderate in project and functional matrices, and high in a balanced matrix. This can be easily explained, since in a balanced matrix both functional and project managers have the same level of power and conflicts may arise. Conflict for resources is low in a functional matrix and moderate for balanced and project matrices. Reaction time is slowest for a balanced matrix, since both functional and project managers have the same authority to make decisions and need to reach consensus. Reaction time is moderate for a functional matrix and fast in a project matrix. Difficulty in monitoring and controlling is high for a balanced matrix, moderate for a functional matrix, and low for a project matrix. The explanation is the same as for reaction time. Since in a project matrix the project manager establishes tasks and allocates resources, for him or her it is faster to control resources and make changes. In a balanced matrix, monitoring and controlling can be most difficult since the roles of the functional and project managers may not be clear or each manager wishes exert control over the team. With respect to excessive overhead, all three forms of matrix increase administrative cost. However in balanced and project matrices, overhead will be higher, due to the greater role of project management.

Stress is highest in a balanced matrix, because employees don't know when exactly to report to each manager, and sometimes it can take time to report to both. Both functional and project matrices are likely to reduce stress, since lines of authority are more clearly defined.

After analyzing responses to a questionnaire from 510 top and mid level managers from different industries, Larson *et al* (1987) concluded that the project matrix was the most effective of the three matrix organization types.

With respect to the **challenges** of managing matrix organizations, researchers focus on similar issues.

According to Oertig *et al* (2006) in some matrix organizations there can be a tendency for project team members to listen more to their functional manager than their project team leader, because very often the project manager is in a different location or country. The challenge is to make it clear who employees should report to and whose opinion or decision has higher priority. The other challenge in a matrix organization is the conflict that results from different interests. The project manager wants the project be done on time and the functional manager wants to get the best people on his project or assign them additional tasks that are outside of the specific project.

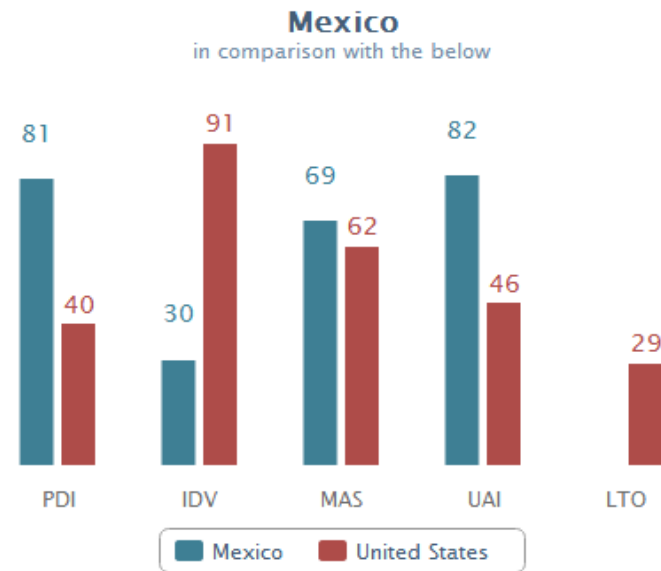
Gill Corkindale (2008) gives recommendations for people leading and working in matrix organizations. She suggests that leaders should: insure that the culture is supportive of employees, communicate effectively, establish clear goals and objectives, empower teams to make decisions and resolve conflicts at an appropriate level, and use their expertise and personal networks to influence those over whom the leader doesn't have formal authority. For employees she recommends: again communicate clearly and effectively, recognize who is making demands on their time and attention, determine how much time and effort each task requires, improve their skills in managing priorities, and keep both managers constantly informed about job progress. In summary, effective communication is the critical factor for success in matrix organizations.

## 1.4 Cultural background

Geert Hofstede, the creator of the cultural dimensions theory, defined culture as “a collective programming of the mind that distinguishes the members of one group or category of humans from another” (Hofstede 1980: 16). This collective programming defines each person’s intellectual and emotional reaction to the symbols used in their life. Culture also includes sets of values, what a person likes and or dislikes, what he can understand in other cultures, and what seems to him as “wrong”. Hofstede states that collective differences in mental programming come from different social classes, religions, occupations, generations, sexes, geographic regions, and nations (*ibid*). Differences also exist between people from different organizations, and this supports the concept of organizational cultures. Since in the development center the majority employees are men with similar occupations who belong to the same social class and religion is not discussed at work, it may be concluded that there are two main factors that influence employees' behavior. These are: local national culture and organizational culture.

To understand differences in national culture, Hofstede’s theory of cultural dimensions was used. He developed five dimensions and a scale, which show whether a country has high or low masculinity, high collectivism or individualism, high or low power distance, high or low avoidance index, and long or short term orientation. Since the last two dimensions describe similar characteristics, he recommends using the avoidance index for Occidental countries and the long/short term orientation index for Oriental countries.

To determine a reliable index for each country, Geert Hofstede surveyed many countries, and made cross-country comparisons. In this age of globalization, these five dimensions have been used extensively by managers to understand the differences between workforces in different environments. Let’s look at Mexican culture (as a case study organization is located in Mexico) using the four cultural dimensions for Occidental countries. Since Mexican teams work closely with US (where headquarter is located) teams, it was decided to present the United States index together with the Mexico index, to illustrate where there are large differences and how organizational culture can mitigate them.



**Figure 4.** Four cultural dimension index for Mexican culture in comparison with United States index. (Geert Hofstede: countries, web site)

The high power distance PDI (81) index shows that Mexico is a hierarchical society. This means that most people accept a hierarchical order in which everybody has a place and which needs no further justification (*ibid*). It means there are very official relationships between managers and subordinates, so it is difficult for employees to talk about problems and mistakes with their manager or ask for advice. According to Peter Senge, team learning requires the manager's participation in team activities, and according to Amy Edmondson, team learning improvements depend on the psychological climate in the team.

With a low individualism index IDV (30), Mexico is considered to be a collectivistic society. This leads to a close, long-term commitment to the member 'group', be that a family, extended family, or extended relationships (*ibid*). Achieving goals is not as important as the relationships at work with colleagues. In this situation, people try not to notice other co-workers' mistakes or weaknesses and can be reluctant to share opinions if they are unhappy with their job position, manager, or work conditions. However, team learning requires sharing opinions and analyzing mistakes, so high collectivism doesn't support team learning. This can be even more difficult in a matrix structure organization, because Mexican employees are members of two teams: the local team in Mexico and the

project team world-wide. The employee may wish to maintain good relationships with both sides, even in situations where the sides' interests conflict. This case study will show how the organizational culture in the development center smoothes these internal conflicts and provides the atmosphere needed for successful team learning.

In Mexico, the masculinity index MAS is high (69), but it is almost as high in the USA (62). Hofstede states that a high score in masculinity indicates that the society will be driven by competition, achievement, and success. Being a winner or best in the field is a value that people learn from school. In masculine countries, people “live in order to work” (*ibid*), managers are expected to be decisive and assertive, the emphasis is on equity, competition and performance, and conflicts are resolved by fighting them out. The achievement orientation that drives masculine society can be a positive factor for team performance, but competition correlates negatively with team learning principles. To provide a good team learning environment, negative comments about other people's mistakes need to be eliminated and people need to be willing to share their achievements, new findings and ideas. However, if a competitive person on a team wants maintain his advantage, he may choose to hide his explicit knowledge.

A high uncertainty avoidance index, UAI, (82) shows to what extent people are open to new things. Mexican culture shows a very high preference for avoiding uncertainty. According to Hofstede, countries with high uncertainty avoidance index have an emotional need for rules (even if the rules never seem to work), innovation may be resisted, and security is an important element in individual motivation. This indicates that Mexican culture doesn't encourage people to be open to new ideas introduced in the media, to try new methods at work, or to be open to all ideas during brainstorm – all of which can improve team learning opportunities.

Dr. Rajagopal and Ananya Rajagopal, who have done research in Mexico for many years, have compared the behavior of employees in Mexico to other nations (USA, Japan, China, and other Latin America countries). In their analysis (Rajagopal 2006) of the differences between Mexican and US employees, they found that US team members feel more

comfortable in a group environment which is organized in a formal manner, and that team members feel that a relaxed environment weakens both individual and group performance. In contrast, they found that Mexican employees feel more comfortable in an informal and relaxed group environment.

The tolerance limit for any uncertainty in teamwork (*ibid*) is very small for the Americans who are working on a team, while Mexican employees can better tolerate the teamwork ambiguities that may negatively affect teamwork.

With regard to the trust inside the team, when taking decisions (*ibid*), Americans trust the members of the team, while Mexicans rely more on facts and precedents instead of trusting their co-workers.

Leandra Celaya and Jonathan S.Swift (Celaya, Swift 2006) have worked with US managers who were heading to work in Mexico. After asking ten questions that included Spanish language level, understanding of cultural differences, and previous experience in communicating with Mexicans, they found that of managers were ready only in 34.1% to work in Mexico. They recommended that US companies who plan to start or expand business in Mexico take the following steps (*ibid*):

- 1) use training programs that include sessions with experienced expatriates;
- 2) organize field trips. Celaya and Swift consider this to be a key element for US managers preparing to work in Mexico;
- 3) place greater emphasis on the cross-cultural skills of expatriates both in terms of their initial selection and their subsequent training;
- 4) devote significant time to preparations (long-term training programs rather than a 3-days course on cultural differences);
- 5) organize training programs not in a time-limited, task-specific way, but set a goal to educate the whole person (known as a gestalt approach).

Despite the fact that traditional Mexican organizational culture doesn't support organizational learning, researchers have found that previous experience can be a challenge for every company. Sethi (2000) has concluded that the most effective way of overriding

the adverse influence of individuals' previous group identities is to build a strong sense of superordinate identity through organizational culture.

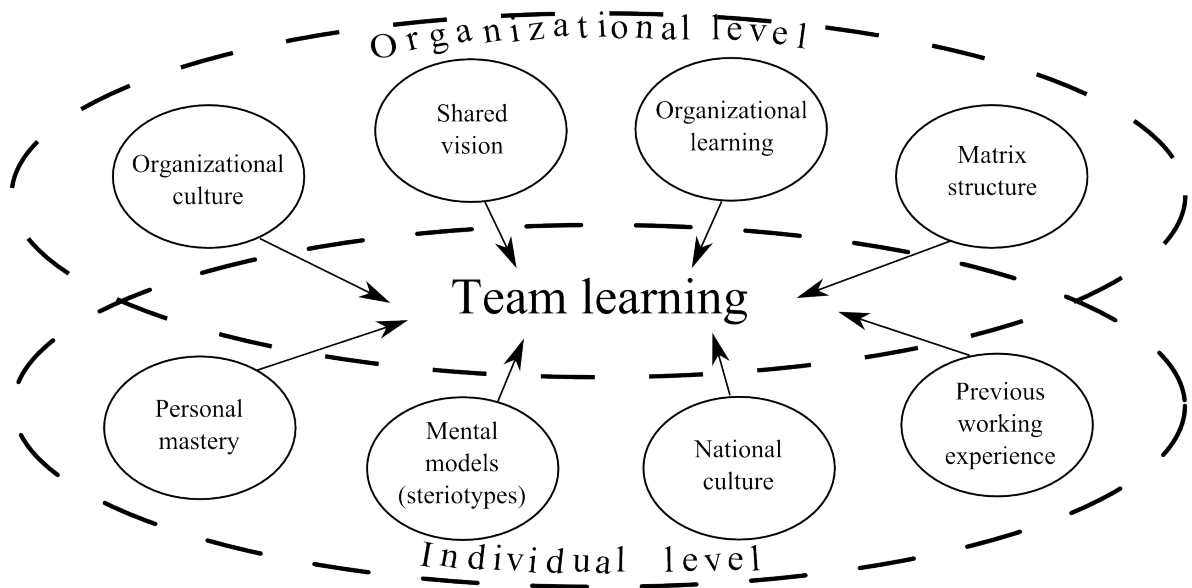
Based on the Mexican culture factors described above and the conclusion that organizations should smooth cultural differences, the next hypothesis was suggested:

H5: Employees who are new graduates are more open to team learning activities and experiments.

Hofstede analysis on Mexican culture suggests that people straight from the university will not be influenced by Mexican organizational culture and will feel more comfortable in sharing knowledge, talking about mistakes, and learning from others.

With hypothesis 5, we will find out which factor has stronger influence: traditional Mexican organizational culture or the organizational culture in the development center.

After reviewing the work of organizational and team learning researchers, the generalized model of factors that influence team learning was created.



