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# ABSTRACT

Abstract

Six sigma is a quality improvement philosophy with systematic and formal approach. In order to successfully implement and utilize six sigma the basic disciplines of it should be adopted by the entire organization. Furthermore, employee involvement is crucial in six sigma implementation. This thesis addresses the challenges of long-lasting involvement in the case company. It focuses on gaps of involving six sigma trained employees, Black Belts.

Theoretical framework of the thesis illustrates different factors influencing employee involvement. Influencing factors can be divided into ten categories: organizational culture, managerial commitment, leadership style, employee empowerment, employees' perceptions, communication, training, goals, performance measurement and incentives. Factors and categories overlap and are related to each other. The framework provides holistic view of employee involvement in six sigma context but can be used also with other quality management philosophies.

This thesis was conducted as a case study and written on an assignment to a power and automation technology company. Due to the nature of research problem, the data collection was conducted by interviewing case company personnel. In order to study involvement from employees' point of view interview questions were designed to be open-ended and to allow the interviewees to tell freely about the phenomenon.

This thesis provides empirical support on previous studies in organizational support, management commitment and employee empowerment. In addition, it indicates the importance of separate function for Black Belts in the organization. The gaps in Black Belt involvement can be categorized under two categories: Management driven gaps are related to management commitment, organizational structure and culture and information systems. Black Belt driven gaps are related to practice and effort of using six sigma. This thesis finds solutions for bridging these gaps in the case company by applying findings from literature research and suggestions given by the interviewees. For each gap, actions are suggested for bridging the discrepancy between current and desired situations.
The thesis states that in order to embed six sigma in the organization the most crucial gaps, lack of management commitment, six sigma vision and possibilities to use six sigma, should be diminished.

| Key words | Six sigma, involvement, gap, Black Belt |
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| Further information | |

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**TIIVISTELMÄ**

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Tiivistelmä

Six sigma on systemaattinen ja muodollinen laadunparannusmenetelmä. Onnistuneen implementoinnin edellytyksenä on, että koko organisaatio omaksuu six sigman ajatusmallin ja olennaisimmat menetelmät. Henkilöstön sitoutuminen on yksi kriittisimmistä tekijöistä six sigman implementoinnissa. Tämä tutkielma pyrkii selvittämään millaisia haasteita toimeksiantajayrityksellä on henkilöstön pitkäjänteisessä sitouttamisessa. Tutkielma keskittyy kuiluihin, joita on six sigmaan koulutettujen työntekijöiden, Black Beltien, sitouttamisessa six sigmaan.

Teoreettinen viitekehys on muodostettu aikaisemmista tutkimuksista löydettyjen havaintojen pohjalta. Se esittelee tekijät, jotka vaikuttuvat työntekijöiden sitoutumiseen. Nämä vaikuttavat tekijät voidaan jakaa kymmeneen kategoriaan, joita ovat organisaatiokulttuuri, johdon sitoutuminen, johtamistyyli, työntekijöiden valtuuttaminen, työntekijöiden näkemykset, viestintä, koulutus, tavoitteet, suorituksen mittaus ja palkitseminen. Kategoriat ja tekijät ovat osittain samankaltaisia ja liittyvät toisiinsa. Viitekehys tarjoaa kokonaisvaltaisen kuvan henkilöstön sitoutumisesta six sigmaan, mutta sitä voidaan käyttää myös muita laadunhallintamenetelmiä tarkastellessa.

Tämä tutkielma on tehty toimeksiantotyönä sähkövoima- ja automaatioteknologiayhtymälle. Tutkimusmenetelmänä on käytetty tapaustutkimusta, jossa tietoa on kerätty haastattelemalla kohdeyrityksen henkilöstöä. Jotta sitoutumista voidaan tutkia työntekijöiden näkökulmasta, tutkimuskysymykset olivat avoimia ja mahdollistivat haastateltavien vapaamuotoisen kerronnan.

Empiirinen aineisto tukee aikaisempien tutkimusten löydöksiä organisaatiokulttuuriin, johdon sitoutumiseen ja henkilöstön valtuuttamiseen liittyen. Lisäksi tutkielma tuo esille erillisen Black Belt –ryhmän tärkeyden Black Beltien sitouttamisessa six sigmaan. Tutkielma luokittelee löydetyt kuilut johdon toimintaan ja Black Beltien toimintaan liittyviin kuiluihin, jotka voidaan edelleen jakaa alakategorioihin: johdon toimintaan liittyvät alakategoriat ovat johdon sitoutuminen, organisaatiorakenne ja –kulttuuri sekä tietojärjestelmät, Black Beltien toimintaan liittyvät alakategoriat ovat käytännöt ja viitseliäisyys. Jokaiseen kuuluun liittyen on ehdotettu käytännön toimia, joilla pienentää nykytilan ja tavoitetilan välistä eroa.

Jotta six sigma voidaan onnistuneesti juurruttaa organisaatioon, kriittisimpiin kuiluihin, johdon heikko sitoutuminen, six sigma vision puuttuminen ja heikot mahdollisuudet käyttää six sigmaa, tulisi puuttua.

| | |
|---|---|
| Asiasanat | Six sigma, sitouttaminen, kuilu, Black Belt |
| Muita tietoja | |

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# INVOLVING EMPLOYEES IN SIX SIGMA

## Case ABB Oy, Drives and Controls

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# 1 INTRODUCTION

## 1.1 Background of the study

Six sigma is quality management philosophy that aims at improving quality by reducing variation in production process (Dedhia 2005, 568). Six sigma philosophy extends beyond reducing variation: it covers whole organization aiming at developing the organizational culture to become more quality oriented culture (Breyfogle III 1999, 3-5). It has been widely applied in multinational corporations such as Motorola and General Electric where successful adoption of six sigma has resulted in notable cost savings and quality improvements. However, successful implementation requires that entire organization adopts the basic disciplines of the philosophy. Wide range participation in six sigma activities in all organizational levels is essential for gaining benefits from six sigma. (Dedhia 2005, 571-572.)

Successful quality management is highly dependent on employee involvement. Even though widespread involvement does not solely ensure effective adoption of new quality culture, the importance of involvement cannot be neglected. (Taylor & Wright 2003, 109.) Lack of employee involvement has harmful effect on sustainability of six sigma in a long-term (Welikala and Sohal 2008, 640). Quality improvements should not be delegated to one department or quality specialists instead the entire organization should be involved in improvement actions. Successful quality culture change requires that everyone in the organization is responsible for quality improvements. (Terziovski, Sohal & Moss 1999, 925.) Long-term adoption of quality management method such as six sigma is not only dependent on effective use of statistical methods; it is also strongly related to human element. Neglecting people involved in quality improvements will cause difficulties in changing quality culture permanently. (Edwards & Sohal 2003, 566.)

Even though six sigma has been widely researched, employee involvement in six sigma context has not been studied as extensively. However, research about employee involvement can be found from total quality management studies. Previous studies tend to focus on specific factors in involvement such as employees' perceptions or manager's role instead of whole picture. The perspectives of the previous researches are more focused on the factors of six sigma success instead of the factors that have negative effect on employees' willingness to get involved in six sigma activities. Besides six sigma context minor research has been carried out about gaps in employee involvement. In this thesis gaps in employee involvement stand for discrepancy between current situation and desired situation (Meirovich, Galante & Kanat-Maymon 2006, 82). The aim of the thesis is to identify why six sigma is not fully utilized in the case company and give suggestion how the organization can improve utilization.

## 1.2    Research questions and limitations

This thesis has been written on assignment for the Drives and Controls business unit of ABB Oy. The need for the research has arisen from problems faced by the case company: long-term involvement of six sigma trained personnel has not been successful and six sigma is not utilized extensively enough. The case company has trained employees to become six sigma Black Belts but it has not resulted in long-term involvement. Due to the real-life problems in the case company the research questions have been designed to focus on these issues. The thesis will answer to following research questions:

*What are the gaps of involving Black Belts in six sigma? How to bridge the gaps?*

Since the problems related to employee involvement in six sigma context are not widely studied before, this thesis will focus on the negative factors that prevent or impede personnel for participating in six sigma activities. The focus of the thesis is closely related to human behavior, the aim is to study why employees are not involved in six sigma and how the level of involvement can be improved.

## 1.3    Structure of the study

The thesis consists of eleven chapters starting with introduction. The first chapter presents background of the study and the research problem. In the second chapter basics of six sigma philosophy is introduced: the chapter discusses the definition of six sigma and the quality in six sigma context. It also presents the improvement model typical for six sigma projects and brings out the differences between six sigma and other quality management philosophies such as total quality management and lean.

After introducing six sigma, the thesis will move on to the third and fourth chapters that discuss issues related to change management and employee involvement in the quality management context. The aim of the chapters is to provide wide overview of the previous researches related to the research problem. In the chapter three change management in general and change management in six sigma context are discussed. The factors related to quality culture change have been grouped into four categories: organizational culture, leadership style, managerial commitment, communication and inducements. Employees' role in change is discussed in the chapter four where employee empowerment, employees' perceptions and personal development are reviewed. The fifth chapter summarizes the factors and issues found into theoretical framework that presents the most common factors influencing employee involvement based on the chapter three and four. The framework visualizes different aspects and their relationships related to employee involvement. The aim of the fourth chapter is to present key ideas from the previous studies that have been discussed in more detail in the previous chapters. The framework in the chapter five

provides foundation to the empirical research by helping to understand the underlying background of employee involvement in six sigma context.

Research methodology is presented in the chapter six. In addition to the research strategy and process also reliability and validity of the study are discussed. Moreover the case company is introduced in the chapter six. Empirical data is presented and discussed in the following chapters. Six sigma in the case company is described in the chapter seven. It explains the current situation regarding six sigma in the case company: first it describes general circumstances such as quality management program in ABB, six sigma familiarity, trainings and projects, later it discusses six sigma support from organization and management, target setting and availability of tools and data for six sigma utilization. In the chapter eight improvement possibilities are presented and challenges related to the possibilities discussed. The chapter is divided into three sections: it studies the possibilities from Black Belts' and from organization's point of view and later it presents one improvement suggestion in more detail.

Based on the chapters seven and eight the framework for Black Belt involvement is presented in the chapter nine. It combines the factors discussed in the previous chapters together with the findings from the literature review which are presented in the chapter five. The Black Belt involvement framework provides foundation to the chapter ten which presents conclusions of the study. Furthermore it discusses theoretical implications of the study and give suggestions for further research. The study is summarized in the chapter eleven.

# 2 SIX SIGMA PHILOSOPHY

## 2.1 The basics of six sigma

### 2.1.1 Definition

Six sigma is a comprehensive method of improving quality; it includes problem solving and optimization as well as cultural change (Raisinghani, Ette, Pierce, Cannon & Daripaly 2005, 491). Six sigma can be described as organizational culture rather than a set of tools and techniques to improve quality (Schroeder, Linderman, Liedtke & Choo 2008, 537). The focus is in measuring product quality, reducing variation, improving processes and reducing costs (Dedhia 2005, 568). The main goal is to increase customers' satisfaction by meeting their expectations and requirements in terms of product or service characteristics and delivery time. Performance improvements are achieved by reducing waste and inefficiency and designing products and internal processes. (Welch & Welch 2005, 247.) Linderman, Schroeder, Zaheer and Choo (2003, 195) have created the following definition for six sigma:

> *Six Sigma is an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined defect rates.*

According to the definition six sigma is customer-oriented method which aims at eliminating defects by improving processes with statistical methods. The focus is on customer satisfaction. (Linderman et al. 2003, 195.) The ultimate goal is increased net income that can be achieved through increased customer satisfaction which is related to process improvements and defect reduction (Raisinghani et al. 2005, 504). The improvement process increases quality level and reduces costs and cycle time which lead to improved profitability and competitive advantage (Breyforgle III 1999, 3). Six sigma is capable of improving performance of routine and repetitive tasks but it can also be used in complex projects for ensuring the best quality in the designing phase (Welch & Welch 2005, 248-249). Magnusson, Kroslid and Bergman (2000, 14) describe six sigma as a company-wide strategic initiative for improving process performance. They define six sigma more precisely:

*At the core of six sigma is a formalized, systematic, heavily result oriented, project by project improvement methodology tailor-made to achieve improvements on variation first of all, but also in cycle time and yield.*

Six sigma consists of statistical tools that are used with a structured methodology in order to expand the knowledge (Magnusson et al. 2000, 14). The goal is to develop performance for achieving better, faster and less expensive products and services. Increased profit margins are gained by implementing six sigma to a project after project in a continuous manner which makes it an on-going improvement method. (Breyforgle III 1999, 5.) Six sigma involves whole organization and its different functions: management, shareholders employees, organization's structure, training scheme, measurement systems, projects with bottom-line results and financial support. Six sigma philosophy aims at changing the organizational culture towards more quality-orientated and developing organizational approach towards out-of-the-box thinking. It consists of a measurement system to evaluate business processes' ability to meet their goals and strategies to improve process performance (Breyfogle III 1999, 3-5, 15). Six sigma is based on statistics, statistical thinking and statistical tools (Magnusson et al. 2000, 15).