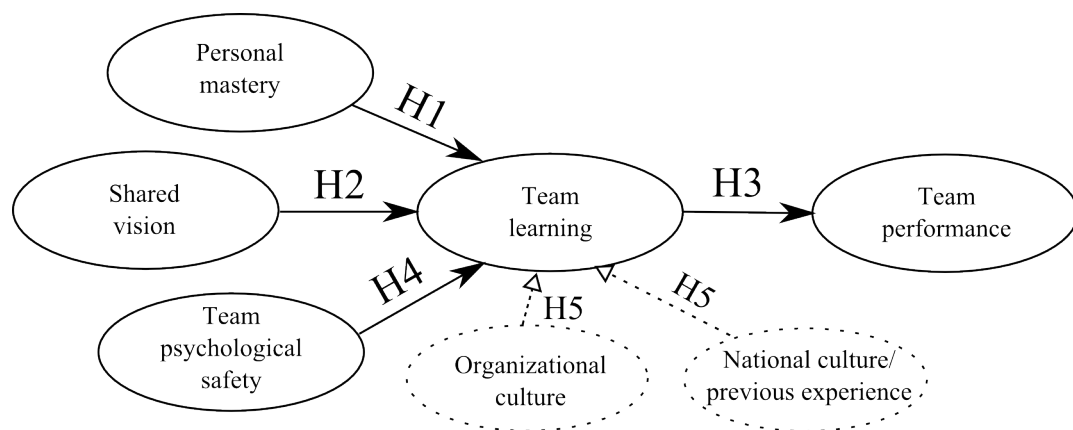
**Figure 5.** Generalized model of factors that influence team learning (composed by author)

Figure 5 illustrates that team learning occurs at the intersection of the organizational and

individual levels. As was mentioned previously, learning can occur on three levels: individual, group (team) and organizational (Nonaka 1994). According to Kozlowski *et al* (2009), team learning is an area at the juncture of the individual and the organizational levels. However, not only personal mastery and activities supporting organizational learning may influence learning process in the teams. The organizational and national culture may influence team learning, and one factor can be a stronger influence on people's behavior. Mental models and previous working experience can also influence the level of comfort employees have for participating in team learning activities. The existence of a shared vision in the company gives (or doesn't give) motivation in achieving common goals which, in turn, affects the extent of team learning.

Additionally, there are internal factors in the team that influence team learning: task design, team psychological safety, leader coaching, and team composition, *etc.* described by Edmondson (1999).

Thus, the research model was created. It is a generalized model of factors that influence team learning that were considered in this work, supported by the theories of Senge, Edmondson, Hofstede, and others.



**Figure 6.** Research model (generalized by author)

The goal for hypotheses 1 to 4 is to find correlation coefficients. The goal for hypothesis 5 is to determine which of the two factors has more influence on team learning in the development center. The results are presented at the end of the third chapter.



## **CHAPTER 2. CASE-STUDY RESEARCH METHODOLOGY AND DATA**

### **2.1 Research methodology and sample**

Since the author has had a unique opportunity to observe directly the learning processes in the development center and for objective reasons it was not possible to get enough data for good statistical analysis, case study was chosen as the research methodology for this paper. All the research conditions for a case-study (a good understanding of phenomenon, sensitivity for novel and unexpected issues in data collection, ability to ask good questions, good listening skills, and flexibility in the data collection process (Yin 1994)) have been met.

According to Yin (*ibid*), case studies are considered to be a research strategy, rather than a method for data collection.

This case study is a single-case study because there was a unique situation in which the company, one of the world leaders in SD, opened a development center in Mexico two years ago and now employs 270 talented and motivated specialists. It is interesting to determine whether such a large new organization can successfully create a team learning environment in a country with a cultural background that is much different than the US. In other words, the work was concentrated on the team learning processes and its influence on team performance in one specific company. Both quantitative and qualitative methods were used: interviews with managers, a questionnaire, and participant observations.

The principal questions addressed by this study are: 1) How has a matrix-structured two-year old organization been able to achieve a high level of team learning?; 2) How does a matrix management structure affect team learning: does it support or hinder it?; 3) Do

Senge's organization learning factors such as shared vision and personal mastery influence team learning as well? and, 4) What team learning practices are used at the development center and how quickly do these practices bring about improvements?

Given the difficulty of performance measurement in SD teams and the need to make a comprehensive study, Amy Edmondson's (1999) approach of questioning the employees and their managers about team learning and team performance was used. This was accomplished by conducting a survey among the employees, interviewing their managers, and then comparing the results.

Members of software development teams are considered to be knowledge workers. (Drucker, 1993) characterized knowledge workers as individuals with high IQ, education, and special set of skills, with the ability to apply these skills and knowledge to identify and solve problems.

By April, 2012 the development center employed 270 employees, including human resources, managers, customer support representatives, programmer analysts, IT consultants, software developers, testing engineers, documentation writers, product managers, etc. To make the case study more homogeneous and following the advice of the development center director, only employees who participated in product development were chosen. The aforementioned group's team learning abilities underpin the success of the center. This decision led to the first narrowing of the sample.

At this point the prospective sample included 178 people.

Since this research is focused on teams, the definition of "team" was established that would be used for this study. The definition taken is from Henrick Kock (2007: 462 - 463) who defined a team as a group of people with the following characteristics:

- 1) a permanent group with a limited number of members;
- 2) the team as a collective has responsibility for work tasks and active co-operation within the team;
- 3) the team has the responsibility and authorization for planning, executing and

evaluating the results of the team's work;

- 4) the team works towards objectives set at the team level and the members participate in the formulation of team objectives; and
- 5) the team works to support the exchange and dissemination of experience and competence, both within and between teams.

Next, three criteria were used to determine the final sample of employees who would be invited to answer the questionnaire:

- 1) the team should conform to the definition above and also have more than 2 Mexican members;
- 2) the team should have two managers: a US project manager and a Mexican line manager, so that the team falls under the matrix structure organization;
- 3) the Mexican line manager should allow his team members to participate in the questionnaire and agree to have an interview with researcher. This enabled us to compare the employees' and managers' opinions on team learning and team performance.

Based on these criteria, the final sample consisted of 84 employees. Some of the excluded workers didn't have a Mexican manager, or they were managed only by a US project manager. Some of the workers couldn't participate in the survey, because their manager was not interested in the results of the study or refused to give an interview.

After conducting the survey, 64 answers were returned which is 76% of the sample (84). This was considered to be high return rate for SD employees. This was due to the support of both the managers and the director of the center, who believed that results of this study would help to improve the team learning processes in the development center.

## **2.2 Research data**

### **2.2.1 Questionnaire and interviews**

To map the features of learning organizations, **questionnaires** are most commonly used (Mets 2007: 143). Edmondson (1996, 1999) has offered two different questionnaires to study team learning and its influence to team performance. Since their first approach was

based on team internal and external learning which is complicated to define in a matrix organization it, it was decided to use the second approach. This questionnaire consisted of ten components with 1 to 7 questions for each component. After discussing the questionnaire with the development center director, a version which eliminated duplicate questions and customized the remaining questions to the realities of the development center was created. Duplicate questions are when the same question is included in different parts of questionnaire so that false responses can be identified. The second way to protect reliability of responses is to use questions with a reversed score. This eliminates the situation where the employee answers “Agree Strongly” to every answer, by giving the question has a negative context. For example: “If I make a mistake in our team, it is often held against me”. In this case, a minimum score represents a positive psychological atmosphere and a maximum score indicates problems on site. However, in the development center, the managers explained to their teams the importance of this research to the company, so the employees answered honestly. The author observed that responses were received 10-15 minutes after the questionnaire was started which guarantees that no one answered it without reading it carefully. The table below (Table 5) compares the number of questions for each component in the Edmondson questionnaire to the number in the questionnaire done for this study.

**Table 5.** Comparison of the number of questions in given research and Edmondson questionnaires

Component	Edmondson (1999)	Given study
Supportiveness of organization context	5	5
Task design	3	2
Clear direction	3	2
Team composition	3	2
Team efficacy	3	2
Team psychological safety	7	7
Team leader coaching	3	2
Team learning behavior	7	6

Team performance	5	4
Internal motivation	4	4
Total:	43	36

Source: compiled by the author.

With respect to the questions where the wording was changed, in all cases the substance of the factor was not affected. In all questions, the phrase “this team” was changed to “our team” to make it more natural for Mexican employees, since they have a high collectivism index. The question “I live, eat, and breathe my job” was considered to be overly dramatic, and it was changed to: “My job and my career opportunities in the company is the most important I have at this moment in my life.”

Each of 36 questions had six possible responses: “Disagree Very Strongly”, “Disagree Strongly”, “Disagree”, “Agree”, “Agree Strongly”, and “Agree Very Strongly”. The scale of six was chosen to eliminate the choice of a neutral answer.

In addition to the questionnaire described above, two questions (Table 6) were added to help understanding of how the matrix organization was perceived in the development center.

Table 6. Additional questions to the survey

When I think about my team, I imagine:	The Mexican part of the team
	People in the same position world-wide
	All people participating in the project, independently of co-worker position or location
When I say “my manager”, usually I am referring to:	My Mexican team manager
	My US project manager

Source: compiled by the author.

Since there were only six female employees among the 84 chosen for the study, it was difficult to include questions about gender and preserve confidentiality. However, to make it possible support or refute the hypotheses made in this study, two additional questions:

“The company is my first employer” with “Yes/No” options, and “My team is...” with the list of the teams whose managers agreed to participate in the research. In the analysis and appendix we changed the team names to “Team 1”, “Team 2” ... “Team n” were included .

The anonymous questionnaire was sent electronically to the chosen participants, using the company’s internal tool for conducting surveys. The author was present in the center in order to answer any questions that might occur while people were answering the questionnaire.

The complete questionnaire can be found in Appendix 1 .

A total of 5 **interviews** were carried out. The interviews were conducted on-site, on a confidential basis. Tapes and transcripts were at all times under the control of the researcher. Transcripts are presented in Appendix 2.

Each interviews had two parts. The first part had questions from Amy Edmondson's survey for managers (Edmondson 1999) and covered two topics – Team learning and Team performance. All of the interview questions had the same choice for responses as the employee questionnaire: “Disagree Very Strongly”, “Disagree Strongly”, “Disagree”, “Agree”, “Agree Strongly”, and “Agree Very Strongly”. Since the answers from employees about team learning and team performance were rated using the same scale as answers of managers, we can compare these results.

For the second part of the interviews, the author prepared open-ended questions to help support or refute the hypotheses.

Depending on the experience managers had before joining the development center, the questions asked were modified. People without work experience in a company in the US were not asked the questions related to comparing the US and Mexican environments.

The team learning questions sections consisted of seven questions. They were:

This team...

1. ... asks its US managers for feedback on its performance.

2. relies on outdated information or ideas.
3. actively reviews its own progress and performance.
4. does its work without stopping to consider all the information team members have.
5. regularly takes time to figure out ways to improve its work performance (without the manager).
6. ignores feedback from non-Mexican colleagues.
7. asks for help from others in the company/their managers when something comes up that team members don't know how to handle.

The team performance part had four questions:

1. This team meets or exceeds the US manager's expectations.
2. This team does superb work.
3. Critical quality errors occur frequently in this team's work.
4. This team keeps getting better and better.

The open-ended questions were divided into two groups: in the first it was asked managers about their teams:

1. What is the biggest difference that US managers have with this Mexican team?
2. What is the main motivation of the members of this team (money, great project, learning from colleagues etc)?
3. If one of your teams develops software faster, what is the reason in your opinion? (different experience, different motivation)
4. How often are performance reviews done and what changes do you see in team members' performance afterwards?

The second group of open-ended questions consisted of questions about the development center in general and cultural differences between the US and Mexico

1. In the development center context, is there a difference between the performance/motivation of the newly graduated employees and employees with a previous experience after they have worked for half a year?
2. What is the difference between interaction inside the team in US and in Mexico?

3. Do you practice knowledge sharing activities (brain storming on someone's problem, seminars when each one tells about discoveries/ideas that he encountered etc, IT new technologies review etc) in your teams or among many teams?

### **2.2.2 Observations**

The author has spent time on-site observing the environment in the development center in order to compare it to the descriptions from the interviews.

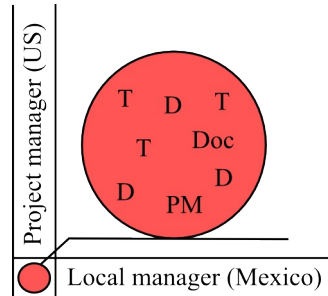
In the development center, teams indeed work in a **matrix structure**. Each team member has two managers: a local manager in Mexico, who tries to maintain a good work atmosphere, resolve any conflicts that arise, identify what training is needed and provide it to the team, review the team's progress every week, and help with technical problems. The project manager in the US is the leader of the development group. For example, there is a US project manager for testers and one for developers. For large groups, there is a US manager responsible for each software component. Project managers know the product profoundly and can explain it to the developers. They also assign tasks, and check the quality of completed work. The Mexican manager is always in touch with the project managers to report on each team member's activity, their progress in developing technical skills, and how he can help each group/member of the team to improve.

The matrix structure type in the development center is a project matrix and, as was mentioned in the first chapter, Larson *et al* (1987) has concluded that this form is the most effective type of matrix organization. In a project matrix structure, the project manager sets tasks and allocates resources, while the local (functional) manager ensures that work is done on time. However, to minimize stress for employees, the functional manager facilitates the communication between employees and US project managers. If employees have personal problems or get sick, the local manager contacts the project manager and keeps him informed until the situation is back to normal. A conflict of interests may arise because the learning activities provided by the local manager appear to interfere with the progress of project work that the US project manager expects.

Figure 7 shows that each team in Mexico may include people in different roles (D -



developers, T - testers, Doc - documentation writers, PM - product manager) who are working on the same project and have two managers.



**Figure 7.** Organization structure for each team in the development center in Mexico (compiled by the author)

In the development center that was studied in this paper, **performance measurement** is difficult. The software is proprietary, many projects are long-term, and the end of the first phase of development may take 3-5 years. Some modules of the product can be unexpectedly difficult, and a developer may work on them for six months to a year, while some features may be completed in only a week. Counting the lines of code written by each developer would not give an objective measure, because each module has a different level of complexity. Nor would counting the number of modules that were completed by each developer, because development time depends on prior knowledge of the module, and this can sometimes require as much as a month of training.

However, for some of positions in the development center performance can be measured objectively. For example, members of the client support team should handle a call in no more than 15 minutes. Therefore, in eight hours (a full work day) each client support team member should serve at least 32 clients. If an employee handles more than 32 clients, he will be rewarded for his performance by being promoted. If he consistently serves fewer than 32 customers a day, his manager will try to help him improve, and, if this is not successful, the company will find a replacement.

At the development center, in addition to the customer technical support team, there are different product teams, which include software developers, software testers, technical

documentation writers, and product managers. While the performance of a technical documentation writer can be measured by the number of pages written per day, for other team members, whose work may have different complexity, it is difficult to establish an objective measurement index.

So far, only subjective measurements have been used in the development center. The US technical managers know the average level of knowledge for each position. When they assign a task to a team member, they also give an estimate of when it should be completed. However, usually the quality of the work is more important than meeting the deadline. When an employee consistently fails to meet the US manager's expectations on quality and/or deadlines, he or she is put on a performance plan and monitored for a month. Performance plan includes a description of minimum work that should be done per day and employee should report to his or her project manager daily. If the person doesn't show improvement in his work after a month, the team may look for a replacement.

Usually, performance reviews in the company are done twice a year. The local manager gathers opinions of each team member's productivity from the US manager and colleagues (both in Mexico and other countries where team members work) and presents them to the employee, together with his own comments on how performance can be improved. These reviews use only the subjective opinions, because of the unavailability of objective measures, as was described.

In the future, the development center plans to use COCOMO II tools to measure and improve team performance. This tool wasn't used before because it requires having teams with employees at different experience levels: team members who are fully trained, people in training, and new people. Since training in this company can take up to a year, and it is impossible to hire trained specialists, most teams have achieved the required mix of experience levels only now.

Since the COCOMO II technique needs to collect data for 6 months before any results can be measured, and another 6 months is needed to collect a second set of data that can be compared to the first, the first measured performance results will only be available at the

end of the 3<sup>rd</sup> year of operation for the development center.

Another technique, the "appraisal report", is also used to help employees establish and achieve long-term goals. Although it is not obligatory, it is highly recommended. The company believes that every employee is independent and constantly seeking improvement, so it has provided this tool on the internal website to help them establish goals, measure results, and see whether there has been improvement. This process has several steps:

- 1) Before the fiscal year (June, 1 – May, 31 next year) the employee completes the form with his current skills and plans for the next year. Based on his position and level (junior, specialist, senior), the system automatically uploads the required measures, for example: quality of code, number of bugs fixed, and others. Also soft skills are listed including: ability to maintain a good relationship with the team, communication with the US project manager, and others. Altogether there are around 20 measures. Each employee evaluates his current skill level: 0 – doesn't apply, 1 – poor, 2 – meets expectations, 3 – exceeds expectations, 4 – constantly exceeds expectations, 5 – expert. A year later, the employee's manager adds his own evaluation of the employee's skills. Then, during the performance review, the manager and employee compare grades and see whether there has been improvement in the year, and whether they both understand what level of skills that the employee should have.
- 2) The second part of the process is to establish goals. The employee may determine as many goals as he or she wishes to achieve in the year. Each goal needs to have a full description, reasons for the goal, and how its achievement will be measured. At the end of the fiscal year the employee and manager discuss whether or not the goals were achieved.
- 3) The third part is an analysis of training needs. Each person lists the training he or she needs with an explanation how it will improve his or her performance. During the year the local manager helps the employee find training, frees up time for training by negotiating with the US project manager, and finds answers to any questions his team members may ask.

Recently, the development center in Mexico decided that appraisal reports would be mandatory.

The **psychological atmosphere** in the development center is very open and supportive. Every employee can come up with idea and realize it if it helps others. Among learning activities there are seminars about the soft skills needed by engineers and technology workshops (OS administration courses, advanced programming language courses etc). These are conducted by qualified specialists and are free for all employees.

A large number of discussion clubs and other **knowledge sharing activities** have been developed through the initiative of employees. Two examples, that support team and organization learning, are described below.

“Spark talks” was started in February 2012 and is a biweekly forum, where passionate people share their knowledge on different subjects with the objective of igniting (or sparking) new ideas. Anyone may prepare a one hour presentation about an area of knowledge in which he or she has expertise. Some people talk about results of their Master's research (for example, the semantic web and 3D modeling), others introduce their hobbies (for example astronomy with a demonstration of professional equipment and results achieved in exploring planets). After the presentation, there is a discussion with questions and ideas about how this information can be implemented in their work.

“Programming reading circle” is another new initiative where people from the development center who are interested in new technology, read and discuss academic papers. Each week there is a different topic, such as programming in C++ or artificial intelligence. The people who have a strong background in the topic choose academic papers about the subject which are distributed among the participants. A week later, the group gets together to discuss what they read and how this knowledge can be applied to their work.

The development center is very different from the HQ office. The DC is directed by the general country manager, who has Mexican background and has worked for the company for 15 years. Since Mexican culture is collective, every floor has an open design with

1.40m high partitions between desks, so people can talk to one another without making an appointment or being afraid that they may disturb the person they want to talk to. In the common area there are activities like ping-pong and table football, as well as sofas where people can talk to each other in a relaxed environment.

The development center already has its own traditions, like a monthly newspaper where you can read about key performers, activities, products' success in the market etc. Each month people get together to celebrate birthdays by eating cakes and singing.

Everyone feels free to request any activity that he wants to participate in and to offer ideas like blood donations or bike days, and these ideas are always considered.

## **CHAPTER 3. CASE-STUDY RESULTS ANALYSIS**

### **3.1 Analysis of results**

The purpose of this chapter is to support or refute the hypotheses made in the Chapter 1, to develop the model of the components that influence team learning in the development center in Mexico, and to describe the correspondence between the factors of Peter Senge, Amy Edmondson, and new model offered by the author. The first step is to validate the data which was collected. Since all the research methods: questionnaire, interviews and observations, were dependent on humans, it was needed to ensure that their responses were thoughtful, and not random.

Both in the questionnaire and interviews, a high numerical value for the responses to some questions represented a positive response, while for other question this was reversed: a high value represented a negative response. Appendix 2 presents the original scores. However, in the analysis values for these “reversed score” questions were reversed, so that a high score would consistently represent a positive response. An example of a reversed question is: “If I make a mistake on our team, it is often held against me” from the section, Psychological Safety, where “1” (“Disagree Very Strongly”) was considered to be a positive response. For analysis, the answers to all reversed questions have been changed to their complement: 1 $\Leftrightarrow$ 6, 2 $\Leftrightarrow$ 5 and 3 $\Leftrightarrow$ 4.

#### **3.1.1 Data validation**

The correlation of empirical results to a theoretical model depends on the quality of questionnaire, as well as the measured phenomenon itself (Mets 2007: 141).

To validate the reliability of data received from questionnaires and interviews, the responses of employees and managers in the sections on Team learning behavior and Team

performance were compared. In the questionnaire, there were six questions for the Team learning section and four questions for the Team performance section. There were similar questions in the Managers’ interviews. For the Team learning behavior section, there were seven questions, and to evaluate team performance, they needed to answer four questions. Both groups used a 6 part scale to answer the questions: “Disagree Very Strongly” (1), “Disagree Strongly” (2), “Disagree” (3), “Agree” (4), “Agree Strongly” (5), and “Agree Very Strongly” (6). For the interviews and on the questionnaire the actual words were used, however, for the analysis numeric values were used for convenience.

The tables below compare the mean values for Team learning behavior and Team performance for 14 teams which are lead by 5 managers. Some managers are responsible for multiple teams, and were not able to make time to evaluate each team individually, so they gave an average for all their teams. The maximum value for the mean is 6 or “Agree Very Strongly” which represents a high level of concurrence.. The minimum value is 1 “Disagree very strongly”, which means that the respondents don’t think that the factor is be well established at the company.

**Table 8.** Manager 1 and Team 1 opinion comparison

Factor/Participant	Team members	Team manager
Team1 learning behavior	4.00	4.29
Team1 performance	4.75	5.75

Source: compiled by the author.

In Table 8 it can be seen that for Team1 the perception of team learning behavior is almost the same for the team members and their manager. However, team performance is viewed differently. During the interview with this manager, it was learned that in the last few months the team was finishing a product development cycle, and they had many problems to resolve and were very loaded. At the same time, the manager saw how effectively the team worked during this period. This may explain why, from the team members perspective, their performance was somewhat low (since they had many bugs to fix), but from the manager's perspective the team performance was high, very close to maximum

value 6 (since they successfully fixed many bugs).

**Table 9.** Manager 2 and Team 2 opinion comparison.

Factor/Participant	Team members	Team manager
Team2 learning behavior	4.26	5.43
Team2 performance	5.02	4.75

Source: compiled by the author.

In Table 9 the results for Team 2 are also largely similar between the team members and their manager. This gives us more assurance of the reliability of the data. For team 2, it was found that the manager has a more positive view of team learning behavior. In the interview, it was learned that this manager had been with the company for only four months, and all his time was focused on improving performance. That is probably why he perceives the situation differently than the team members. For team performance an opposite effect occurred. According to the team members, their performance is better than the manager believes. Based on the interview, the manager acted as a buffer between the team members and the US project managers, who are primarily concerned with performance. As a consequence, the team members were not fully aware of their performance problems, while the manager was well aware of them and was working with each team member to make improvements.

**Table 10.** Manager 3 and Team 3, 4 and 5 opinion comparison

Factor/Participant	Team members	Team manager
Team3 learning behavior	4.33	4.29
Team4 learning behavior	4.50	
Team5 learning behavior	3.67	
Team3 performance	4.83	4.50
Team4 performance	4.90	
Team5 performance	4.13	

Source: compiled by the author.



Table 10 shows that, despite the fact that different teams have different opinions of their learning behavior and performance, the average for their manager is close to the overall average for the members of the different teams.

**Table 11.** Manager 4 and Team 6, 7 and 8 opinion comparison

Factor/Participant	Team members	Team manager
Team6 learning behavior	3.50	3.86
Team7 learning behavior	3.67	
Team8 learning behavior	4.67	
Team6 performance	4.50	5.50
Team7 performance	5.25	
Team8 performance	4.00	

Source: compiled by the author.

Table 11 compares the opinions of manager 4 and his teams 6, 7 and 8. Again, the values for the each team may vary and this is natural, because each team has a different manager in the United States, who have different experience and come from different backgrounds. However, the average for Team learning behavior given by the manager is close to the average for all his teams. For performance, the average from the teams is 4.60 and manager’s average is 5.50. This can be explained by the differences in answers to the question “Critical quality errors occur frequently in this team's work. (reversed score)”. Team members considered every error they found during the development process, while the manager said in the interview that he was only looking at the errors that were delivered to US managers or to customers, and that he didn't remember many errors at that level, so he gave maximum points for team performance.

**Table 12.** Manager 5 and Team 9, 10, 11, 12, 13 and 14 opinion comparison

Factor/Participant	Team members	Team manager
Team9 learning behavior	3.50	3.57
Team10 learning behavior	3.78	
Team11 learning behavior	4.57	

Team12-14 learning behavior	4.94	
Team9 performance	4.94	4.75
Team10 performance	4.33	
Team11 performance	5.45	
Team12-14 performance	5.58	

Source: compiled by the author.

Manager 12 has the largest number of teams under his supervision. Teams 9, 10 and 11 gave representative amount of answers for the team – 4/6, 3/5, 5/9 – and they will be reviewed them one by one. For teams 12, 13 and 14, we received answers only from 1 member – 1/3, 1/7 , 1/4 – and will combine their opinions for this analysis, since they all have the same manager in Mexico.

Manager 5 had the most management experience in the company (before Mexico he managed in the US). This may explain why his opinions regarding learning behavior and team performance are more critical than the opinion of his team members, most of whom are young specialists.

Comparing mean values for the team-manager pairs, it can be seen that the results are consistent between the managers and their teams. Those case where there is a difference of more than 1 point can be explained by additional factors found during in interviews with the managers. In conclusion, the data that was collected is reliable and can be used to continue the analysis.