### 2.1.2    *Six sigma quality*

The Greek alphabet sigma ($\sigma$) describes variability. Six sigma quality level indicates how often defects are likely to occur in process and thus measures process capability by analyzing variability in the process. (Breyfogle III 1999, 3). Quality is often measured by defects per million opportunities (also known as part per million, ppm) because it is simple and easy to use metric and suits well on monitoring improvements (Magnusson et al. 2000, 26). Six sigma quality level requires that the process is capable to produce 99.99966% quality that is maximum 3.4 defects per million opportunities (parts or process steps). In this situation the process mean can shift by as much as $1.5\sigma$. It has been studied that in the average company the quality level is four sigma but world class companies may have six sigma quality level. (Breyfogle III 1999, 8-11.) However, even in the best companies the six sigma quality level is extremely difficult to achieve (Magnusson et al. 2000, 26). The world class companies are studied to have the six sigma performance level in the short term or the four sigma performance in the long term (Breyfogle 1999, 147).
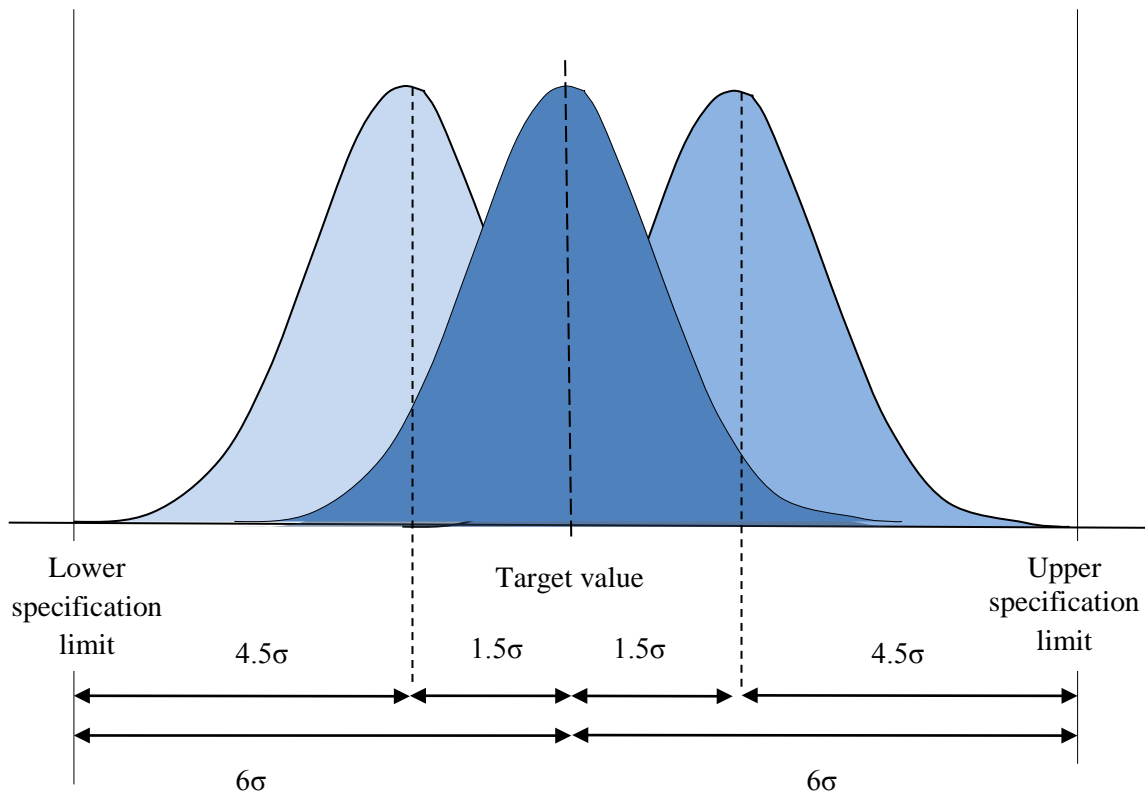
Figure 1    The effects of a 1.5σ shift if the normal distribution (cf. Magnusson et al. 2000, 26 & Breyfogle III 1999, 10.)

The figure 1 illustrates the normal distribution and the effects if the mean shifts 1.5σ from the target value. In the six sigma quality level the mean is allowed to shift 1.5σ in order to maintain the quality level. The mean can vary 1.5σ from the target value and still the process performance is within the lower and upper specification limits and only 3.4 defects per million opportunities fail to meet the specifications. In the six sigma quality level, the specification limits (lower and upper specification limits) are set within six sigma from the target value.

Table 1    The number of defects in different six sigma specification limits
           (Breyfogle III 1999, 10.)

| Specification limit | Percent ("the goodness level") | Defectives ppm |
|---|---|---|
| $\pm1\sigma$ | 30.23 | 697 700 |
| $\pm2\sigma$ | 69.13 | 308 700 |
| $\pm3\sigma$ | 93.32 | 66 810 |
| $\pm4\sigma$ | 99.3790 | 6 210 |
| $\pm5\sigma$ | 99.97670 | 233 |
| $\pm6\sigma$ | 99.999660 | 3.4 |

In the table 1 the percent ("the goodness level") indicates quality of the process; in six sigma quality level the percent is near 100% but in the two sigma level the process is capable to produce 69.13 % quality. Like "the goodness level", the number of defects per million parts varies greatly: for example in two sigma level the number of defects is 308 700 per million and in six sigma level only 3.4 per million. The wider the specification limits are, the smaller the number of defects that fails to meet expectations. (Breyfogle III 1999, 10.) If the six sigma quality level is four, the number of defects per million opportunities is 6210 which equals to 99.3790% quality. (Breyfogle III 1999, 8-11.) In six sigma performance organization produces 1826 times fewer defects than in the four sigma level. From $4\sigma$ level to $6\sigma$ level profit has been studied to increase by at least 10% (Breyfogle III 1999, 147).

The $1.5\sigma$ variation is often considered as typical process shifting in the six sigma methodology. (Breyfogle III 1999, 136.) Variation is observed because the deviation from the target value in process or product characteristic causes excess cost. These costs can occur within the company but there might be also extra cost outside the organization for example to the customer or society. Poor process performance can cause excess costs for example in the following functions: inspection, account receivables overdue, late incoming materials and high inventories. (Magnusson et al. 2000, 27-28.)

Variation can be categorized into two types: common cause variation and special cause variation. Common cause variation is also known as random variation and it is inherent part of the process. It is impossible to eliminate random variation without changing the design of the process or the product. Special cause variation has larger effect than common cause variation. It is unpredictable in terms of occurrence and effect causing haphazard changes to the conditions. The six sigma quality improvement method consists of eliminating special causes of variation, reducing dispersion and centring to the target value. Process predictability is increased by eliminating the special causes of variation. The wide dispersion is caused by the large variation in the values of the characteristics. In order to reduce dispersion, the main special causes need to be identified and their influence eliminated. Centring is used to improve process performance if the average values are not close to the target value. Improvement process may result in improved target value

or even developed process that increases customer satisfaction. (Magnusson et al. 2000, 23-24.)

### 2.1.3 Six sigma role structure

Six sigma uses a special role structure where individuals participating six sigma activities have received various levels of training. The training scheme begins with Green Belt training, followed by Black Belt training and the most skilled participants continue training to become Master Black Belts or Champions. The Green Belt training provides necessary skills and knowledge for employees to support six sigma projects. After training they should be able to focus on graphical analysis techniques. (Lloréns-Montes & Molina 2006, 488.) Green Belts are part-time specialists dividing their time between improvement projects and normal work tasks which differentiate them from the more advanced six sigma roles. (Dedhia 2005, 573).

Improvement teams are led by Black Belts who receive intensive four-week training program over a four-month period (Lloréns-Montes & Molina 2006, 488, Dedhia 2005, 573). They focus solely on improvement projects and leave their normal positions for committing to six sigma. (Lloréns-Montes & Molina 2006, 488.) Their role is also mentor Green Belts and work on projects across the business (Henderson & Evans 2000, 270). In addition to the Green and the Black Belts there are also two roles for promoting and implementing six sigma in the organization: Master Black Belts and Champions. Master Black Belts can be seen as internal consultants for six sigma who are responsible of six sigma strategy, training, mentoring, deployment and results. (Henderson & Evans 2000, 270.) Champions focus on six sigma support, deployment and promotion on business units or significant business areas (Henderson & Evans 2000, 270, Lloréns-Montes & Molina 2006, 488). They are responsible of translating the organization's vision, mission and goals into improvement projects. Furthermore, their role is to ensure that the six sigma program is executed as planned (Dedhia 2005, 573.)

## 2.2 Six sigma improvement model - DMAIC

There are five steps in the six sigma improvement methodology: define, measure, analyze, improve and control (Magnusson et al. 2000, 15). The abbreviation DMAIC is often used to indicating these steps. These five steps are the key processes of six sigma projects and the DMAIC is served a framework for implementing six sigma (Jones, Parast & Adams 2010, 416).

An improvement process begins with define –phase. First the processes or products that need improvement and have large improvement potential have to be identified. Identification can be based on six sigma measurement system but also other factors such as customer complaints, non-conformity reports and employee suggestions. There can be need for improvement only in single characteristics of the process/product or in some situations whole process/product requires improvement. Processes or products are evaluated with the following criteria: benefits for customers, benefits for company, the complexity of the process and cost saving potential. These criteria are used for prioritizing among potential improvement projects by using pareto-chart and cause-effect diagram. In this phase a person or a project team responsible is nominated for this improvement project. (Magnusson et al. 2000, 56.) The phase sets guidelines for improvement if the project has been clearly defined (Dedhia 2005, 570).

After defining the process or product needing improvement measurement step will begin. This phase consist of selecting the process'/product's characteristics to be improved. (Magnusson et al. 2000, 57.) Controlling of the improvement is based on measurements which emphasizes the importance of this phase (Dedhia 2005, 570). Selection also includes identifying the inputs of the process or product that can have effect on the process/product performance. The results of selecting process and characteristics are following variables: $ys$ (result variables) and $xs$ (input variables). These variables are based on the expression "$y$ is the function of $x$". Input variables are control factors which mean that they can be controlled physically. After selecting process and characteristics the needed data about the variables is collected. Data collection is based on restrictive decision about data types, gauge accuracy, sample size, measurement intervals, duration of measurements and the method of data recording. (Magnusson et al. 2000, 57.)

Third step in the improvement model is analyzing. Data analysis creates knowledge for decision making and helps finding the solution for improving selected process or product. (Dedhia 2005, 570.) Analysis phase includes data evaluation like calculating the mean value and dispersion of each $x$ and $y$ variables. Result variables' ($ys$) predictability is also measured; which means testing whether the result variables are predictable in the performance. In this phase the performance results for $ys$ are often compared to similar processes or products. In some situations the results are benchmarked with the other companies whose performance in comparable process/products is better. Analysis phase determines the goals for the improvement project. (Magnusson et al. 2000, 58.)

Improvement actions are defined in the fourth step of DMAIC-model. The result variables ($ys$) to be improved and the method of improvement actions are decided. (Magnusson et al. 2000, 58.) Improvement actions can be both corrective and preventive (Dedhia 2005, 570). The result variables can be improved in three ways: improving their predictability, diminishing dispersion and/or centring the distribution. Improvement process begins with identifying the input variables ($xs$) which improve the values of result variables

(*ys*). If the improvement project focus on centring of the distribution of the *y*, often small interventions in the input variables are sufficient for shifting the mean value of *y*. If the focus is on predictability or dispersion, special causes of variation are observed among the input variables. The improvement project is concentrated on these special causes. (Magnusson et al. 2000, 58.)

The last phase of the improvement project is controlling in order to ensure that the improvement actions result in desired outcomes (Magnusson et al. 2000, 50). After the improvement actions are implemented the processes need to be controlled. Besides controlling the actions, the desired results should be institutionalized which can be carried out by updating the flow charts or procedures of the process or the drawings of the product. It is important to share the experiences and results from the project thorough the entire organization. (Magnusson et al. 2000, 60.)

## 2.3    Quality management philosophies compared to six sigma

### 2.3.1    Total Quality Management

Like six sigma, total quality management aims at improving processes by using analytical and statistical tools. The target of total quality management is to increase customer satisfaction and gain customers' loyalty. It also aims at improving performance. Six sigma focuses more on cost savings and improving financial performance by improving processes. Furthermore, total quality management is seen as more customer driven approach compared to six sigma that primarily concentrates on eliminating defects from processes. (Andersson, Eriksson & Torstensson 2006, 290.) Also the nature of the targets differ: Pande, Neuman and Cavanagh (2000, 44) argue tangible targets are lacking in total quality management: they state that increase in customer satisfaction is unclear goal and it is impossible to track progress towards better customer satisfaction. The authors find that six sigma goals such as "3.4 defect per million opportunities" provide more measurable way to monitor performance. Moreover, it is easier to track progress towards clear and tangible goals. In total quality management it is challenging to measure performance and achievements against the goal because improvements are usually intangible by their nature (Andersson et al. 2006, 290).

### *2.3.2 Lean*

The key idea behind lean is to improve process flow by reducing lead time and inventory and also increasing productivity and customer satisfaction. Whereas six sigma aims at eliminating defects, lean philosophy focuses on removing waste from processes. It aims at understanding customer value which differentiates it from the six sigma approach where the customer satisfaction is not the main driver for quality improvement. (Andersson et al. 2006, 290.) Both six sigma and lean focus on achieving financial benefits from improvements: six sigma focuses on removing variation in the processes and lean helps to improve the efficiency of processes (Dedhia 2005, 572). It has been argued that lean reduces organization's flexibility when trying to reduce lead time in processes (Andersson et al. 2006, 290).

# 3 MANAGING CHANGE IN EMPLOYEE INVOLVEMENT

## 3.1 Change management principles

Change process begins with identifying drivers of the change; factors inside and outside organization that helps understand the needs for change. It is important to give reasons why change is needed. (Oakland & Tanner 2007, 584.) People need motivation for participating in the change process thus without motivated employees change will not succeed. Employees can be motivated to change by illustrating that change has more positive outcomes than staying in the current situation. (Kotter 1995, 60.) Before the actual change process detailed planning has to be developed and leadership styles determined. Change process begins with developing the organization and the resources to support the change. (Oakland & Tanner 2007, 584-585.) Kotter (1995, 62-63) argues that there is a strong need for powerful guiding coalition who will carry out the change. Without effective change management the resistance towards change will strengthen which can have detrimental impact to the change process. Effective change management involves everyone in the organization to the change process and takes into account employees' perceptions and attitudes towards the change (Clarke & Garside 1997, 541). During change managers should receive support and mentoring from the top management so that managers in the lower organizational levels can successfully lead their departments through the change. Training should be provided to managers for ensuring that they have capabilities to manage the change effectively. (Shanley 2007, 975.)

Managers have to develop vision that is easy to communicate to employees. It should give guidelines about the actions needed for the change. The vision should be as concise as possible in order to be easily understood. (Kotter 1995, 63.) It is important for managers to have a holistic view about the change and not only focus on human resource or information technology issues. It might be useful to have external view and support that helps finding the best way to carry out the change. (Oakland & Tanner 2007, 585.) Changing leadership style could be challenging for managers which why external support may be useful (Bititci, Mendibil, Nudurupati, Garengo & Turner 2006, 1344).

Effective communication is essential for the successful change. People will not change their behavior and make sacrifices unless they believe that it will have positive outcomes. Creating positive beliefs requires communication about the change and its benefits. Managers cannot rely solely on company newsletter which why all the existing communication channels have to be used. Communication is more than just words, it is also actions. Managers have to lead by example since they are symbols of the change and they have to show the desirable behavior to employees. (Kotter 1995, 64.) It is also important to find

a balance between the change process and normal operations that neither of them is neglected (Clarke & Garside 1997, 542). People expect short-term wins from the change and without benefits in the short-term their motivation can drop. Managers have to create positive outcomes in the shorter time frame especially if getting the full benefits of the change is long-term process. (Kotter 1995, 65-66.)

Performance measurement should be developed to encourage people to change their behavior. Employees behavior is influenced by all factors in the change; managers, organizational structure, evaluations and processes and systems used. Managers have also to take into account employees' beliefs and values because they have great influence on attitudes. (Oakland & Tanner 2007, 584-585.) Groen, Wouters and Wilderom (2012, 136) have studied that developing performance measurement together with employees has positive effect on their attitudes about performance improvements which also has positive impact on their initiative. Employees' attitude towards performance evaluation is more positive if employees had possibility to participate in developing performance measurements. It increases social pressure to achieve those measures because employees share the same priorities and targets. Developing measures highlights improvement opportunities which indicate that employees have capabilities to perform better. (Groen et al. 2012, 136.) Organizational culture, management style and performance measurement system need to be developed to support organizations' goals and needs. Developing the performance measurement system together with cultural change leads to more interactive management style which proves that those three factors are related to each other. In order to achieve performance improvements, the performance measurement system should encourage to continuous improvement. Developing performance measurement system requires collaboration with different levels of organization because of the cross-functional nature of the performance measurement. (Bititci et al. 2006, 1344.)

Successful change requires that the new practices and working methods are adopted in the entire organization. Organizational culture needs to be developed for supporting and maintaining the change. Institutionalization can be facilitated by showing employees how the performance has improved because of new approach and behavior. People need to understand that performance has improved because of the new practices not because of the charismatic manager or some other irrelevant factor. It is also important to complete the change and not to suspend the change process after the first performance improvements have been achieved. The change is not complete unless new approach and behavior have been institutionalized among employees and managers in all organizational levels. (Kotter 1995, 66-67.)

## 3.2 Change management in six sigma context

### 3.2.1 Organizational culture

Cultural change has been studied to be the most effective way to implement quality practices to organization because new quality practices require changes in organization's culture, processes and beliefs (Rad 2006, 618). According to Yeh (2003, 264) successful implementation of quality management program requires supportive environment where employees are familiar with their tasks and roles and where feedback is given. Supportive environment has a positive effect to employee involvement since in supportive culture employees are more willing to handle extra activities which are caused by the quality improvement program. (Yeh 2003, 264.) Aligning the change to the organizational culture facilitates adoption of desired behavior which in turn enables the organizational change. The key factors facilitating the change should be identified and utilized in order to support behavioral change. (Oakland & Tanner 2007, 583.) The importance of quality improvements needs to be embedded in organizational culture by emphasizing employee commitment (Oliver 2009, 559). Supportive environment encourages employees to engage in improvement activities and to participate in training and education (Zu, Robbins & Fredendall 2010, 97).

Organizational culture has to nurture learning and development during six sigma implementation (Sony & Naik 2012, 813). Successful six sigma adoption is related not only to quality-oriented but learning-oriented organizational culture as well (Oliver 2012, 17). It emphasizes the importance of human development in the cultural change (Zu et al. 2010, 97). The role of management is significant in creating nurturing organizational culture that promotes continuous quality improvement (Boon, Arymugam, Teh & Chong 2008, 919). Top management has to actively participate in developing the organizational culture in order to achieve successful cultural change (Ugboro & Obeng 2000, 263). However, there is a difference how managers and employees perceive cultural change: often managers find the change has only a little impact on culture while employees find greater cultural change. Since employees tend to feel that the change has more outcomes to their lives, the change might have negative influence on their attitudes (Patti, Fok & Hartman 2004, 225). Together with organizational culture, organizations' ethics should support quality management. It is important that there is congruence between managers' and employees' perceptions about ethics so that both parties share same goals. (Svensson & Wood 2005, 146-147.)

Rational culture has also positive influence on six sigma adoption. Because rational culture focuses on external competitiveness like achievements and productivity, it is compatible with six sigma goals. Rational culture emphasizes the importance of customer

satisfaction which encourages employees to build closer relationship with customers in order to understand better their needs. Understanding customers' needs will lead to better understanding of the needs for the six sigma practices. Successful adoption of six sigma requires management practices that focus on both human aspects and external targets because organizational culture has to be both flexible and controlling. Managers have to take human resources management into account but also focus on achieving external targets. (Zu et al. 2010, 97-100.) Six sigma has special role structure; there are improvement specialists who are responsible for improvement efforts. This role structure supports continuous improvement because six sigma specialists focus on six sigma procedures and tools, techniques and metrics for facilitating six sigma improvement procedures and performance improvements. (Zu & Fredendall 2009, 51.)

Cultural barriers have to be eliminated and organizational structure developed to support six sigma implementation (Huq, Aghazadeh, Najjar & Hafeznezami 2010, 117-118). Organizational structure has a positive effect on sustaining six sigma if the culture is consistent with the six sigma principles (Yeh 2003, 263). Buch and Tolentino (2006, 364) also argue that in successful six sigma implementation the organization should provide a supportive environment for employees to participate in improvement activities. Environment should support learning and facilitate the change. Supportive environment has significant role in employees' attitudes towards involvement. Especially the perceptions of communication are strongly related to supportive environment. (Shadur, Kienzle & Rodwell 1999, 496.) The organizational change is dependent on understanding of the quality philosophy because without understanding it is difficult to change attitudes, behavior and management style for supporting new organization culture. Change management should be tied with management styles and the organizational culture since those issues go hand in hand with the change. In addition to the organizational issues the change management should also take into account individual attitudes among personnel. (Hur 2009, 859.)

Individual commitment is strongly affected by supportive and encouraging environment (Sony & Naik 2013, 812). Organizational commitment tends to be higher if employees feel that they are working in "doing" culture where collaboration is valued and employees are encouraged to take responsibility of their work. (Sigler & Pearson 2000, 43-45). Organization culture should encourage employees to form mutual relationship with the organization for maximizing the advantages of quality improvement system. Organization should emphasize the importance of knowledge sharing among employees in quality culture adoption. (Joiner 2007, 624.) Kathuria and Davis (1999, 160) have studied that supportive, recognizing, inspiring and mentoring culture has a motivating effect on employees' performance. In this culture employees are encouraged to meet customers' demands by improving the quality. Managers motivate employees to manage their work-related issues independently; for example employees are encouraged to monitor quality of their own work. (Kathuria & Davis 1999, 160.) Organizational culture effects on job

satisfaction and employees' commitment towards the organization. Organizational culture and six sigma practices should be developed so that when these practices are taken into use employees' job satisfaction should remain on the same level or increase. (Boon, Arumygam, Bakar, Loke & Vellapan 2007a, 72). Organizational culture that encourages employees to involve quality activities has positive impact on job satisfaction. The culture does not only influence on employees' behavior but also their perceptions and interactions in the organization. (Boon et al. 2008, 919-920.) Organizational culture should emphasis the long-term goals over the short-time targets in order to involve employees. Focusing only the targets and how to achieve them, the company may lack employees' involvement in a longer time frame. (Welikala & Sohal 2008, 640.) In order to succeed in quality culture transformation participation should be used to motivate and involve employees in the change (Abraham, Crawford & Fisher 1999, 127). In the supportive organizational culture successes and failures are shared in order to learn from them (Savolainen & Haikonen 2007, 16). Creating better understanding about improvement opportunities, employees' roles and challenges faced by organization facilitates employees' ability to make improvements for processes and organization's performance. This can be ensured by involving all employees to problem-solving and creating possibilities for information sharing. Cross-functional activities increase the collaboration and communication among employees and thus facilitate information exchange. (Kovach & Fredendall 2013, 15.)