### **3.1.2 Mean and principal component analysis**

In the next step, to the goal was to determine whether all the factors introduced by Amy Edmondson (1999) which influence team learning and team performance are well established in the development center. For this analysis a table of mean values for each question was created. This analysis shows that 34 out of 37 statements were rated from 4 (“Agree”) to 6 (“Agree very strongly”). This highlights the success that the development center has had in creating an environment and organizational culture that support team

learning and high team performance. Appendix 4 summarizes the minimum value, maximum value, mean, standard deviation, and variance for each question rated with a mean greater than 4.

However, there were three statements for which the mean was between 3 (“Agree”) and 4 (“Disagree”). This means that the employees in general don’t feel confident and/or have different opinions about these statements:

- Questions 9. “Our team spends time making sure every team member understands the team goals.” Mean is 3.89 out of 6.
- Question 24. “Our team tends to handle differences of opinion privately or off-line, rather than addressing them directly as a group.” Mean is 3.69 out of 6.
- Question 28. “We invite people from outside the team to present information or have discussions with us.” Mean is 3.61 out of 6.

Managers should pay attention to these issues if they want to continue to improve the learning atmosphere in the development center.

The next step is to determine whether the factors identified by Amy Edmondson (1999) can be fully transferred to the development center in Mexico. There are two well-known methods for doing this: factor analysis and **principal component analysis** (PCA).

Sometimes in academic literature these two methods are considered to be one and the same (Jolliffe 1986; Costello 2005). However, PCA is not a true factor analysis method and there is disagreement among statistical theorists about when it should be used, if at all (Costello 2005).

Jolliffe (1986, 2002) says that “both PCA and factor analysis aim to reduce the dimensionality of a set of data, but the approaches taken to do so are different for the two techniques. Principal component analysis has been extensively used as part of factor analysis, but this involves ‘bending the rules’ that govern factor analysis, and there is much confusion in the literature over the similarities and differences between the techniques”.

Nevertheless, according to DeSarbo (2007), traditional PCA has been very useful for a

variety of different research endeavors. PCA can be used as a preliminary confirmatory analysis to test the underlying of a given data set (Didow *et al* 1985).

In factor analysis, the answers on questionnaires give different, sometimes even unexpected, combinations of factors, while some factors that were expected in theory are not formed at all (Mets 2007: 141).

The analyzed variance is the main difference between the two methods. In PCA, all of the observed variance is analyzed, while in factor analysis, only the shared variances are considered (University of Wisconsin-Madison 2010).

Since a small sample size was analyzed in the paper, both factor analysis and PCA gave similar results for the study. Since the entire observed variance was analyzed, it was decided to use the PCA method as the primary method for this analysis.

PCA is the default method of extraction in many popular statistical software packages, including SPSS and SAS, which probably contributes to its popularity. SPSS software for PCA with a rotation method of Varimax with Kaiser normalization was used. The software gave a set of components in 11 iterations. According to the PCA, there are 10 components that influence team learning in the development center, but these don't completely correspond to Edmondson's 10 factors. The questions where the component has been represented with at least 0.6 value were taken into account. Questions with a reversed score are marked in gray.

**Table 13.** 10 components that influence team learning in the development center

#	Question	Component									
		1	2	3	4	5	6	7	8	9	10
7	Those who receive or use this team's output rarely give us feedback about how well our work meets their needs.	,724									
32	Our US managers often complain about how our team works together.	,695									,329
30	The quality of work provided by our team is improving over time.	,677					,408				

9	Our team spends time making sure every team member understands the team goals.			<b>,878</b>								
23	We regularly take time to figure out ways to improve our team's work processes.			<b>,708</b>								
12	For our team it is possible to achieve our team's goals.			<b>,788</b>								
17	It is safe to take a risk in our team.			<b>,684</b>								
13	With focus and effort, our team can do anything we set out to accomplish.	,428		<b>,629</b>								
5	Our team is kept in the dark about future plans of the project that may affect our work.			<b>,792</b>								
3	Excellent work pays off in this company.			<b>,620</b>		,365					,331	
34	I feel bad and unhappy when I discover that I have performed less well than I should have in my job.					<b>,883</b>						
36	I feel bad and unhappy when I discover that I have performed less or worse than other members of my team.					<b>,867</b>						
35	I feel a great sense of personal satisfaction when I do my job well.					<b>,614</b>		,351				
29	Those who use the work our team does often have complaints about our work.					<b>,820</b>						
31	Critical quality errors occur frequently in our team.	,417				<b>,667</b>						
14	If I make a mistake in our team, it is often held against me.							<b>,723</b>				
20	Working with members of my team, my unique skills and talents are valued and utilized.				,318	,315		<b>,617</b>				
37	My job and my career opportunities in the company is the most important I have on this moment in my life.									<b>,791</b>		
33	My opinion of myself goes up when I do my job well.	,323	,401							<b>,617</b>		
19	No one in our team would deliberately act in a way that undermines my efforts.										<b>,737</b>	
27	People in this team often speak up to test assumptions about issues under discussion.										<b>,608</b>	
24	Our team tends to handle differences of opinion privately or off-line, rather than addressing them directly as a group.											<b>,822</b>

Source: compiled by author, using PCA method

However, results of PCA are not reliable, because the minimum sample size should be at least five times the number of variances that were analyzed. In this study, in order to make the PCA results representative at least 185 complete responses (5 times 37 questions) would be needed (Hatcher 1994: 13). However, since for objective reasons, described in Chapter 2, there were only 64 responses, the results of PCA can be considered interesting as an overview, but there is not enough confidence to use them in further analysis.

Let's give names to the components that influence team learning in the development center according to the PCA analysis.

**Table 14.** Possible components that influence team learning in the development center

Factor	Name
1	Need for improvement
2	Team self improvement
3	Confidence in the team
4	Clear vision
5	Satisfaction from a well-done job
6	Quality of work
7	Trust inside the team
8	Importance of the job in life
9	Psychological safety in the team
10	Professional communication

Source: compiled by the author.

### **3.1.3 Influence of matrix organization on team learning**

One of the principal questions addressed by this research is whether a matrix organization helps or hinders team learning. For this purpose, four groups of respondents were identified. The first group is team 1, since the team manager stated in the interview that this was the only team whose local manager was also their project manager. Thus, team 1 members are outside of the matrix context. The second group is the respondents who chose "my project manager" to answer the survey question: "When I say "my manager", I usually

refer to...”. These employees are considered to understand correctly the existing project matrix structure in the development center. The third group is the respondents who answered “Both”, indicating that both the project and functional manager role have equal importance for them. The last group for the analysis is the employees who chose the local (functional) manager as their primary manager, which shows that neither the project matrix structure nor the managers’ roles were clearly understood. Table 15 shows the number of respondents in each of these four groups.

**Table 15.** Respondents distribution into groups based on the question "When I say “my manager”, I usually refer to...":

Group	Number (percent)
Not-in-the-matrix group	4 (6.25%)
“Project manager“ group	20 (31.25%)
“Both managers“ group	30 (46.88%)
“Local manager” group	10 (15.62%)

Source: compiled by the author.

Table 15 reflects that 31.25% of respondents intuitively know that the project manager has more responsibilities and they should primarily report to him. 46.88% of employees answered that both – project and functional managers – have the same importance for them. This may be explained by the fact that functional managers are in the same location as the employees and have daily contact with the employees. Whereas employees interact with the project manager only through emails and phone calls. Finally, 15.62% of the respondents, working in a project matrix structure, consider the local manager as their main manager. Although 10 people out of 64 is not a big number, the development center management should explain to them that they report primarily to the project manager and his orders and requests have priority.

The next step is to determine whether there was a meaningful difference in the organization context factors that influence team learning among the four groups. Edmondson (1999) has noted that organizational context influences team learning and for a

matrix structure two factors can be chosen for analysis: Supportiveness of organization context and Team leader coaching. Supportiveness of organization context includes how comfortable the employees are working in a matrix organization, whether they understand their role, whether there is any conflict between the local and US project manager, etc. Team leader coaching questions shows to what extent employees find their manager to be supportive and helpful in their work. Edmondson (1996) says that if team leader is supportive, coach-oriented, team members are likely to consider the psychological environment to be safe, and this is positively associated with team learning. In contrast, if employees don't know who to ask or are afraid to turn to their team leader, then team learning will most likely suffer.

The analysis will be done using t-test. The t-test is used to compare means for two groups. The test measures the probability that the difference between the means is due to some real differences between groups or is due to random chance (Janes 2002: 469). In addition, it shows to what extent the groups share the same opinion.

To make a t-test analysis a null hypothesis must be proposed. The null hypotheses that was used states that all differences between the two sets of data are random, and there is no difference in team learning factors between employees who understand the context of project matrix structure and employees who considers their functional manager as their primary manager. Then it is possible to move on to the analysis step.

The second, third and fourth groups' answers were compared to the answers for the first group (that is outside of matrix context) for two factors: Supportiveness of organizational context and Team leader coaching. Next the average for each employee for each factor was calculated. Then, two-sample t-tests were run, assuming unequal variances for each factor, resulting in the variance between averages for members of each of the four groups, t stat, t Critical one-tail, and t-Critical two-tails.

The output of the t-test for each question is presented in Table 16. More detailed data can be found in Appendix 5.



**Table 16:** t-test output

t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2
Mean	4.2	4.41052632
Variance	0.50666667	0.72210526
Observations	4	19
Hypothesized Mean Difference	0	
df	5	
t Stat	-0.5187955	
P(T<=t) one-tail	0.31301938	
t Critical one-tail	2.01504837	
P(T<=t) two-tail	0.62603876	
t Critical two-tail	2.57058183	

Source: compiled by author using MS Office Excel.

The means for each factor were compared among the four groups, showing that for all factors in all four groups had similar values (4.2 to 4.6 for Organizational context and 4.6 to 5.0 for Team leader). Next t Stat with t Critical two-tails were compared by the rule “Reject the null hypothesis when: calculated  $t$ -value > critical  $t$ -value” (Basic statistics: Two sample t-test 2008). A two factor comparison between first group and others showed that the critical  $t$ -value (around 2) is always bigger than t Stat (from -0.96 to 0.05). This led to the conclusion that the null hypothesis is correct: all differences between the two sets of data are random and there is no difference in team learning factors between employees who understand the context of project matrix structure and employees who consider the functional manager to be primary.

The next step was to analyze whether team learning behavior differs for the groups described below. Again the t-test was used with a null hypothesis that there is no difference in team learning behavior between employees who understand the context of project matrix structure and employees who consider the functional manager to be primary.

The mean analysis showed that all pairs that were compared have similar mean values: pairs 4 – 4.01, 4 – 4.15, and 4 – 4.35. Mean analysis shows that the last group (people who

trust the local manager more) had slightly better team learning behavior than others. This can be explained because the local manager is responsible for team learning activities on site and there is a closer, more trusting relationship between the local manager and team members and this leads to better learning.

However, the results on t-test showed that the difference in all three pairs was random, supporting the null hypothesis. Therefore, it may be concluded that learning behavior doesn't depend on organizational structure.

### **3.2 Validity of the hypotheses**

Now that the data has been validated, and the correspondence in the main theories of this study determined, it is possible to analyze the validity of our hypotheses.

For hypotheses 1 to 4, Spearman's rank correlation coefficient was used to determine whether the two tested factors correlate between one another, and, if so, what type of correlation they have: positive or negative. All calculations were done using software R.

For hypothesis 5 the t-test for two-sample assuming unequal variances was used. All calculations were done using MS Office Excel software.

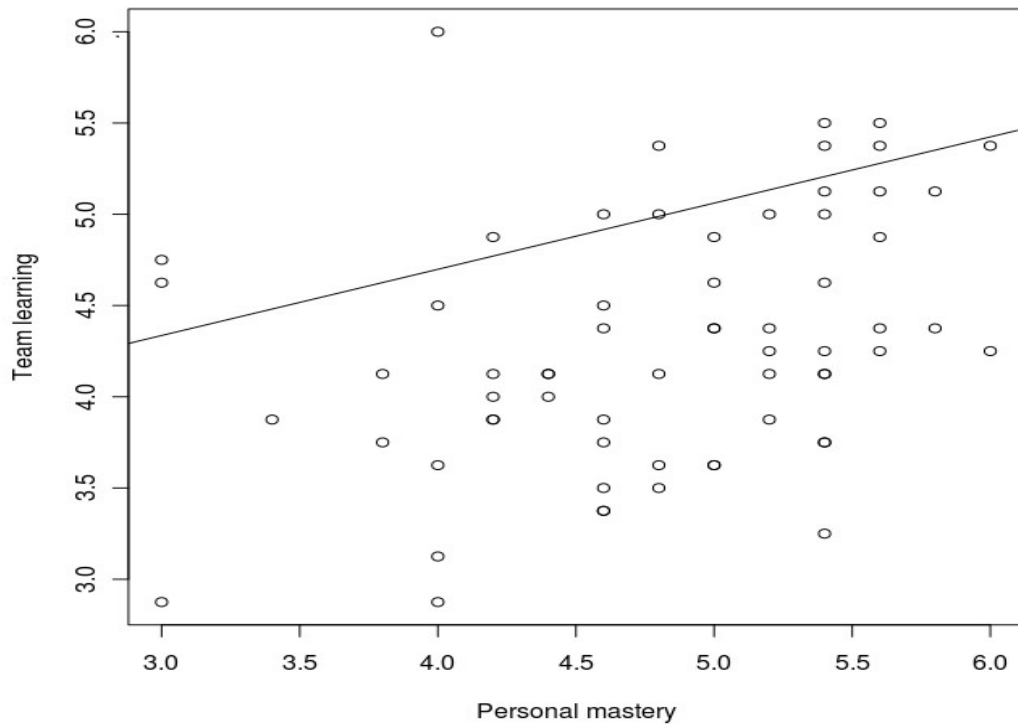
**Hypothesis 1: In the development center, personal mastery is positively associated with team learning.**

Personal mastery is one of the dimensions of Peter Senge's theory. In his work (2006) he proved that personal mastery is one of the most important components of team learning. Our goal is to test this hypothesis using the data received from the employees of the development center.