After successful implementation it must be verified that new practices have been truly adopted and there will not be recourse to the old ways (Kotter 1995, 67). Quality culture implementation should be carried out until the organization achieves desired culture that focus on quality improvements (Hur 2009, 859). Everyone in the organization should pay attention to quality issues and include them in their day-to-day activities as well as in decision making so that the long-term adoption can be achieved. Organization wide commitment requires that all members of the organization are involved in quality improvements, not only a specialized quality department. (Sohal & Terziovski 2000, 166.) Emphasizing innovation and learning helps creating and sustaining quality-oriented organizational climate that focuses on continuous improvement (Rad 2006, 620). Managers should encourage employees to work together and share their skills and knowledge in business processes for improving performance (Baird, Hu & Reeve 2011, 804). In the beginning of implementation both employees and top management have great enthusiasm towards new quality culture but the level enthusiasm will decrease as time passes. This causes difficulties in adopting the quality culture for the long-term. It is important to pay attention to successful change of old working habits into the new methods in order to maintain the quality culture change. (Pheng & May 1997, 169.)

In their study Buch and Rivers (2001, 369-370) found out that the new quality culture sustained at the same level two years after implementation but in the third year the culture changed back to the pre-implementation level. The lack of management commitment may

have effect on the failure of sustaining new culture. The authors also argue that the job re-design has decreased employees' job satisfaction which is related to their willingness to adopt the change. The clarity of tasks and work responsibilities as well as understanding organization's goals facilitates the adoption of the new culture (Yeh 2003, 264). Cross-functional teams can give wider perspective of quality issues which helps employees to understand better the improvement processes and their responsibilities in these processes. (Huq et al. 2010, 118.) Six sigma improvement activities require time and energy from the employees who are responsible for improvement projects. The organization should support these employees by ensuring that they have necessary resources and support in their projects and normal duties. Assistance may include also financial support since executing the improvements may need funds. (Ho, Chang & Wang 2008, 268.) Encouraging culture has more significant role in the quality culture adoption than monitoring employees' performance has. Managers should focus on encouraging employees to involve quality improvements and not only on controlling their performance since encouragement leads to performance improvements more likely than the controlling. (Hur 2009, 859.)

Employees have to feel that they are appreciated and they have possibilities to give suggestions about improvements. The lack of communication and commitment throughout the organization complicates the successful adoption to the change. (Sim & Rogers 2009, 45.) In addition to management support there should be support among employees. Managers should pay attention to developing supportive culture among co-workers from different levels of organization but also from the same organizational level. (Joiner 2007, 625.) It is important to support collaboration between different departments especially in product development and process improvement projects (Zu et al. 2010, 99). Baird et al. (2011, 804) have studied that there is a relationship between teamwork and quality practices. They suggest that managers should develop organizational culture towards more collaborative especially between work units and divisions because employees tend to use quality practices more often in collaborative environment. (Baird et al. 2011, 804.) Effective teamwork requires experienced team leader especially if the team is facing a challenging problem. The team doesn't necessarily have to consist only on six sigma experienced employees, there can be also newcomers if the team leader has participated six sigma improvement projects before. (Easton & Rosenzweig 2012, 491.)

Taking employees' rights and needs into account has positive effect on work climate and thus employee commitment. "The quality of work life" is related to respecting employees' rights which in turn influence their commitment. (Howard & Foster 1999, 17.) It is important that employees do not feel obligated to accept the new quality program without understanding its implications. On the other hand, the managers have to understand that they need also to take employees feelings into account because adoption will

not succeed only by assigning new responsibilities to employees. Employees can be involved to the new quality culture but it does not mean that they endorse the change which does not facilitate the long-term adoption of six sigma. (Edwards & Sohal 2003, 565.) Recognition relates positively to employee involvement and in supportive environment managers should recognize employees for their six sigma achievements (Buch & Tolentino 2006, 363). In such environment employees receive feedback from their work or their supervisor which helps in institutionalization of quality culture (Yeh 2003, 264). Motivated and appreciated employees will be more committed to the organization and to their work which results in stronger effort to improve performance. However, employee commitment requires encouraging environment where employees can feel that their work is important and appreciated. (Pamfilie, Petcu & Draghici 2012, 195.)

In organizational culture where employees take charge of their work and actively control the environment, employees are more likely to be committed to the organization. Collective culture has positive effect on employees' commitment. (Sigler & Pearson 2000, 45.) Managers cannot rely solely on employee commitment in the change process, they still have to take employees' interest into account and focus on involving employees to the cultural change. Employee commitment and the effective change management facilitate the adoption of new quality culture by reducing resistance to change. (Peccei, Giangreco & Sebastiano 2011, 199.) Commitment has been studied to be higher in the culture where power distance is greater when differences between managers' and employees' status and power are large. Reducing power distance between managers and employees may cause resistance and even lead to lower levels of organizational commitment. Power distance is also related to empowerment, larger power distance between managers and employees has positive influence on employees' perceptions of empowerment. Sharing power may not always results in positively especially if employees feel that they are obligated to take new responsibilities. (Sigler & Pearson 2000, 44-45.)
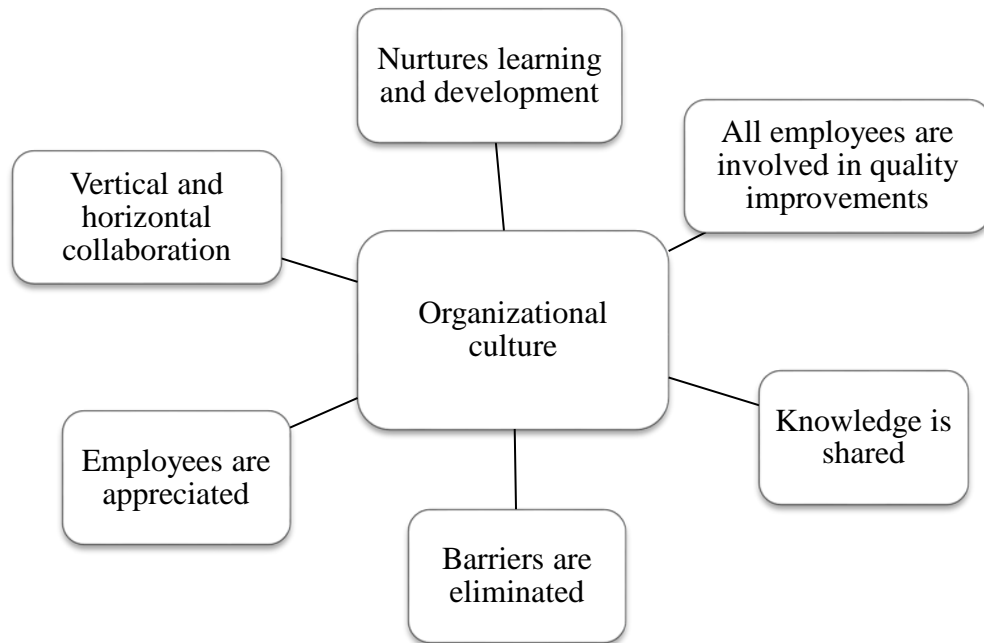
Figure 2        Six sigma supportive organizational culture

In the figure 2 characteristics of six sigma supportive organizational culture are illustrated. In supportive culture employees are appreciated and all employees are involved in six sigma activities. Furthermore knowledge is shared and there is collaboration between different organizational levels and also between different departments in the same organizational level. Barriers of the change are eliminated and learning and development nurtured in the supportive organizational culture.

### 3.2.2    Leadership style

Interactive leadership style that takes into account employees' ideas and feelings has supportive influence on quality management. In interactive leadership there is mutual trust between employees and managers. Six sigma requires consultative leadership where employees are able to manage their work independently and improve their performance for satisfying customers better. Top management has a key role in providing information about the customers' needs which why interactive leadership is dependent on top management's commitment. (Politis 2003, 189.) During six sigma implementation management style should be based on open-mindedness and shared vision (Sony & Naik 2012, 812). Maintaining optimism and positivism among employees facilitates the adoption of six sigma (Svensson & Wood 2005, 147). Kotter (1995, 62) argues that there is a need

for a strong and powerful leadership coalition who guides the organization through transformation. Leadership commitment should be continuous throughout implementation and emphasize the cultural change and long-term goals (Motwani, Kumar & Antony 2004, 281). Continuous review is essential for ensuring that the change will achieve the set goals and improvement actions have been carried out as planned (Oakland & Tanner 2007, 583). Management has to provide necessary resources for six sigma implementation adjusting internal policies and procedures to meet the requirements of six sigma implementation (Laosirihongthong, Rahman & Saykhun 2006, 316).

There is a relationship between leadership style and employees' attitudes towards quality management system. If employees' attitudes towards managers are negative, they tend to find the change of quality management system positive. Employees are more willing to accept the change if their perceptions towards managers are less favorable. On the other hand, if employees are satisfied with current leadership style, they tend to react more critically towards the new quality management system. Communication has an effect on perceptions: if communication is both top-down and bottom-up, it results in more positive attitudes towards managers which lead to low need for change and resistance to the new quality management style. One-sided communication has contrary effect: it creates positive perceptions towards the change. (Meirovich et al. 2006, 81-82.) However, the relationship between leadership and employees job involvement is weak; leadership does not significantly influence employees' involvement (Boon et al. 2007b, 956). Pessimism and negativism about the change should be diminished because they may harm not only successful adoption of quality culture but also organizations' overall performance (Svensson & Wood 2005, 147). Employees should be motivated constantly to adopt organization's values and to involve quality actions that support organization's goals (Parumasur & Govender 2013, 649). Managers should focus on continuous improvement and employee involvement in the entire organization while managing the change (Laosirihongthong et al. 2006, 316). Furthermore, they should strongly support the focus on quality and be willing to develop organization towards quality-orientation. They should be capable of changing their leadership comprehensively in order to facilitate the quality culture change. (Sila & Ebrahimpour 2005, 1137.) Internal policies and procedures have to be developed to promote the six sigma quality culture (Laosirihongthong et al. 2006, 316).

Human resource management practices have to be developed to support the change and the new quality culture. Without proper support from human resource management, the vision and the actions of management are useless. (Blackburn & Rosen 1993, 61.) Developing human resource management to support six sigma is essential for sustaining the quality culture change because without employee involvement the change will not succeed in the long-term (Welikala & Sohal 2008, 640). Human resource management should include training, employee satisfaction, works systems, employee involvement in decision making, empowerment, communication and teamwork (Sila & Ebrahimpour

2005, 1137). It has influence especially on employees' quality awareness which supports the adoption of quality practices. Managers should collaborate with human resource management for developing the organizational culture into supportive environment for quality improvements. Quality management practices should be integrated into human resource management in order to achieve long-term benefits from quality improvement program. (Abu-Doleh 2012, 230-231.) Human resource policies should have motivating effect on employees. Together with shared values and high level of socialization they help internalizing organization's mission and increases effectiveness of work teams. Shared mission strengthens teams' adoption of quality practices and thus has positive impact on teams' performance. (Escribá-Moreno et al. 2008, 56.)

Even though human resource management has important role in the six sigma institutionalization, fundamentally six sigma is business-driven process, not program for human resource management. Six sigma begins from the management level after which the implementation is carried out in the lower levels of organization. (Cheng 2013, 31.) Managers should also focus on the soft side – employees – because the successful cultural change is strongly dependent on people and their involvement to the quality improvements (Lam 1995, 77). Soft factors such as committed leadership and employee involvement promote the quality improvement practices and improve the overall performance of the organization. By taking soft factors into account managers can contribute to the successful adoption of quality practices. (Abdullah et al. 2008, 447.) Soft side of the business operations such as employees' optimism or pessimism toward the quality management should not be neglected by management because negative perceptions may detrimentally influence the six sigma outcomes (Svensson & Wood 2005, 146-147). Top management should also focus on maintaining the quality culture after implementation. Reviewing of the critical quality programs is necessary in order to sustain the new quality culture. Top management should encourage employees to implement quality initiatives by allocating sufficient resources to these improvement projects. (Ugboro & Obeng 2000, 263.)
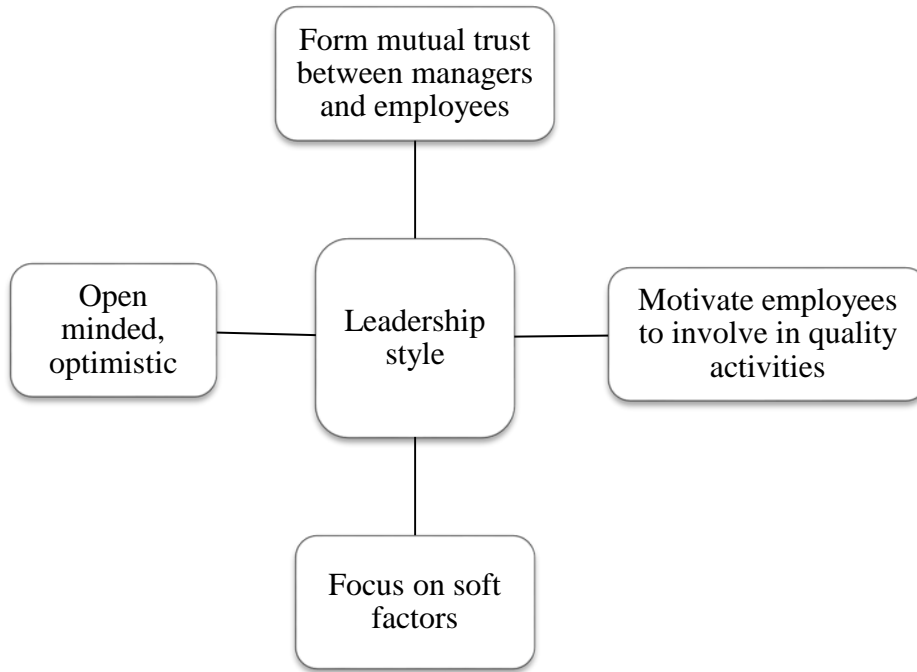
Figure 3          Six sigma supportive leadership style

Figure 3 presents factors in six sigma supportive leadership style. Managers should be open-minded and optimistic regarding six sigma and also motivate their subordinates to participate in six sigma activities. Moreover they should focus on soft factors and try to build mutual trust between them and employees.

### 3.2.3    *Management commitment*

It has been studied that management commitment and involvement have the most significant role in six sigma implementation (Antony & Banuelas 2002, 25). The success of organizational culture transform is strongly dependent on management support (Abraham et al. 1999, 127). Taylor and Wright (2003, 108) also conclude that the quality culture change needs to be led from the top management. For successful six sigma implementation managers should have a need, a vision and a plan for implementation (Breyfogle III 1999, 4). Improvement projects are based on the organization's vision, business strategies and goals (Cheng 2013, 31). The need for the change has to be converted into an operational context so that employees understand the effects of the change. The operational goals help employees to understand what kind of actions the change requires from them. (Oakland & Tanner 2007, 582.) The recognition of a problem is the first step in implementing six sigma (Mills, Dye & Mills 2009, 115). The priorities for change have to be identified and the change process has to be carried out as planned. There might be risks related to the change but managers need to understand that it is not possible to avoid risks

entirely. It is important to complete the change so that all the potential benefits of six sigma can be seen. (Oakland & Tanner 2007, 580-582.)

Managers have to convince people throughout the organization that there is a need for improvement so that six sigma can be implemented successfully (Mills, Dye & Mills 2009, 115). The need is based on the customers' and market requirements for better quality which should be emphasized to employees in order to increase their self-confidence and pride in serving customers. Employees' awareness of the importance of the change supports the long-term adoption of six sigma. (Abdullah et al. 2008, 447.) However, customer focus does not have significant relationship with six sigma implementation success. The lack of customer focus does not necessarily have negative influence on the success of six sigma. (Aboelmaged 2011, 536.) On the other hand, Taylor and Wright (2003, 108) have come to an opposite conclusion about the relationship between customer focus and six sigma. Quality culture change is more likely to sustain if the benefits of the change are connected to external issues like customer satisfaction. Managers tend to focus more on internal issues such as reducing quality problems at the operational level rather than achieving competitive advantage in the market. The focus should be more on improving customer satisfaction instead of improving internal efficiency. (Taylor & Wright 2003, 108.) Managers have to develop the organization so that both the organization and the employees are ready for the change (Sony & Naik 2012, 812). Changing employees' behavior requires top management support as well as involvement from other management levels (Coyle-Shapiro & Morrow 2003, 334). However, the leadership does not strongly contribute to employees' job involvement (Boon et al. 2007b, 956).

Top management's responsibility is to make sure that the six sigma philosophy will spread to the whole company and all employees are involved in the six sigma activities (Ho et al. 2008, 268). Six sigma should be institutionalized to the entire organization rather than only to the quality department or the quality specialists. Managers might still believe that quality does not concern all people in the organization which prevents them to develop the organizational culture and the organization's mission towards quality-oriented. Both managers and employees should be responsible for quality in all levels of the organization. (Terziovski et al. 1999, 925.) All employees need to understand the importance of quality and what quality means for the organization (Oliver 2009, 558). The congruence between top managers' and middle managers' orientations towards six sigma has significant impact on its success. Incongruence can be seen as a barrier to effective adoption of the quality philosophy because the orientations of top and middle managers have to be equivalent not only with each other but also with the six sigma approach. (Soltani & Wilkinson 2010, 386.) Top managers have significant role in developing cultural change and quality policies and that role should not be delegated from top management to others in order to succeed in the change (London, 2005, 275). In order to turn resistance to change into active participation and commitment, managers have to show

strong visual leadership and act as examples of desired behavior and willingness to change (Pun & Gill 2002, 456). Willingness to change is related to the self-interest: top managers need to prioritize the six sigma philosophy over their own interest and lead the change from the top levels of the organization (Soltani & Wilkinson 2003, 386). Kotter (1995, 64) also emphasizes the importance of managers' actions, they need to show their commitment not only by communicating but also showing the desired behavior to employees. If managers neglect the active participation in the six sigma implementation and rely that employees can carry out quality improvements independently, implementation is likely to fail (Ho et al. 2008, 268.) Managers have to be familiar not only with six sigma but also with the processes and the products in order to understand the improvement possibilities (Goffin & Szwejczewski 1996, 30).

Top management has to promote the six sigma method to employees as well as support learning and continuous improvement (Savolainen & Haikonen 2007, 15). Employees need support and trust but not strict supervision from the management. Managers have to trust that employees are capable of performing their duties independently. (Boon et al. 2006, 536.) Personnel need trust and support when new quality practices are implemented to their workloads, not only in the beginning of the cultural change. Managers' trust has positive effect on employees' job satisfaction leading to stronger organizational commitment (Boon et al. 2007a, 72). Management style has to be learning oriented instead of being mistake focused (Oliver 2009, 558). Support also includes personal involvement in the six sigma activities: managers need to participate in trainings and improvement meetings (Ho et al. 2008, 268). Not only attending the meetings is sufficient, managers should also visit manufacturing sites and understand how the six sigma activities are performed in practice (Henderson & Evans 2000, 270). They need to emphasize critical factors of cultural change in communication and actions. (Abraham et al. 1999, 127).

Visible commitment effects employees' perceptions toward six sigma; positive perceptions are higher if managers involve in six sigma projects (Davison & Al-Shaghana 2007, 257). The lack of management commitment leads to the lack of commitment also among personnel since non-commitment from manager level does not motivate employees to adopt quality improvement activities (Pheng & May 1997, 168). However it is not sufficient to change only managers' behavior in the six sigma adoption because the effects do not reach to employees and change their behavior (Robertson 1994, 36). By showing their commitment management emphasizes the importance of quality issues and also helps employees to understand that quality is embedded to the organization culture (Oliver 2009, 558). Managers' enthusiasm is very powerful signal to employees about the importance of quality (Goffin & Szwejczewski 1996, 29). If management pays lip-service and does not show visible commitment employees might not understand the importance of the quality improvements. Six sigma implementation and the quality improvements are monitored continuously by the top management who share information to employees

through middle managers. Quality issues should be on the agenda of every meeting which emphasizes the importance of six sigma. (Davison & Al-Shaghana 2007, 257-258.) If managers participate in planning and problem solving processes actively, it has positive impact on employees' involvement which in turn results in better quality and increased customer satisfaction (Kathuria & Davis 1999, 161). It is crucial to remove the barriers that might prevent the change to happen. It is time and resource consuming to try to remove all the barriers so managers should focus on the most significant ones. There can be obstacles in the organizational structure as well as in the employees' attitudes that complicates the transformation. (Kotter 1996, 65.)

Resistance of managers creates the most dangerous threat to the successful transformation (Kotter 1995, 65). Due to the new quality culture the role of managers may change and their responsibilities decrease. Also employee empowerment may create resistance among middle managers since their roles have been changed and some of their power taken away. (Edwards & Sohal 2003, 563.) Managers may be reluctant to share their responsibilities and power to employees since the quality improvement culture may be seen more mundane than strategic method (Hill & Huq 2004, 1039). Training should be provided to managers in continuous basis to eliminate crucial barriers and resistance to change (Savolainen & Haikonen 2007, 15). It has been studied that middle managers have important role in successful implementation; their resistance can cause implementation to fail. They may feel that they have not been informed enough about the change. Six sigma can cause extra trainings and meetings for production workers which may reduce the time spend in the production process. It may cause difficulties in meeting the production targets which has a negative effect on middle managers' perceptions about six sigma. Since middle managers tend to focus on meeting the budgets and productions targets, six sigma may hinder their work. (Edwards & Sohal 2003, 563.) Changing formal communication channels may reduce the importance of middle managers in communication between top management and employees. They may feel that six sigma threatens their position in the organization. Due to the fear of losing their job middle managers may try to maintain their power by resisting six sigma implementation. (Denham, Ackers & Travers 1997, 156.)

Work nature of middle managers is under the greatest change in quality culture adoption: the new quality culture may require dramatic changes in middle managers' management style which may cause resistance (Lam 1996, 44). Middle managers may prioritize their own interest and only ostensibly commit to the six sigma practices. They may also emphasize their power and control over non-managerial employees which is contrary action to empowerment. (Soltani & Wilkinson 2010, 387.) The resistance of middle managers can be explained with their long work experience in the organization since the experience may lead to stronger resistance. The impacts of six sigma are perceived less

positive and more dramatic by middle managers if their work experience in the organization is long. (Lam 1996, 45.) Davis and Fisher (2002, 410) have studied that middle managers generally find quality management approach being effective in managing and they support the quality culture change. In the organizations studied by Davis and Fisher the resistance had been prevented by giving more power and freedom to middle managers to actively participate in quality approach implementation. If middle managers are given more autonomy to do their job, they have more positive attitudes towards top-management control and they are more willing to work harder in order to achieve quality improvements (Psychogios, Wilkinson & Szamosi 2009, 461). On the other hand, the lack of resistance does not necessarily indicate that middle managers are involved in the quality culture. They may not encourage employees to actively involve to the quality improvement activities which leads to the lack of involvement among workers. (Davis & Fisher 2002, 412.)