As described in Table 1 (p.17), personal mastery was questioned in the "Internal motivation" and "Job involvement" sections of survey. Team learning was questioned in the "Team learning behavior" and "Team leader coaching" sections. First the two averages for each respondent were calculated: the average for the Personal mastery questions and the average for the Team learning questions. Then Spearman's rank correlation coefficient was

calculated and a scatter plot with a regression line was built.

The correlation between personal mastery and team learning in the development center is 0.344. While this is positive, it is very weak. It supports hypothesis 1. However, the development center management should work on activities that will help to transfer individual knowledge into group (team) learning.



**Figure 8.** Correlation between personal mastery and team learning

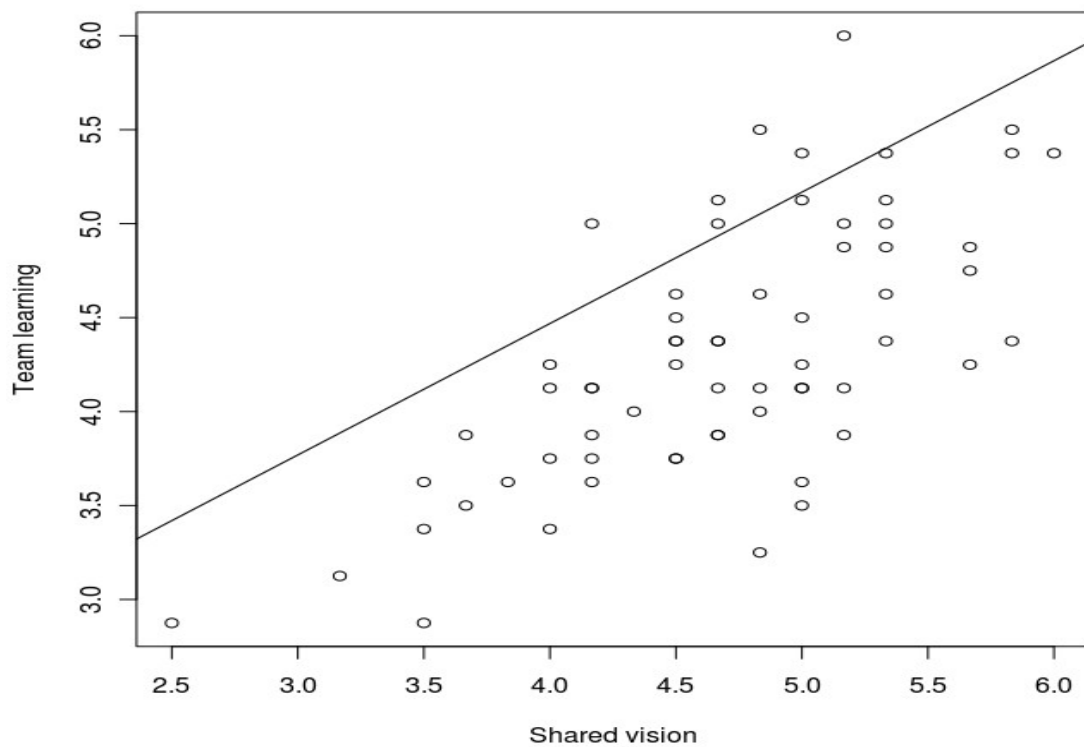
Figure 8, shows that the correlation between personal mastery and team learning for each respondent is distributed almost randomly, hence in the development center personal mastery influence weakly team learning.

**Hypothesis 2: In the development center, shared vision is positively associated with team learning.**

Peter Senge (1990, 2006) pointed out how important it is to have shared vision in order for a company to have a high level of team performance. An objective of this study was to

analyze whether shared vision is important in the development center. From Table 1 (p.17), shared vision was tested by the questions derived from the Edmondson components: Task design, Clear direction, Team efficacy. Two averages for each respondent were calculated: the Shared vision average and the Team learning average. Then Spearman's rank correlation coefficient was calculated and a scatter plot with regression line built .

The correlation between shared vision and team learning in the development center is 0.686. This is positive and strong. Hence, the more people share in the vision of the company, the higher the level of team learning in the development center.



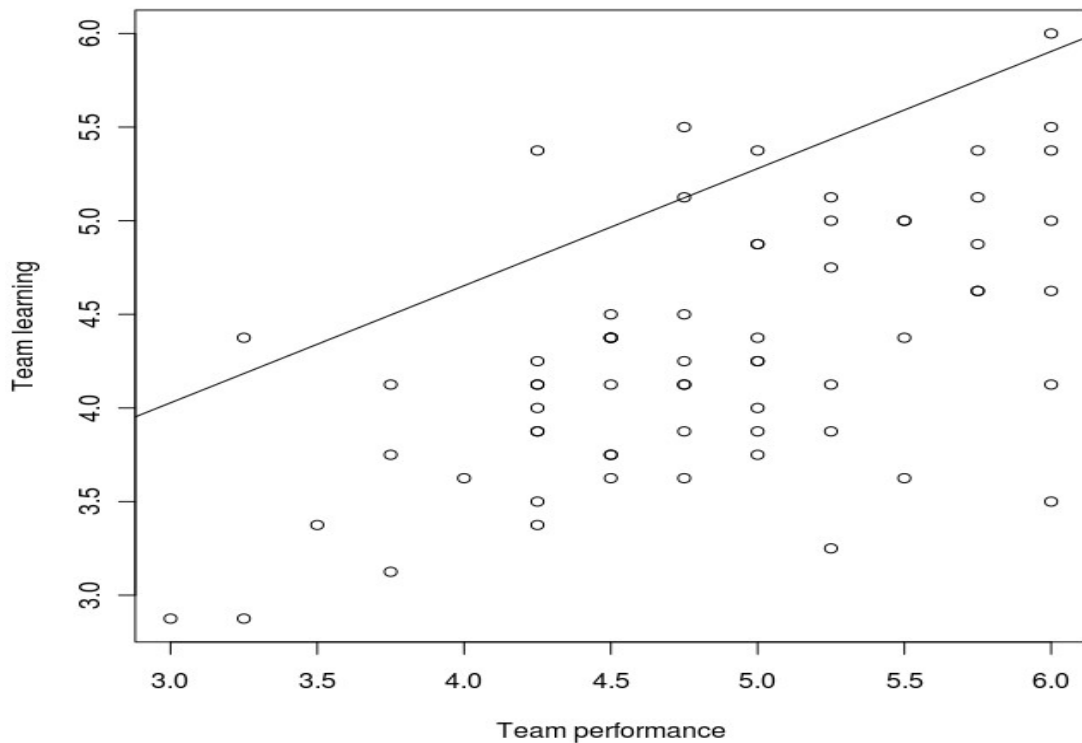
**Figure 9.** Correlation between shared vision and team learning

Figure 9 shows that the responses are distributed in a pattern, hence in the development center shared vision has strong correlation with team learning, confirming hypothesis 2.

**Hypothesis 3: Learning behavior in teams is positively associated with team performance.**

Edmondson (1999) has proved that learning behavior correlates positively to team performance. Our goal is to test if this hypothesis applies to the development center which is a young, matrix-structured organization with highly skilled employees. Two averages for each respondent were calculated: Team learning average and Team performance average. Then Spearman's rank correlation coefficient was calculated and a scatter plot with regression line built .

The correlation between team learning and team performance in the development center is 0.577. This is positive although moderate correlation. Hence, it can be said that the Edmondson hypothesis applies to the development center too: the more people participate in team learning activities, the higher the level of performance for the team.



**Figure 10.** Correlation between team learning and team performance

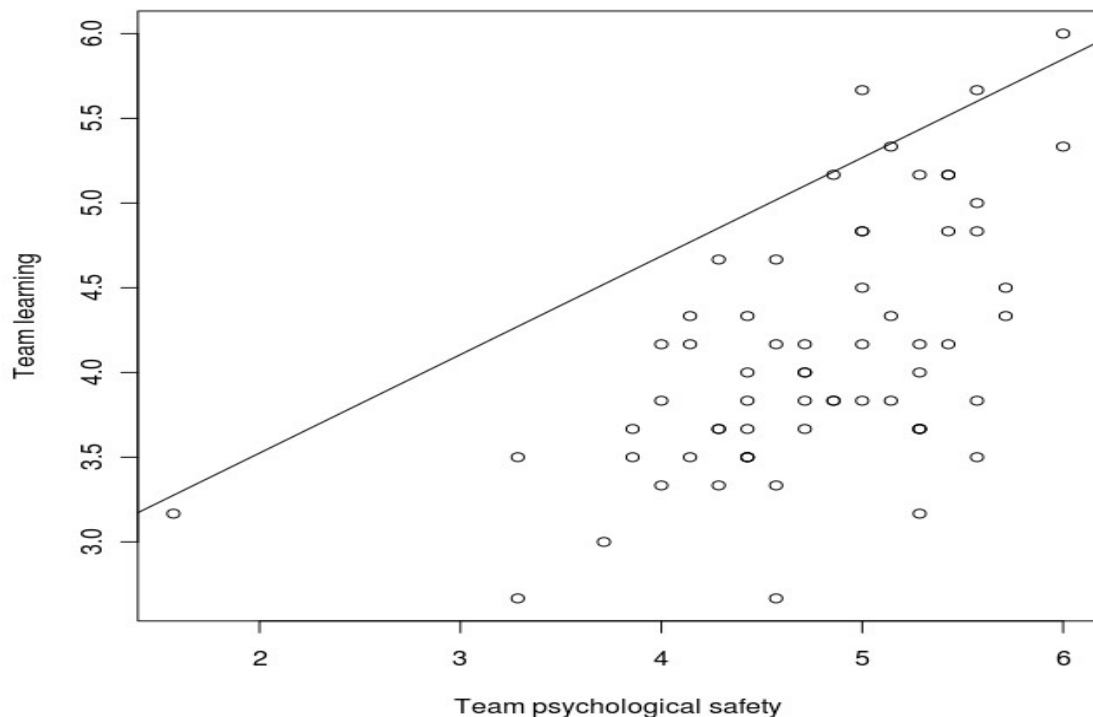
Figure 10 shows that the personal correlations are distributed in a pattern, hence in the development center team learning has moderate correlation with team performance, which confirms hypothesis 3.

**Hypothesis 4: Team psychological safety is positively associated with learning behavior in organizational work teams.**

This hypothesis was also introduced and proved in a study by Edmondson (1999). For the development center, where 67% of the people are experienced and 33% are recently graduated, in the fast tempo of development, psychological safety in teams is very important, because it has a positive correlation with learning behavior, which, in turn, positively correlates with team performance as has been shown above.

Two averages for each respondent were calculated: Team psychological safety and Team learning behavior. Then Spearman's rank correlation coefficient was calculated and a scatter plot with regression line built .

The correlation between these two factors is 0.573. This is a positive and moderate correlation.



**Figure 11.** Correlation between team psychological safety and team learning

In Figure 11, there is one person in the lower left corner who is a significant outlier. Spearman's correlation is less sensitive to strong outliers than the Pearson correlation. On this basis, it cannot be predicted whether the correlation would be stronger without the outlier. In conclusion, in the development center psychological safety within the team correlates moderately and positively with team learning.

**H5: Employees who are new graduates are more open to team learning activities and experiments.**

For this hypothesis the t-Test for two-sample assuming unequal variances was chosen. To calculate data, MS Office Excel software was used, function TTEST (Eesti Maaülikool: Andmeanalüüs MS Exceli abil).