Characteristics of the organization have to support the six sigma philosophy and managers need to develop conditions that allow six sigma adoption (Sony & Naik 2012, 812). Soltani and Wilkinson (2003, 384) have studied that middle managers may face difficulties in trying to combine the six sigma practices with top managers' perspectives. Middle managers are expected to follow top managers' courses of action rather than the six sigma principles which may hinder effective adoption of quality philosophy. In order to facilitate adoption top management should provide financial support and monitor the implementing progress. (Laosirihongthong et al. 2006, 316). Allocating resources to quality improvement activities indicates managers' visible commitment to the quality issues which have positive impact on employees' perceptions towards the quality culture. Without visible commitment from the management level employees may not see the relationship between their jobs and quality improvements and rather consider them as separately issues. (Anderson & Adams 1997, 5.) Managers have to ensure that there is a supportive team climate in project teams which enables knowledge creation and sharing (Arumugam, Antony & Kumar 2013, 398).
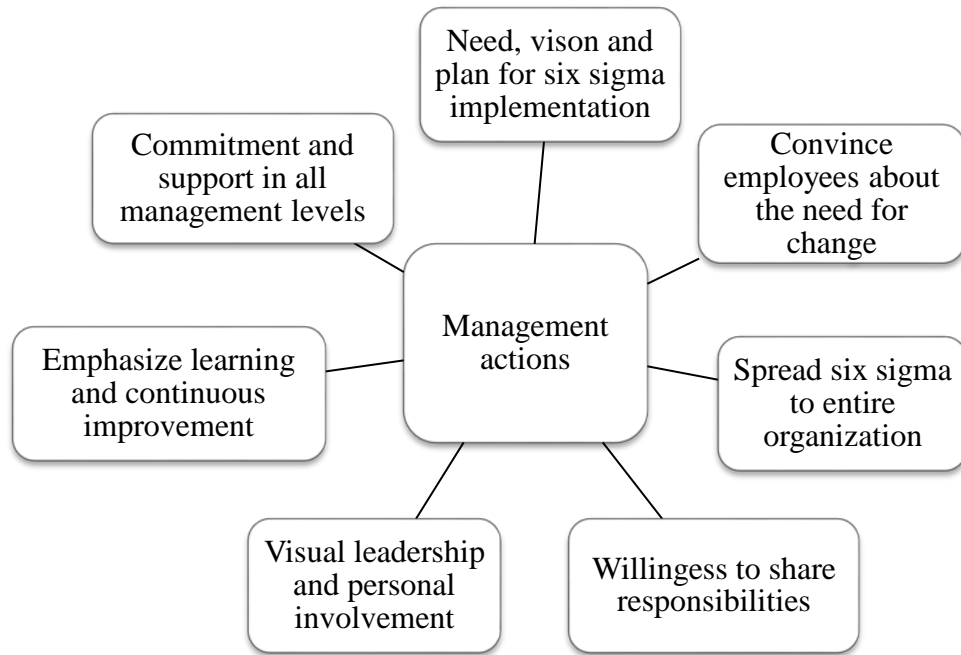
Figure 4       Six sigma supportive management actions

Management actions have significant role in six sigma involvement. First there has to need, vision and plan for six sigma implementation and second managers have to convince employees that the change is needed. They are also responsible of spreading six sigma to entire organization, including all managers. Furthermore they need to show visible commitment by sharing responsibilities and participating in six sigma activities. Managers have to emphasize learning and continuous improvement to employees.

### 3.2.4    Communication

In order to succeed in the six sigma implementation the company has to pay attention to communication. Open and honest communication between management and employees promotes implementation of new quality culture. (Blackburn & Rosen 1993, 52.) The organization should focus on removing barriers that prevent open communication between different organizational levels because information sharing and feedback have effect on commitment and job satisfaction (Meirovich, et al. 2006, 83). One key factor related to communication is organizational climate: support and organizational climate have to be taken into account when developing communication plans (Shadur et al. 1999, 496). The role of communication is important especially in the early stage of implementation because open and comprehensive communication mitigates the fear of change and the fear of not meeting the new quality standards among employees (Henderson & Evans

2000, 277). Communication increases employees' job involvement which helps personnel to engage in the organization (Boon et al. 2007b, 955). Information sharing is the key factor in employee involvement and it should be the first practice to be executed when encouraging employees to involve the improvement activities (Sumukadas 2006, 158). Employees' efforts towards better quality are related to shop-floor communication; high level of shop-floor communication increases the effectiveness of the quality efforts (such as process control) and thus improves the performance. Especially problem solving in a small group, feedback and instructive communication have positive influence on the performance. (Zeng, Anh & Matsui 2013, 468.)

However, communication has strong positive impact only if employees already have positive attitudes towards the change and six sigma before briefings about the forthcoming change. Negative attitudes may strengthen if employees are critical to the new quality culture. Communication amplifies employees' perceptions towards the quality culture regardless them being negative or positive. (Wood & Peccei 1995, 60.) Managers should pay attention to communication within the organization because employees' motivation and their trust towards management are related to the communication. By improving the communication between managers and employees it is possible to strengthen employees' trust towards managers and thus increase employee satisfaction. (Zelnik, Maletič, Maletič & Gomišček 2012, 56.) Feedback is given to employees on their performance which has positive effect on employees' commitment and belief in the quality improvement practices. It has also positive impact on employees' perceptions towards the success of the improvement process. (Losonci et al. 2011, 37.) Feedback makes communication more effective because it enables both employees and managers to give suggestions and understand each other's needs (Pheng & May 1997, 168).

Communication should not be only from managers to employees but also from employees to managers as well as vertical communication among employees (Boon et al. 2007b, 955). Teamwork can help in sharing knowledge and competencies among employees and influence joint decision making and coordination. Especially cross-functional teams facilitate knowledge sharing in the organization. (Wu & Lin 2009, 926.) Employees who are involved in teamwork feel that communication is more open in the organization. Collaboration between employees should be encouraged in order to develop employees' perceptions towards communication more positive. (Davison & Al-Shaghana 2007, 259.) Social support within teams facilitates knowledge sharing among personnel (Arumugam et al. 2013, 398). Organizational structure should have been developed to support information sharing among employees; meetings should be organized in regular basis so that employees can share their experiences and best practices and also discuss successes and failures (Oliver 2012, 17-18). Information sharing from bottom to top enables managers to understand employees' concerns and hear their ideas and suggestions. Employees from all levels of the organization should have possibility to express their ideas and concerns

to their managers. (Blackburn & Rosen 1993, 53 & 64). Managers should also pay attention to employees' perceptions and encourage them to communicate openly about issues relates to job satisfaction (Boon et al. 2008, 922). Effective communication includes meetings in all organizational levels as well as encounters between managers and members of lower levels of the organization (Allen & Kilmann 2001, 126).

In order to successfully inform and promote the change all existing communication channels should be used since using only one channel reaches relatively small amount of people and during the changing situation it is crucial to reach all employees (Kotter 1995, 64). The most important communication channel is face-to-face meeting, whereas electronic and print media only supplements face-to-face information sharing. Communication should be comprehensive and timely so that employees have up to date information about organization's performance and about the current situation of the six sigma implementation (Blackburn & Rosen 1993, 52). Comprehensive communication prevents misunderstandings especially if both managers and employees can share their knowledge freely (Hansson et al. 2003, 1002). Communication culture should be developed to ensure the reliability of information in all levels of the organization (Antony, Bhuller, Kumar, Mendibil & Montgomery 2012, 47). Culture should enable knowledge sharing among employees in order to better satisfy the customers. Sharing knowledge facilitates the effective deployment of six sigma and it should be perceived as an important factor in satisfying customers. (Wu & Lin 2009, 927.) Communication without effective actions is not sufficient for quality culture adoption. On the other hand, the planned actions need to be informed to employees as well. Managers should communicate their intensions and the actions planned in order to implement quality practices successfully. (Allen & Kilmann 2001, 126.)

Goztas, Baytekin and Kamanlioglu (2009, 67) suggest that successful communication should answer to the questions "who, why, when, how and where" in order to cover all relevant issues. They also suggest that there should be a communication plan for six sigma implementation. The plan should be divided into two categories: general communication plan and project based communication plan. General communication plan focuses more on introducing the six sigma philosophy, creating suitable organization culture for six sigma and informing constantly about improvement projects. Every improvement project should have a project based plan especially in the implementation phase. (Goztas et al. 2009, 67.) Formal and informal expressions of organizational strategy should be used in order to assure the effective communication. All the members in the organization should be aware of the upcoming changes. (Allen & Kilmann 2001, 125.) Employees should be informed about the expectations of the management so that they know how they should behave (Larson 2003, 18). Pun and Gill (2002, 456) emphasize the importance of comprehensive communication. In order to decrease the resistance to change, managers have to make sure that employees understand the current situation in the organization, why the

change is needed, the desired outcome of the transformation and how the change will be executed. Mere communication is not enough if the message is not understood same way in all organizational levels. Both managers and employees need to share the same vision about the new quality culture in order to adopt the culture effectively. (Pun & Gill 2002, 456.) The new quality culture should be included in to the business strategy and it should be informed via all existing communication forums: in business plan, vision statements, mission statements, annual planning meetings, posters and plaques as well as in memos and letters from senior management (Allen & Kilmann 2001, 126). Communication should not include only issues related to the quality; employees need also information about development opportunities and organization's mission, vision and strategies (Ugboro & Obeng 2000, 263).
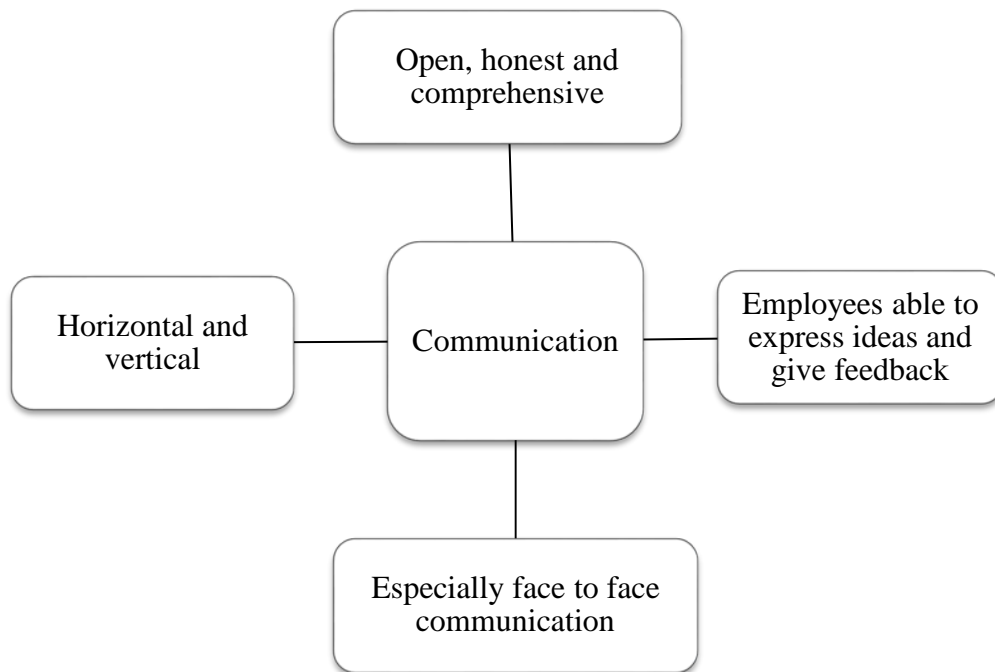


Figure 5      Best practices in six sigma communication

Communication related to six sigma should be open, honest and comprehensive. In addition six sigma related issues should be communicated in face to face meetings especially in six sigma implementations. Communication should be both vertical and horizontal. Furthermore, employees should have possibility to express their ideas to their managers and give and receive feedback.

### 3.2.5    Inducements

### 3.2.5.1    Goals

Goals can encourage employees to improve their performance by defining a performance level that is possible to reach in the future. But being too difficult they have contrary effect than managers have desired: employees' commitment is weaker, resulting in poorer performance if the employees perceive goals difficult to achieve. If targets are set carefully, not being too difficult to achieve, they can effect employees' perceptions about future performance. In setting goals the behavioral aspects have to be taken into account since successful implementing of six sigma is dependent not only on technical issues but also on people and their behavior. (Linderman et al. 2003, 201.) Together with goals management should provide tools and methods to solve challenging problems. It is useless to set ambitious goals if employees have not knowledge or skills to achieve them. (Linderman, Schroeder & Choo 2006, 787.) Goals should be clear so that they can be understood easily (Oliver 2009, 558). Managers should make sure that everyone understand quality goals otherwise the unawareness will prevent the effective adoption of six sigma. The organizational structure has to support the achievement of goals. (Goffin & Szwejczewski 1996, 29). Goals have to illustrate the importance of the quality improvements for the organization so that they encourage employees to achieve the quality improvements. Quality should be included in the strategy and quality goals must be linked to the operational goals so that quality is not an unrelated part of the organization's performance. (Oliver 2009, 558.) Robertson (1994, 36) suggests that goals should be developed so that they would influence work style behavior more than task-specific behavior which would lead to greater frequency of desired behavior.

Setting only long-term goals may decrease employee involvement since they cannot expect any outcomes in the short-term. In order to keep employees motivated and ensure the successful implementation of six sigma there should be short-term goals that support the process of achieving long-term targets. (Kotter 1995, 65.) The importance to attain long-term goals should be emphasized since the adoption of six sigma is dependent on long-term commitment. Employees may focus more on the short-term wins and neglect continuous improvement after the short-term goals have been achieved. (Welikala & Sohal 2008, 640.) Goals have not desired impact if they are not internalized by the individuals. Desired behavior and outcomes should be emphasized to employees for facilitating the assimilation of goals. (Henderson & Evans 2000, 275.) The clarity of goals has positive impact to employees' attitudes towards the change (Weber & Weber 2001, 296.)

Goals can be seen as incentives but also restrictive factor for human actions: they motivate employees to achieve certain outcomes by behaving in desired manner. Especially

goals should emphasize the importance of learning in order to succeed in six sigma projects (Linderman et al. 2003, 787.) They should motivate employees to continuous improvement and learning because they help creating organizational culture that emphasizes learning (Oliver 2012, 17). Allowing employees to take part in the goal-setting supports the employee empowerment which in turn increases their motivation to involve in the quality improvement activities (Anderson & Adams 1997, 6). Employees' performance improvement is related to joined decision making which why personnel should be able to participate in the goal-setting activities (Oliver 2009, 559). Collaborative goal setting emphasizes the relevance of goals to employees (Oliver 2012, 17).
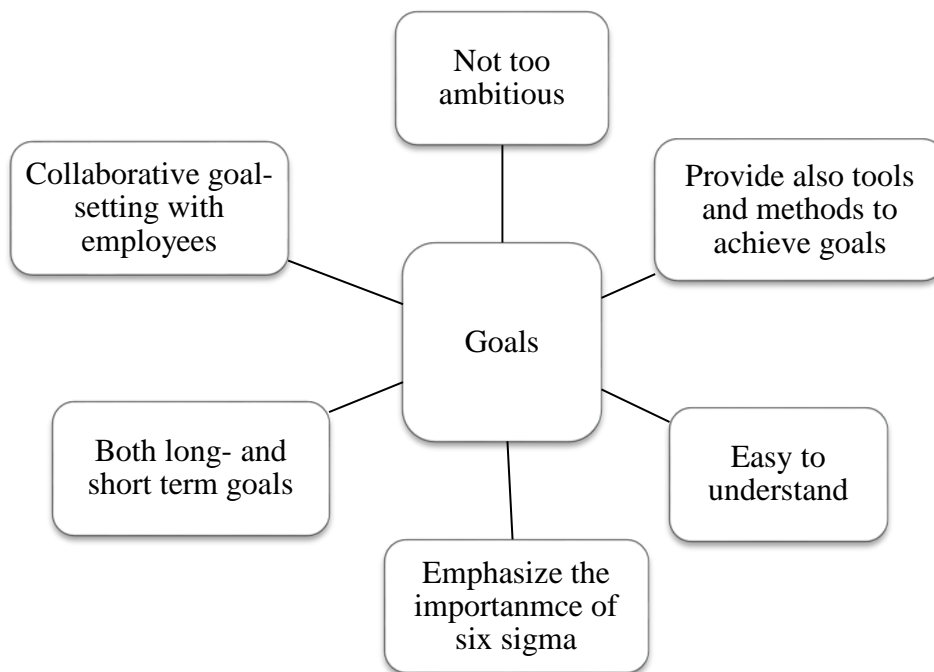


Figure 6          Characteristic of effective six sigma goals

Figure 6 illustrates the nature of effective six sigma goals. In order to be effective goals should be set together with employees and furthermore the necessary tools and methods to achieve goals should be provided to employees. In addition they should highlight the importance of six sigma and have both short- and long term goals that support each other. Goals need to be easy to understand by every employee and not to be too ambiguous so that they do not have discouraging effect.

### 3.2.5.2   Performance measurement

After implementing and training, monitoring is carried out to ensure the use of the quality actions. Appraisal has positive influence on employees' commitment to the quality issues

especially if employees find it useful. On the other hand performance measurement has positive effect even if employees have critical attitudes towards it. It can be stated that participation of the appraisal impacts positively on employees' perceptions towards the quality issues regardless of their reactions to the appraisal. (Wood & Peccei 1995, 60-61.) Performance evaluation on quality-based criteria should be extended to cover all employees because it reflects that everyone is responsible for the quality (Davison & Al-Shaghana 2007, 259) It increases employee commitment and their adoption of the organizational culture (Wood & Peccei 1995, 60). Monitoring the achievement of goals and giving feedback to employees should be included in the quality practices. Feedback should be given to all levels of the organization and it should be based on the internal and external customer satisfaction about the desired quality. (Allen & Kilmann 2001, 126.) Performance measurement also controls the change process and helps to identify the areas needing improvements. It is an important part of communication since it provides feedback from the improvement projects. (Oakland & Tanner 2007, 582.) Benchmarking strengthens trust and commitment between employees and managers. Due to benchmarking there is larger amount of information available to employees which facilitates the improvement processes. Employees feel that benchmarking increases the level of support they receive from managers and it also develops their skills and abilities. (Magjuka & Baldwin 1991, 216.)

Six sigma goals should be in line with the performance measurement system so that employees are not obligated to choose between achieving the six sigma goals or achieving the targets of the performance measurement and reward system. It is important that performance measurement system supports the six sigma goals and reward employees for their actions towards better quality. (Sinclair & Zairi 1995, 45.) Inability to successfully benefit from six sigma is related to traditional performance evaluation that does not emphasize quality goals. It has been studied that organizations tend to get stuck in the existing performance measurement system and they are not ready to develop it towards quality approach. (Soltani, Meer, Gennard & Williams 2004, 415.) Financial measurements are not perceived appropriate if they are solely used; instead of them there should be financial and non-financial measurement for monitoring performance. Measurement systems that employees perceive appropriate are usually process-oriented (like cause and effect diagram), long-term oriented (market share) and customer oriented (customer satisfaction). Employees do not find measurements defined by management very suitable. (Kumar, Grosbois, Choisne & Kumar 2008, 221.) The measurement system should focus more on quality and customer satisfaction than financial measures. It should respond employees' needs in all levels of organization and focus on satisfying the internal customer. (Schalkwyk 1998, 130.)
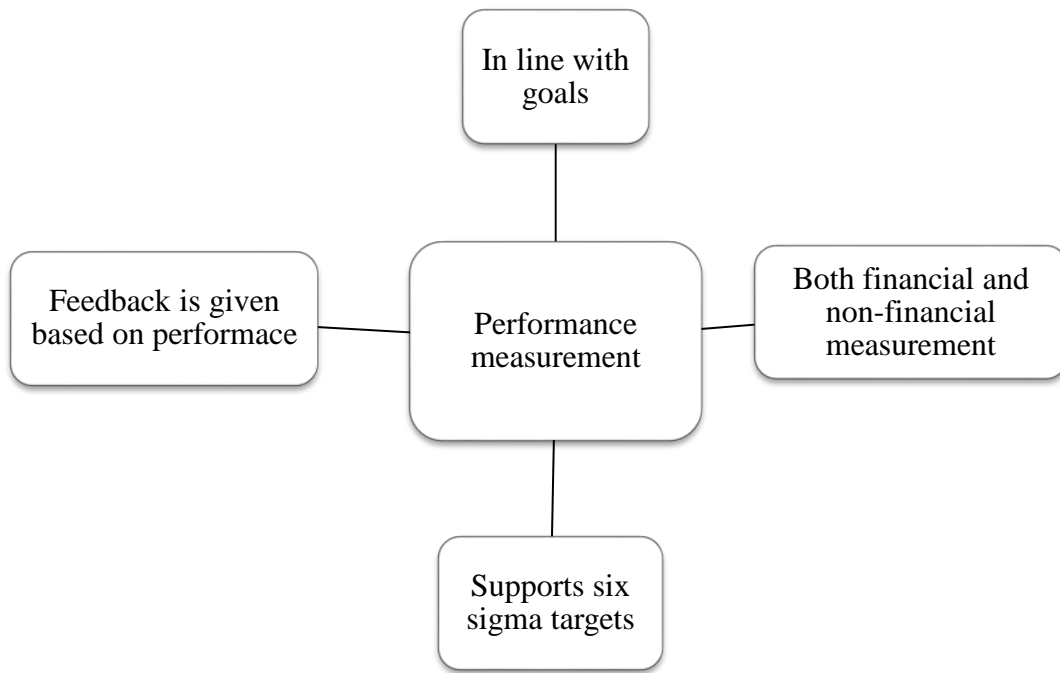
Figure 7        Performance measurement in six sigma

Performance measurement should be in line with six sigma targets and also employees' goals so that they encourage employees to use six sigma. Measurement should be based on both financial and non-financial outcomes. Furthermore managers should give feedback to employees on their performance so that employees have possibility to improve it.

### 3.2.5.3  Incentives

Employees' actions and accomplishments need to be recognized in order to change their behavior (Blackburn & Rose 1993, 56). Recognition increases employees' motivation to participate subsequent projects since rewards substantiate achievements which in turn increases the attractiveness of participation in the future (Ho et al. 2008, 269). However, rewarding alone is not sufficient method of involving employees in the quality improvements. Leadership style influences on employees' willingness to involve in the quality practices together with rewarding. Suitable leadership style for the current situation makes the rewarding system effective. (Ehigie & Akpan 2004, 36-38.) Rewards can be financial or non-financial and they can be given to an individual or a team. (Blackburn & Rose 1993, 57). Sumukadas (2006, 158) suggests that the incentive system should include skill based compensation, nonmonetary rewards and incentives for quality improvement initiatives. For the long term success the company needs to create rewarding methods to recognize employees' accomplishments related to the six sigma actions. By using rewards

the organization can promote changing employees' behavior towards the desired out-comes over the long term. (Henderson & Evans 2000, 275.) They also motivate employ-ees: the value of the improvement project is revealed through rewards which motivates employees to put more effort to improvement activities (Ho et al. 2008, 269). Incentives should encourage and motivate employees to participate in the quality activities in the future (Sun et al. 2000, 353). The compensation system has important role in employee involvement and it should be developed to support the quality goals instead of the pro-duction out-put based targets (Sumukadas 2006, 158). Job satisfaction is weakly related to rewards and recognition which means that they do not have motivating effect on em-ployees regarding to job satisfaction (Boon et al. 2007a, 71). Even though incentives are not the key factor in employee motivation, they are necessary in achieving the quality improvements since the reward system emphasizes the importance of desired behavior and good performance (Zelnik et al. 2012, 56).