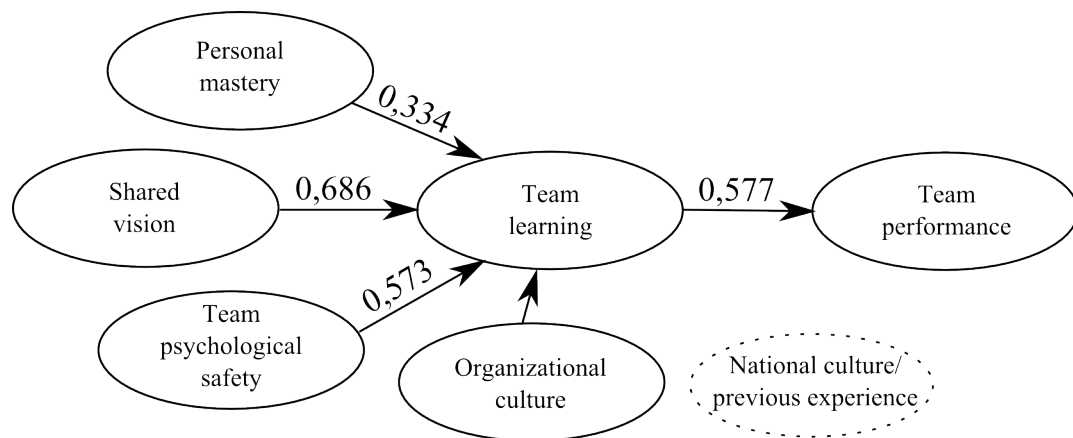
To analyze hypotheses 5 using t-test, a null hypothesis must be proposed that states that all differences between two sets of data are random. Then it is possible to move on to the analysis.

To support or refute hypothesis 5, first, all respondent were divided into two groups: new graduates and experienced people according to their response to the question: "This company is my first employer in my major (I was a New Graduate hire): Yes/No". The whole sample contained 43 (67%) experienced people and 21 (33%) people straight from college. Next the average for each question for each group was calculated and two averages for six questions for Team learning behavior were calculated. Then, two-sample t-tests were run, assuming unequal variances for each question resulting in the variance between averages of new graduates and experienced people, t stat, t Critical one-tail and t-Critical two-tails.

Then the means for each question were compared, showing that for a majority of the questions both groups gave similar values. Next t Stat with t Critical two-tails were compared by the rule "Reject the null hypothesis when: calculated  $t$ -value  $>$  critical  $t$ -value" (Basic statistics: Two sample t-test 2008). For all six questions, the critical  $t$ -value (around 2) was always bigger that t Stat (from 0.2 to 1.2). This led us to conclude that the

null hypothesis is correct: all differences between means of new graduates and experienced employees were due to random chance. This refutes hypothesis 5 and shows that in the development center employees who are new graduates are as open to team learning activities and experiments as their experienced colleagues. This statistical result was also supported by the views that managers expressed during the interviews. They also stated that the difference in learning behavior of new graduates and experienced employees after half year of working in the company doesn't exist or very small.

Among the questions to which new graduates gave more negative responses than experienced people are: “Our team tends to handle differences of opinion privately or off-line, rather than addressing them directly as a group” and “People in this team often speak up to test assumptions about issues under discussion”. On the other hand, they feel more positive about getting information from outside of the team.



**Figure 12.** Research model with answers (composed by author).

Figure 12 shows to what extent the key factors correlate to team learning and team performance. Hypothesis 5 is demonstrated as organizational culture that influences team learning and overcomes national culture with previous experience that could affect learning behavior in teams in the development center.



## **CONCLUSION**

The principal questions addressed by this study were: 1) How has a matrix-structured, two-year old organization been able to achieve a high level of team learning?; 2) How does a matrix management structure affect team learning: does it support or hinder it?; 3) Do Senge's organization learning factors such as shared vision and personal mastery influence team learning as well? and 4) What team learning practices are used at the development center and how quickly do these practices bring about improvements?

First, it was found that in the development center team learning exists at a high level, in spite of the culture, organizational structure, and number of new graduates, all of which, according to various theories, hinder team learning. Mexican culture is characterized by high collectivism, where people are reluctant to address mistakes in order to preserve amicable relationships. Mexican culture also has a high index of uncertainty avoidance, which means that Mexicans avoid experimenting. In a matrix structure conflicts related to possible changes in team membership may arise and there may not be enough psychological safety on the team. This suggests that organizational culture is the strongest force driving organizational development in the center.

Four out of the five hypotheses that were analyzed had been proven previously by other researchers (Senge 2006, Edmondson 1999). These hypotheses relate to the positive correlation between factors including personal mastery and team learning, shared vision and team learning, team learning and team performance, team psychological safety and team learning. The goal of this study was to determine whether these correlations were also true in a matrix organization. In fact, in the development center, all the hypotheses showed positive correlation. Hence, it can be concluded that the matrix structure in the development center functions in a way that doesn't hinder team learning. Moreover,

according to the survey and interviews, within the matrix structure, employees of the development center have wider connections and are able to seek advice and discuss ideas with a large number of experienced people.

Additionally, only one of the four hypotheses had a weak correlation, which was between personal mastery and team learning. This suggests that the development center should encourage people to share their knowledge, by organizing postmortem reviews, presenting existing or resolved problems, discussing graduate papers, and holding informal conversations about technology development.

It seems likely that the correlation between personal mastery and team learning will become stronger soon, because much has already been done. The psychological atmosphere in the development center is very open and supportive. Every employee can propose ideas and realize them if they help others. Among current learning activities there are seminars about the soft skills needed by engineers and technology workshops (OS administration courses, advanced programming language courses etc). These are conducted by qualified specialists and are free for all employees. A large number of discussion clubs and other knowledge sharing activities have been developed through the initiative of employees.

The fifth hypothesis was whether employees who were new graduates are more open than experienced employees to team learning activities and experiments was studied. Analysis showed that all statistical differences between new graduates and experienced employees were due to random chance. This means that learning behavior in the development center is not influenced by national culture or previous working experience. This result was also supported by the opinions of managers in the interviews.

Despite the fact that development center opened only two years ago, all factors needed for team learning are in place as the result of a strong organizational culture.

Taking into account all the information discussed and analyzed above, it is recommended that the managing staff of the development center pay closer attention to knowledge transfer from the individual level to the group (team) level and to the organizational level.

Although many knowledge sharing activities have been implemented in the center, data analysis shows that personal mastery still correlates weakly to team learning. This means that even if an individual develops, reads more, and participates in training, the team IQ doesn't grow, because each person grows only in individual knowledge without transferring that knowledge to the team or the group.

For future studies, it is recommended using only those questions that were selected by the PCA method which include components that primarily influence team learning. Another recommendation is to encourage more people to participate in the questionnaire so that statistical methods like factor analysis and PCA can be reliably used.

There are three limitations to keep in mind before referring to the results of this paper.

The first limitation of the study is cultural (emotional) background. All data was received from humans (interviews, observations, questionnaire) and the scores given to the same questions in the same situation by people with different emotional background may differ. However, there is no study that could provide an index that would enable us to transform answers from Mexican culture to a non-cultural world average. Hence, the results for development center cannot be reliably compared to results from other cultures.

The second limitation is the size of sample. For objective reasons 64 respondents returned the survey. This is a representative sample for the development center, however it is not sufficient to use factor analysis of principal component analysis confidently.

The third limitations is the results of principal component analysis in the research. The results were calculated for the development center with a goal of creating a draft model of the main factors that influence team learning. If the company continues conducting surveys every year that will enable them build a model based on sufficient data.

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## APPENDICES

### Appendix 1 – Questionnaire

Note: The questionnaire contained only list of questions. However, in this appendix is left the name of the components by Edmondson for better understanding of analysis in the paper. You will see the name of the component before each group of questions.

-----  
Given questionnaire helps to find out in what extend team learning occurs in the development center. The questionnaire is anonymous, however we ask you to choose the name of your team at the end of the survey.

In every question "team" refers to your team in Mexico.

Your opinion and comments will be used to improve learning environment in the development center. It also will be used as a part of Master thesis "Team learning in matrix organization" by Evgeniya Trofimova, University of Tartu, Estonia after internal review and filtering.

All comments, questions and ideas please send to [evgeniya.trofimova@\\*\\*\\*.com](mailto:evgeniya.trofimova@***.com).

It will take you about 10 min to fill it.

Thank you

#### **Survey:**

//Supportiveness of organization context

1. Our team gets all the information it needs to do our work and plan our schedule.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

2. It is easy for our team to obtain expert assistance when something comes up that we don't know how to handle.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

3. Our team is kept in the dark about future plans of the project that may affect our work.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

4. Our team lacks access to useful training on the job.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

5. Excellent work pays off in this company.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Task design

6. The work that our team does makes a difference for the people who use it.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

7. Those who receive or use this team's output rarely give us feedback about how well our work meets their needs.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Clear direction

8. It is clear what our team is supposed to accomplish.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

9. Our team spends time making sure every team member understands the team goals.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Team composition

10. Most people in our team have the ability to solve the problems that come up in our work.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

11. Certain individuals in our team lack the special skills needed for good team work.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Team efficacy

12. For our team it is possible to achieve our team's goals.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

13. With focus and effort, our team can do anything we set out to accomplish.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Team psychological safety

14. If you make a mistake in our team, it is often held against you.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

15. Members of our team are able to bring up problems and tough issues.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

16. People in our team sometimes reject others for being different.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

17. It is safe to take a risk in our team.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

18. It is difficult to ask other members of our team for help.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

19. No one in our team would deliberately act in a way that undermines my efforts.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

20. Working with members of my team, my unique skills and talents are valued and utilized.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Team leader coaching

The team leader ...

21. initiates meetings to discuss the team's progress.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

22. is available for consultation on problems.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Team learning behavior

23. We regularly take time to figure out ways to improve our team's work processes.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

24. Our team tends to handle differences of opinion privately or off-line, rather than addressing them directly as a group.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

25. Team members go out and get all the information they possibly can from others – such as US colleagues, or other teams of the development center.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly  
26. Our team frequently seeks new information that leads us to make important changes.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly  
27. People in this team often speak up to test assumptions about issues under discussion.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly  
28. We invite people from outside the team to present information or have discussions with us.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Team performance

29. Those who use the work our team does often have complaints about our work (for example, too many bug reports from customer service).

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

30. The quality of work provided by our team is improving over time.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

31. Critical quality errors occur frequently in our team.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

32. Our US managers often complain about how our team functions.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Internal motivation

33. My opinion of myself goes up when I do my job well.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

34. I feel bad and unhappy when I discover that I have performed less well than I should have in my job.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

35. I feel a great sense of personal satisfaction when I do my job well.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

36. I feel bad and unhappy when I discover that I have performed less or worse than other members of my team.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Job Involvement

37. My job and my career opportunities in the company is the most important I have on this moment in my life.

Disagree Very Strongly   Disagree Strongly   Disagree   Agree   Agree Strongly   Agree Very Strongly

//Additional questions:

38. When I think about my team, I imagine:

-The Mexican part of the team

-People in the same position world-wide

-All people participating in the project, independently of co-worker position or location

39. When I say “my manager”, usually I refer to:

-My Mexican team manager

-My US project manager

40. This company is my first employer in my major (I was New Grad hire):

-Yes

-No

41. My team is:

-Team1

-Team 2

...

-Team 14

-Other

## Appendix 2 – Transcripts of interviews with managers

### Manager 1

Team learning behavior: Team you manage...

asks its US managers for feedback on its performance.	Agree Very Strongly	6
relies on outdated information or ideas. (reverse score)	Disagree	3
actively reviews its own progress and performance.	Agree Strongly	5
does its work without stopping to consider all the information team members have.	Agree	4
regularly takes time to figure out ways to improve its work performance (without the manager).	Agree	4
ignores feedback from non-Mexican colleagues. (reverse score)	Disagree	3
asks for help from others in the company/their managers when something comes up that team members don't know how to handle.	Agree Strongly	5

Team performance:

This team meets or exceeds US managers expectations.	Agree	4
This team does superb work.	Agree	4
Critical quality errors occur frequently in this team's work. (reverse score)	Disagree Strongly	2
This team keeps getting better and better.	Agree Very Strongly	6

Open questions about their teams:

1. What is the biggest difference US managers have with this Mexico team?  
*They are fundamentally different. Let me explain. People here they are brand new and they are excited about doing what we are doing. People in US, they have been working for a lot longer. They are more concentrated on what they do, so they are not that excited and energetic. They are older, they are more gated, they lack some drive. The team here has more (drive and enthusiasm). About cultural differences. The team I have here we are like*



*family: we make pranks, we hang out together after work, we like each other. Each month after salary day we go for a picnic in the park, we make parties at my place. And it helps team work, cause we like each other. We don't compete, we help each other. In the US people are older, they have families, there are not that many new grades. But we were also united, for me it is different to work in a team where everyone is just an individual. But in Mexico I feel team spirit more naturally.*

2. What is the main motivation of the members of this team (money, great project, learn from colleagues etc) at work?

*I would say the main motivation for them is an opportunity to create new technologies. Create cool complicated challenging complex features that solve many problems in the world. On the interview I've chosen people who are ready to a very difficult work. I am sure that in my team no one will choose boring project because of money, so money is not the main issue in theirs motivation.*

3. If one of your teams develops faster, what is the reason in your opinion? (different experience, different motivation)

*They are motivated and they rely on each other. We joke around when someone screw up. From the beginning they were not afraid to make mistakes and talk about it, cause the first person in the team who broke the build was me. I explained why it is very bad and why it is important not to do so (cause 500 developers may be on hold before you fix it), but we try to joke on mistakes. Every problem that happens – I take it as my fault. People in the team, they are new, they are learning, so I try to be responsible for all failures we have. But I should mention, critical errors happen very rare. And if it happens, we care about the person who failed: we bring him coffee, cause he is stressed and we try to support him.*

4. How often performance review is done and what changes do you see in team members performance after it?

*I talk to each member of the team every week: what problems they have encountered, what is their progress (how many bugs were fixed) etc. And also, each 6 month we have a performance review that happens around the company: I use not only objective metrics, but*

*also talk to people who work with my team about their performance, soft skills etc. Only numbers may not show the real situation: person may work on a very difficult issue for a long time and not fix bugs or just fix bugs that are not complex.*

Open questions (in general about the development center)

1. In the development center context, is there a difference between performance/motivation of the new grad employee and employee with a previous experience after half a year of working?

*New hires that work in my team are very open, they may tell: "I have no clue about this thing" and it is OK. As I've mentioned before, we work on a very complex things that you normal state that you feel lost for a first year (!). So my aim is to explain them not to freak out, I try to make them feel special, cause we are a small team and we work on a difficult project. We have an experienced person in the team, but he has worked with the other OS that we do, so he is the one who feels stressed. The other experienced person works on the feature under a huge time pressure, so he also feels stressed. To put it into a nutshell, both new grades and experienced people feel that they need to learn a lot and they help each other with it.*

2. What is the difference between interaction inside the team in US and in Mexico?

*People in Mexico are more social. If they need to interact in US, you write an email or go and talk just about the business. In Mexico we like to socialize, so the environment is more open. Here you can talk to the person just standing up (cause we have open cubicles), in US you need to go to the other person's room, you don't know if person is busy etc.*

3. Do you practice knowledge sharing activities (brain storming on someone's problem, seminars when each one tells about discoveries/ideas that he encountered etc, IT new technologies review etc) in your teams?

*In the extent that we can. We have a list of the questions we want to find answers to, but as very often we are under the pressure of time, we can not do it right away. After, when we have some break, we discuss it, search for the answers or talk to colleagues.*

## Manager 2

Team learning behavior: Team you manage...

asks its US managers for feedback on its performance.	Agree Very Strongly	6
relies on outdated information or ideas. (reverse score)	Disagree Strongly	2
actively reviews its own progress and performance.	Agree Very Strongly	6
does its work without stopping to consider all the information team members have.	Agree Very Strongly	6
regularly takes time to figure out ways to improve its work performance (without the manager).	Disagree	3
ignores feedback from non-Mexican colleagues. (reverse score)	Disagree Very Strongly	1
asks for help from others in the company/their managers when something comes up that team members don't know how to handle.	Agree Very Strongly	6

Team performance:

This team meets or exceeds US managers expectations.	Agree	4
This team does superb work.	Agree	4
Critical quality errors occur frequently in this team's work. (reverse score)	Disagree Strongly	2
This team keeps getting better and better.	Agree Very Strongly	6

Open questions about their teams:

1. What is the biggest difference US managers have with this Mexico team?

*I guess that in US every member of the team get excellent results, because they hire experienced people, top performers in the field. In Mexico, we have many new grads, most employees are very young, without experience and they are in the beginning of learning curve that's why learning here, in Mexico, is a bit slower now. But we improve.*

2. What is the main motivation of the members of this team (money, great project, learn from colleagues etc) at work?

*In my opinion, the main motivation is to learn more about technology in a world leader SD company. If you work here, you may work in every place. On the second place, there should be participating in a great project. I also think that money is on the last palce, because everyone knows that if they will learn fast and work better, in five years they will have much bigger salary.*

3. How often performance review is done and what changes do you see in team members performance after it?

*I make 1-to-1 performance review every week with each member of the team, because lately, before I'd joined 4 month ago, team had problems with performance and now they already meet US managers expectations. I also read each email (about error, successes) that moves in the list and keep track on each team member performance. This year I will start making appraisal reviews once a year.*

Open questions (in general about the development center)

1. In the development center context, is there a difference between performance/motivation of the new grad employee and employee with a previous experience after half a year of working?

*Yes, in the beginning there are some difference, but in my opinion new grads learn very fast and all everyone in the team is very friendly. So after three or four month I don't see any difference in their behavior or self-confidence.*

2. Do you practice knowledge sharing activities (brain storming on someone's problem, seminars when each one tells about discoveries/ideas that he encountered etc, IT new technologies review etc) in your teams?

*When I became the manager of this team four month ago, they had problems with performance, so my first goal was to help them improve. Now, when US managers seem to be happy with results Mexican part of team deliver, I will start thinking about brainstorms, other technologies reviews and team building activities. During last month, I was giving UNIX administrating classes for the team primarily, but other organization members could join. Also I encouraged one of team members to announce the Programming Reading Club.*

*Many members of the team have sharing knowledge ideas, I support them all, but first keep an eye on the performance.*

**Manager 3**

Team learning behavior: Team you manage...

asks its US managers for feedback on its performance.	Agree Strongly	5
relies on outdated information or ideas. (reverse score)	Agree	4
actively reviews its own progress and performance.	Agree	4
does its work without stopping to consider all the information team members have.	Agree Strongly	5
regularly takes time to figure out ways to improve its work performance (without the manager).	Agree	4
ignores feedback from non-Mexican colleagues. (reverse score)	Disagree	3
asks for help from others in the company/their managers when something comes up that team members don't know how to handle.	Agree Strongly	5

Team performance:

This team meets or exceeds US managers expectations.	Agree	4
This team does superb work.	Agree	4
Critical quality errors occur frequently in this team's work. (reverse score)	Disagree Strongly	2
This team keeps getting better and better.	Agree Strongly	5

Open questions about their teams:

1. What is the biggest difference US managers have with this Mexico team?

*In my opinion, culture is one point of difference. We have different code, different way to make work done, different approaches to figure out the same problems. We should also*

*improve communication, but I also mean that US should be more involved, they should understand Latin culture: we have different ways to ask, to fix problems. US people are more formal and Mexican employees make more communication inside the team and our we are more social. So, to make a success, US and Mexico managers should be synchronized and have the same answer for each issue.*

2. What is the main motivation of the members of this team (money, great project, learn from colleagues etc) at work?

*In my case, I see that people from my teams they love their projects. But, of course, money counts. But back to being interested in what you do, when I was interviewing these guys, they all were extremely interested in the project we do and same they stay after passed time.*

3. If one of your teams develops faster, what is the reason in your opinion? (different experience, different motivation)

*Even if it happens, the reason is that people are different: they had different background, but also they learn in different ways and with a different speed. And it is almost impossible to predict it during interviews. But I consider that team members that have better communication with US managers, know the product better and it helps them to solve problems faster.*

4. How often performance review is done and what changes do you see in team members performance after it?

*I have 1-on-1 interviews each quarter, so it is 4 a year plus one major in a year. That means totally I have 5 performance interview with each member of the team. Currently, we develop with US managers a model how to measure performance, but we are on the stage where we choose what to measure. It will be not only numbers, because person may be a good developer but have lack of soft skills. And we will work on integration of this person into the team. In some cases I saw improvements, but some people are not interested in performance review results and these people need more attention. I am working on that.*

Open questions (in general about the development center)

1. In the development center context, is there a difference between performance/motivation of the new grad employee and employee with a previous experience after half a year of working?

*I would say that experienced people are more open. New grads try to fix their problems themselves and it may take more time or solution will not be that good as it could. It is easy to explain: they don't have work experience. As a manager, I try to monitor it and help when it is needed. But with experienced people there are other problems, For example, it is very difficult to track them, to follow what they are doing, cause they prefer to work more independently.*

2. Do you practice knowledge sharing activities (brain storming on someone's problem, seminars when each one tells about discoveries/ideas that he encountered etc, IT new technologies review etc) in your teams?

*Yes. First, I ask people to make presentation about what they are working on, we do it inside the team only. I prefer formal meeting, because I respect my team members time. On these meetings, once a week, we tell what have we done during last week and how was it. Also we make brainstorms, when the problem involves different people knowledge. We don't make any official documentation each meeting, but we have Wiki and we have recorded 30 videos of discussions with US part of the team and these videos are required to be watched for new employees in the teams.*

#### **Manager 4**

Team learning behavior: Team you manage...

asks its US managers for feedback on its performance.	Agree	4
relies on outdated information or ideas. (reverse score)	Disagree Strongly	2
actively reviews its own progress and performance.	Disagree Strongly	2
does its work without stopping to consider all the information team members have.	Disagree	3
regularly takes time to figure out ways to improve its work performance (without the manager).	Disagree Strongly	2

ignores feedback from non-Mexican colleagues. (reverse score)	Disagree Very Strongly	1
asks for help from others in the company/their managers when something comes up that team members don't know how to handle.	Agree Strongly	5

Team performance:

This team meets or exceeds US managers expectations.	Agree Very Strongly	6
This team does superb work.	Agree Strongly	5
Critical quality errors occur frequently in this team's work. (reverse score)	Disagree Very Strongly	1
This team keeps getting better and better.	Agree Strongly	5

Open questions about their teams:

1. What is the biggest difference US managers have with this Mexico team?

*We don't have any difference from US. I've heard from US managers that*

2. What is the main motivation of the members of this team (money, great project, learn from colleagues etc) at work?

*By order: (1) great place to work, (2) great project, (3) money. As everyone has been hired to the top-end salary in the country, money is not an issue yet.*

3. If one of your teams develops faster, what is the reason in your opinion? (different experience, different motivation)

*Amount of experienced people in concrete subject in the team. If we have one experienced person and other not, I push them to share knowledge.*

4. How often performance review is done and what changes do you see in team members performance after it?

*The company official performance review happens every 6 month. But also each member of my teams after being hired got achievement plans and each 3 month we look at them and*



*see if aims has been achieved, if not – what was the problem. And each month on 1-on-1 meeting, we establish new smart objectives. On the performance review I also take into account US technical manager comments.*

Open questions (in general about the development center)

1. In the development center context, is there a difference between performance/motivation of the new grad employee and employee with a previous experience after half a year of working?

*For a team working objectives – there are no difference.*

2. Do you practice knowledge sharing activities (brain storming on someone's problem, seminars when each one tells about discoveries/ideas that he encountered etc, IT new technologies review etc) in your teams?

*I do it every week. It is not an official meeting, once a week I just come into the place where my teams sit and offer a puzzle or a problem to discuss. Also I ask for team building seminars. And every time I find an interesting publication, I send it to the people and later we discuss it.*

## **Manager 5**

Team learning behavior: Team you manage...

asks its US managers for feedback on its performance.	Agree Strongly	5
relies on outdated information or ideas. (reverse score)	Disagree	3
actively reviews its own progress and performance.	Agree	4
does its work without stopping to consider all the information team members have.	Agree	4
regularly takes time to figure out ways to improve its work performance (without the manager).	Agree	4,5
ignores feedback from non-Mexican colleagues. (reverse score)	Disagree	3
asks for help from others in the company/their managers when	Agree	4

something comes up that team members don't know how to handle.		
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Team performance:

This team meets or exceeds US managers expectations.	Agree Strongly	5
This team does superb work.	Agree Strongly	5
Critical quality errors occur frequently in this team's work. (reverse score)	Disagree	3
This team keeps getting better and better.	Agree Strongly	5

Open questions about their teams:

1. What is the biggest difference US managers have with this Mexico team?

*The biggest challenge is remote managing. I have 6 big teams in Mexico, so I can not micromanage. At the same time, each team manager from US is working remotely with the team and if they would be local, the learning speed of employees would be higher. It is much easier if there is someone local with experience who you can ask quickly. We try all kinds of transfer of knowledge: US managers come here, teams go there, but they don't spend enough time together.*

2. What is the main motivation of the members of this team (money, great project, learn from colleagues etc) at work?

*The main motivation, I think, is the interesting project. Many people are fresh from the college, the company is big and famous, students are interested to work on new technologies. Money can not be main motivation, there are other big SD companies in the city who may offer good compensation.*

3. If one of your teams develops faster, what is the reason in your opinion? (different experience, different motivation)

*I can not give an answer, because it depends on team managers in US.*

4. How often performance review is done and what changes do you see in team members performance after it?

*Every six month I try to give a feedback to each team member. They are so young, I don't see the reason to talk every week with them and to discuss what should they do to get a promotion. They should focus on technology, on the product and maybe in one-two years they may start thinking about their career. If someone dropping a little bit, yes, I work on this issue. In my opinion, to get a promotion, you should go through the full product development cycle and only after that we can talk about the skills a person should improve additionally to get a promotion.*

Open questions (in general about the development center)

1. In the development center context, is there a difference between performance/motivation of the new grad employee and employee with a previous experience after half a year of working?

*No, I don't see the difference.*

2. Do you practice knowledge sharing activities (brain storming on someone's problem, seminars when each one tells about discoveries/ideas that he encountered etc, IT new technologies review etc) in your teams?

*I try to encourage teams to do it themselves, each team chooses the way to do it. On team, for example, follows Scrum method, they get each day together and quickly discuss what they were doing during the day, what problems they have had etc. Some teams prefer to work independently and don't need meetings that often. I encourage teams to talk each week and if they not, I try to assist meetings every month with each team. Also I tend to have people that represent me in each team. My goal is to make teams successful and there are people who help me to achieve it.*

### Appendix 3 – Results of t-test for “Team learning behavior”

Question 23			Question 24		
t-Test: Two-Sample Assuming Unequal Variances			t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2		Variable 1	Variable 2
Mean	5.093023	5.047619	Mean	3.860465	3.333333
Variance	0.848283	0.747619	Variance	1.503876	1.633333
Observations	43	21	Observations	43	21
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	42		df	38	
t Stat	0.193029		t Stat	1.569849	
P(T<=t) one-tail	0.423933		P(T<=t) one-tail	0.06237	
t Critical one-tail	1.681952		t Critical one-tail	1.685954	
P(T<=t) two-tail	0.847867		P(T<=t) two-tail	0.124741	
t Critical two-tail	2.018082		t Critical two-tail	2.024394	
Question 25			Question 26		
t-Test: Two-Sample Assuming Unequal Variances			t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2		Variable 1	Variable 2
Mean	4.627907	4.904762	Mean	4.302326	4.380952
Variance	1.096346	0.590476	Variance	1.120709	1.047619
Observations	43	21	Observations	43	21
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	52		df	41	
t Stat	-1.195671		t Stat	-0.285304	
P(T<=t) one-tail	0.118624		P(T<=t) one-tail	0.388424	
t Critical one-tail	1.674689		t Critical one-tail	1.682878	
P(T<=t) two-tail	0.237249		P(T<=t) two-tail	0.776848	
t Critical two-tail	2.006647		t Critical two-tail	2.019541	
Question 27			Question 28		
t-Test: Two-Sample Assuming Unequal Variances			t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2		Variable 1	Variable 2
Mean	4.302326	4.047619	Mean	3.55814	3.714286
Variance	0.882614	1.047619	Variance	1.871539	1.714286
Observations	43	21	Observations	43	21
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	37		df	41	
t Stat	0.959876		t Stat	-0.441371	
P(T<=t) one-tail	0.171674		P(T<=t) one-tail	0.330632	
t Critical one-tail	1.687094		t Critical one-tail	1.682878	
P(T<=t) two-tail	0.343349		P(T<=t) two-tail	0.661263	
t Critical two-tail	2.026192		t Critical two-tail	2.019541	

**Appendix 4 - Minimum value, maximum value, mean, standard deviation, and variance in the context of each question rated with a mean greater than 4**

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
V35	64	1	6	5,36	,932	,869
V6	64	1	6	5,14	,957	,916
V30	64	3	6	5,14	,814	,662
V18	64	1	6	5,14	1,096	1,202
V13	64	2	6	5,14	,924	,853
V33	64	1	6	5,09	,988	,975
V22	64	3	6	5,08	,896	,803
V16	64	1	6	5,08	1,131	1,280
V12	64	3	6	5,05	,825	,680
V32	64	1	6	4,92	1,117	1,248
V5	64	3	6	4,86	,870	,758
V10	64	2	6	4,83	,901	,811
V31	64	3	6	4,81	,889	,790
V15	64	1	6	4,81	,957	,917
V34	64	1	6	4,80	1,157	1,339
V8	64	2	6	4,80	,946	,895
V19	64	1	6	4,73	1,360	1,849
V25	64	2	6	4,72	,967	,936
V21	64	1	6	4,66	1,101	1,213
V2	64	2	6	4,66	1,072	1,150
V14	64	1	6	4,61	1,177	1,385
V20	64	1	6	4,59	1,080	1,166
V29	64	1	6	4,48	,992	,984
V37	64	1	6	4,41	1,455	2,118
V36	64	1	6	4,37	1,254	1,571
V1	64	2	6	4,34	,912	,832
V26	64	2	6	4,33	1,040	1,081
V4	64	1	6	4,28	1,147	1,316
V17	64	1	6	4,28	1,015	1,031
V11	64	1	6	4,22	1,351	1,824
V27	64	2	6	4,22	,967	,936
V3	64	1	6	4,16	1,263	1,594
V23	64	1	6	4,09	1,377	1,896
V7	64	1	6	4,05	1,240	1,537
V9	64	1	6	3,89	1,197	1,432
V24	64	1	6	3,89	1,258	1,583
V28	64	1	6	3,61	1,341	1,797
Valid N (listwise)	64					

## Appendix 5 – Results of t-test for “Supportiveness of organizational context”, “Team leader coaching” and “Team learning behavior”

Organisational context: group 1 and 2 comparison t-Test: Two-Sample Assuming Unequal Variances			Organisational context: group 1 and 3 comparison t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2		Variable 1	Variable 2
Mean	4.2	4.4105263	Mean	4.2	4.566667
Variance	0.5066667	0.7221053	Variance	0.5066667	0.576782
Observations	4	19	Observations	4	30
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	5		df	4	
t Stat	-0.518796		t Stat	-0.959963	
P(T<=t) one-tail	0.3130194		P(T<=t) one-tail	0.1957178	
t Critical one-tail	2.0150484		t Critical one-tail	2.1318468	
P(T<=t) two-tail	0.6260388		P(T<=t) two-tail	0.3914356	
t Critical two-tail	2.5705818		t Critical two-tail	2.7764451	
Organisational context: group 1 and 4 comparison t-Test: Two-Sample Assuming Unequal Variances			Team leader coaching: group 1 and 2 comparison t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2		Variable 1	Variable 2
Mean	4.2	4.4	Mean	4.625	4.947368
Variance	0.5066667	0.3911111	Variance	0.7291667	1.302632
Observations	4	10	Observations	4	19
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	5		df	6	
t Stat	-0.49121		t Stat	-0.643642	
P(T<=t) one-tail	0.3220392		P(T<=t) one-tail	0.271805	
t Critical one-tail	2.0150484		t Critical one-tail	1.9431803	
P(T<=t) two-tail	0.6440784		P(T<=t) two-tail	0.54361	
t Critical two-tail	2.5705818		t Critical two-tail	2.4469118	
Team leader coaching: group 1 and 3 comparison t-Test: Two-Sample Assuming Unequal Variances			Team leader coaching: group 1 and 4 comparison t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2		Variable 1	Variable 2
Mean	4.625	4.9833333	Mean	4.625	4.6
Variance	0.7291667	0.6462644	Variance	0.7291667	0.488889
Observations	4	30	Observations	4	10
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	4		df	5	
t Stat	-0.793687		t Stat	0.0519953	
P(T<=t) one-tail	0.2359016		P(T<=t) one-tail	0.4802729	
t Critical one-tail	2.1318468		t Critical one-tail	2.0150484	
P(T<=t) two-tail	0.4718032		P(T<=t) two-tail	0.9605458	
t Critical two-tail	2.7764451		t Critical two-tail	2.5705818	

Team learning behavior: group 1 and 2 comparison			Team learning behavior: group 1 and 3 comparison		
t-Test: Two-Sample Assuming Unequal Variances			t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2		Variable 1	Variable 2
Mean	4	4.0175439	Mean	4	4.15
Variance	0.4259259	0.5212801	Variance	0.4259259	0.460441
Observations	4	19	Observations	4	30
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	5		df	4	
t Stat	-0.047941		t Stat	-0.4297491	
P(T<=t) one-tail	0.4818096		P(T<=t) one-tail	0.3447583	
t Critical one-tail	2.0150484		t Critical one-tail	2.1318468	
P(T<=t) two-tail	0.9636193		P(T<=t) two-tail	0.6895165	
t Critical two-tail	2.5705818		t Critical two-tail	2.7764451	
Team learning behavior: group 1 and 4 comparison			Team learning behavior: group 1 and 3 comparison		
t-Test: Two-Sample Assuming Unequal Variances			t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2		Variable 1	Variable 2
Mean	4	4.35	Mean	4	4.15
Variance	0.4259259	0.7558642	Variance	0.4259259	0.460441
Observations	4	10	Observations	4	30
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	8		df	4	
t Stat	-0.8202597		t Stat	-0.4297491	
P(T<=t) one-tail	0.2179124		P(T<=t) one-tail	0.3447583	
t Critical one-tail	1.859548		t Critical one-tail	2.1318468	
P(T<=t) two-tail	0.4358248		P(T<=t) two-tail	0.6895165	
t Critical two-tail	2.3060041		t Critical two-tail	2.7764451	

## RESÜMEE

### MEESKONNA ÕPPIMINE MAATRIKSORGANISATSIOONIS: JUHTUMIJUURING MEHHIKO TARKVARAARENDUTETTEVÖTTES

Tänapäeva globaliseerivas maailmas on ettevõtetevaheline konkurents väga tugev. Eriti tuntav on see tarkmevaraarendusettevõtete puhul, kus samal ideel põhineva toote või teenuse võivad luua erinevad ettevõtted ja teostuskiirusest sõltub, kas ettevõtte võidab turuosa või mitte. Sellises kiiresti muutavas keskkonnas on turul edukad need ettevõtted, mis mitte ainult ei reageeri probleemidele vaid suudavad selles keskkonnas ka kohaneda st suudavad õppida. Neid organisatsioone nimetatakse „õppivateks organisatsioonideks“ (*learning organizations*).

Peter Senge, üks tuntumaid õppivate organisatsioonide uurija, eristas viit komponenti või distsipliini, mis aitavad ettevõtetele õppida. Need on süsteemne mõtlemine, isiklik areng, mentaalsed mudelid, jagatud visioon ja meeskonna õppimine. Teadmuse üleviimine indiviidi tasemelt ettevõtte tasemele toimub reeglina meeskonna õppimise kaudu. Seetõttu on meeskonna õppimine valitud antud töö uurimisobjektiks.

Paljud teadlased on juba uurinud meeskonna õppimist ja on tõestanud, et see mõjutab positiivselt meeskonna produktiivsust.

Autoril on unikaalne võimalus teostada uuring kaks aastat tagasi loodud tarkvara arenduskeskuses Mehhikos. Ettevõtte, mille arenduskeskusega on tegemist, on olnud üks maailma liidritest tarkvaraturul juba 30 aastat. Tegemist on rahvusvahelise ettevõttega, mille peakontor paikneb Silicon Valley's. Ettevõttel on müügiesindused üle maailma, arenduskeskused paiknevad lisaks USA-le ka Indias ja Mehhikos.



Mehhiko keskus avati 2010. aastal ja märtsis 2012. töötab seal juba üle 270 arendaja.

Töö uurimismeetodiks on valitud *case-study*, mis püüab leida vastust küsimusele: kuidas kahe-aasta vanuses maatriksorganisatsioonis on saavutatud kõrge meeskonna õppimise tase ja mil viisil see õppimine toimub.

Autor on analüüsinud mitmeid faktoreid, mis hüpoteetiliselt võiksid mõjutada Mehhiko arenduskeskuse meeskonna õppimist, nagu rahvuskultuur, organisatsiooni struktuur, organisatsiooni kultuur, psühholoogiline kliima projektimeeskondades, ülikoolist otse firmasse tulnud inimeste arv jne.

Uuringus kasutati kolmel erineval viisil kogutud andmeid : intervjuud projektimeeskondade juhtidega, küsimustik töötajatele ja autori vaatlused. Küsitlusel saadi 64 täidetud ankeeti meeskondadest, mille juhatajad on lubanud uurimust läbi viia. Lisaks 5 intervjuud nende juhatajatega ja ulatuslikud vaatlused.

Töös on püsitatud viis hüpoteesi meeskonna õppimise kohta Mehhiko arenduskeskuses: 1)isiklik areng mõjutab positiivselt meeskonna õppimist; 2)jagatud visioon on mõjutab positiivselt meeskonna õppimist; 3)meeskonna õppimine mõjutab positiivselt tulemuslikkust; 4)meeskonna psühholoogiline turvalisus korreleerub positiivselt meeskonna õppimisega; ja 5)värskest ülikoolist töötajad on rohkem avatud meeskonnaõppeks.

Pärast andmete valideerimist on kasutatud faktoranalüüsi, Spearmani korrelatsioonikordajat ja t-testi, et saada hüpoteesidele kinnitust või need ümber lükata. Uuringu tulemused näitavad, et Mehhiko arenduskeskuses seos meeskonna õppimise ja meeskonna tajutud tulemuslikkuse vahel on positiivne ja tugev. Kuid samuti tuvastas uuring, et vaatamata sellele et isiklik areng on positiivselt seotud meeskonna õppimisega, on see seos nõrk. See tähendab, et kuigi inimene võib palju juurde õppida, kuid kui ta ei jaga oma teadmisi meeskonnaga, siis tiimi teadmus ei kasva sama kiiresti, kui selle inimese enda teadmus. Jagatud visioon ja psühholoogiline turvalisus on positiivselt seotud meeskonna õppimisega. Hüpotees kultuuri mõju kohta meeskonna õppimisele ei leidnud kinnitust – nii otse ülikoolist tööle astunud inimesed, kui ka kogenud töötajad on võrdselt

avatud meeskonnaõppeks.

Analüüsid Mehiko kultuuri ja ettevõtte organisatsioonikultuuri, jõuti töös järeldusele, et rahvusliku (Mehiko) kultuuri mõjud ei avaldu organisatsiooni kultuuri domineerimise tõttu.