Rewarding is based on employee's contribution of achieving better quality (Zu et al. 2010, 97). However, employees should be informed of the relation between the rewards and the participation in the six sigma activities before their involvement in these activities. Since employees' motivation is related to the involvement and non-participants are less motivated to six sigma, the rewards should encourage them to take part in the six sigma program. (Buch & Tolentino 2006, 362.) After implementing six sigma the reward prac-tices should be developed to adjust to the new quality culture (Allen & Kilman 2001a, 80). The rewarding system should support the quality objectives so that the reward prac-tices encourage employees to improve their performance even more (Allen & Kilmann 2001b, 127). Through rewarding and recognition the organization can illustrate that it values employees' efforts and achievements towards better quality (Blackburn & Rosen 1993, 58).

Recognition increases employees' motivation to share their ideas about the improve-ments because it shows that managers care about their contribution towards better quality. Employees' motivation to give initiatives also increases if employees feel that the organ-ization is willing to reward them for quality improvement suggestions (Abdullah et al. 2008, 447.) The rewarding policies should take into account the accomplishments in the organizational level as well as achievements of teams and individuals (Allen & Kilmann 2001b, 127). Employees' accomplishments should be recognized in front of the work-force which fortifies the six sigma culture because the desired behavior is rewarded visi-bly (Larson 2003, 18). Both small steps towards better quality and major improvements should lead to recognition by the management side (Blackburn & Rosen 1993, 64). The performance evaluation criteria should include six sigma related outcomes which empha-sizes the importance of quality issues (Henderson & Evans 2000, 276). Incentives create

long-term infrastructural benefits that are necessary for changing the culture towards continuous improvement even though the relationship between the rewards and job satisfaction is not significant (Boon et al. 2007a, 73).

Rewards can be described as feedback for employees' achievements of improving the performance and the quality. Non-financial rewards can include publication of success stories, celebration of achievements and awarding of plaques. (Blackburn & Rose 1993, 58.) Social rewards, like recognition of accomplishments, motivate employees to change their behavior since the lack of recognition affects negatively to the employees' perceptions. Employees also expect intrinsic rewards such as job satisfaction, learning new skills and increased responsibility from the six sigma implementation. (Buch & Tolentino 2006, 362-363.) Intrinsic rewards are individual related because these rewards such as self-esteem and satisfaction are defined by the individual itself (Pheng & May 1997, 168). Acknowledgments of quality improvements have positive impact on adopting the quality programs as well as the organization's performance even though social acknowledgements have weaker impact than monetary rewards (Allen & Kilmann 2001b, 127). Employees are more willing to express their ideas and share their knowledge if managers recognize employees' contribution towards better quality. Managers can motivate employees to participate more actively in information exchange by showing that they are interested in employees' incentives and are willing to reward employees for their ideas. (Abdullah et al. 2008, 447.)

Non-monetary rewards should be used in the early stage of the six sigma implementation but after the implementation is accomplish also the monetary rewards are needed to maintain the quality improving culture (Allen & Kilmann 2001a, 84). According to Buch and Tolentino (2006, 364) employees do not believe that the six sigma improvements result in extrinsic rewards which may indicate that social rewards are alone sufficient reward system for maintaining the six sigma culture. Non-monetary reward practices are used to encourage employees into active participation to the quality improvement projects and the monetary practices to reward employees for their achievements (Allen & Kilmann 2001b, 128).
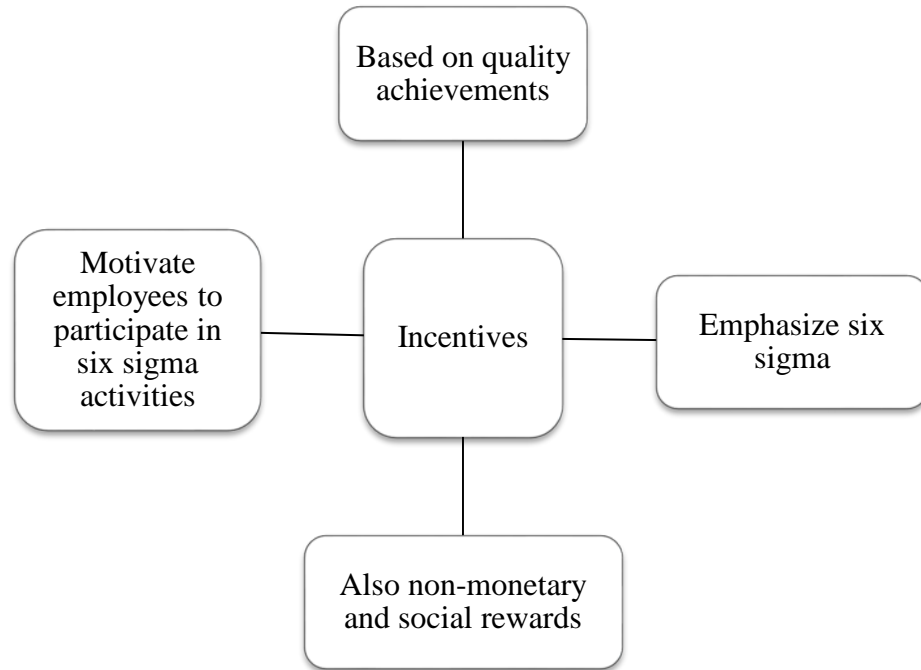
Figure 8        Effective six sigma incentives

In the figure 8 the characteristics of effective incentives are illustrated. They should be based on quality improvement actions in order to highlights six sigma importance in the organization. Furthermore they should be designed to motivate employees to participate six sigma activities. It has been studied that financial rewards are not solely sufficient, there should be also non-monetary and social rewards.

# 4 EMPLOYEES IN CHANGE

## 4.1 Employee empowerment

Employees' involvement increases if they have possibilities to create new ideas and actively participate in decision making in process improvement projects (Boon, Arumygam, Loke & Vellapan 2006, 537). Kappelman and Prybutok (1995, 14) have studied that employee motivation and satisfaction can significantly increase if employees are given more power in the change process especially if they have not had control over the change before. Increased motivation and satisfaction further the success of six sigma. Environment should assure that employees have possibility to focus on quality initiatives and improvements instead of concentrating on their employment situation (Howard & Foster 1999, 17). Employee empowerment increases significantly employee involvement (Tang, Chen & Wu 2010, 1253). Boon, Arumugam, Safa and Bakar (2007b, 955) have also come to the same conclusion that there is a strong relationship between empowerment and job involvement. Since employees' work responsibilities may expand due to the quality practices and work task boundaries may blur. These blurred boundaries and expanded responsibilities require lower management control which gives more power to employees. Empowerment affects positively the intention to involve in the quality improvement program as well as involvement behavior. (Tang et al. 2010, 1253.) Organizational commitment has significant relationship on employee involvement through empowerment which indicates that employees should be empowered in order to increase their commitment (Daily & Bishop 2003, 407).

Empowerment also facilitates employees' possibilities to solve problems without complicate procedures and approvals from management (Blackburn & Rosen 1993, 54). Giving more power to employees allows them to manage problems proactively (Dedhia 2005, 569). Successful empowerment requires allocation of administrative power from managers to employees. Without empowering actions employees are not given power to execute improvement actions without their manager's approval. (Sun, Hui, Tam & Frick 2000, 353.) Empowerment includes participative management which allows employees to take part in goal-setting activities (Anderson & Adams 1997, 5-6). Employee commitment can be strengthened by involving them in the strategic planning and goal-setting. Involvement promotes the quality philosophy which will lead to better understanding about the needs for the change. (Hansson, Backlund & Lycke 2003, 1001.)

Empowerment can be achieved by trusting employees or allowing them to make decisions independently. There is a relationship between trust and level of monitoring: employees feel trusted if they are not monitored constantly. However, trust should be earned

and related to experience, knowledge, previous actions and training. Allowing more independent decision making indicates that managers trust employees and see them as individuals. Empowerment also increases efficiency because employees can make decisions without their manager. There should be clear limits about employees' authority in decision making. Employees should be familiar with the regulations for making and the circumstances for having manager's approval for the actions. (Greasley, Bryman, Dainty, Price, Soetanto & King 2005, 362-363.) Employees should be able to make both individual and collective decisions about quality issues and also participate in defining of the organization's quality objectives. By participating employees to decision making their perspectives are taken into account which strengthens employee involvement. (Ugboro & Obeng 2000, 263.) Information sharing has important role in empowerment because it builds trust between managers and employees. Setting goals together facilitates managers and employees to understand their tasks and responsibilities. (Coleman 1996, 35.) The lack of clear understanding about employees' responsibilities and autonomy has negative influence on the effective adoption of six sigma (Rad 2006, 617). However, employees may not need more power in the organization; they need more independence regarding their own work. Employees tend to prefer more discretion and responsibility on their work and also on decision-making concerning the work tasks. (Hill & Huq 2004, 1039.)

Empowerment is effectively only if employees are self-motivated to take more responsibility. Managers have to motivate employees to act empowered by providing meaningfulness on employees' work and increased responsibilities. (Coleman 1996, 35.) Involvement is related to the possibilities for employees to utilize their capabilities which increase the independence of employees (Hill & Huq 2004, 1039). Motivation is related to the use of abilities: organization should encourage employees to use their skills and knowledge in their work duties for enhancing their performance. The usage of abilities influences positively to employees' perceptions towards empowerment. (Elloy 2012, 630.) Empowerment encourages employees to use more their skills and knowledge which should be taken into account in planning training activities and provide them necessary knowledge to work independently. Employees should be able to expand their knowledge and skills. (Sun et al. 2000, 353.)

Organizational culture where tactical and operational decisions are made at the lowest levels possible increases employee involvement which in turn increases employees' commitment. Involvement is related to employee empowerment which allows employees to participate more actively to decision making. (Daily & Bishop 2003, 407.) The level of empowerment is dependent on managers; if manager is not willing to share power with employees the attempt of empowerment will fail (Greasley et al. 2005, 365). Empowerment and possibility to participate in decision making will lead to willingness to share the organization's goals and thus increased commitment to the organization (Elloy 2012, 630). Participative management gives employees to opportunity to take necessary actions

for satisfying customers' needs (Rad 2006, 617). Tang et al. (2010, 1253) emphasize the importance of the low management control which is the key factor in employee empowerment. Despite the importance of empowerment the quality culture has been adopted without changing the top-down management style in the case studies of Soltani and Wilkinson (2003, 388). In all three case studies managers developed work procedures and standards and employees' role was only to follow these given courses of action. Employees should have more power and possibilities to control their work tasks because the quality improvements may broad employees' responsibilities. Employees should also receive benefits from the change instead having only more responsibilities. (Tang et al. 2010, 1253.) Working in self-management teams should be encouraged and employees should be able to manage their work tasks and decide needed actions by themselves. Employees should be encouraged to be more independent and proactive in their work. (Kathuria & Davis 1999, 161.) However, employees may have critical feelings towards empowerment if they have to control their co-workers' work quality or be monitored by their co-workers. Controlling peers may cause interpersonal conflicts which explain the negative attitudes towards controlling aspect of empowerment. (Ugboro & Obeng 2000, 263.)

Employee involvement is dependent on empowerment and motivation. Wider roles and responsibilities are seen as increased autonomy and empowerment. Employees from all organizational levels should be allowed to take part in six sigma decision making. (Huq et al. 2010, 118.) Allowing employees to participate in the change effort will lead to effective and long-term cultural change (Pun & Gill 2002, 456). If employees are given more responsibility of their work task and managers focus more on coaching than bossing, employees' efficiency increases (Davison & Al-Shaghana 2007, 259). Empowerment can be seen as incentive for active participation if more power is given to the employees who are involved in the change process (Hansson et al. 2003, 1002). Empowerment is related to the feeling of autonomy; employees should be able to influence their jobs, for example make recommendations of improvements or participate in decision making. Employees need to feel that they have more power to influence their jobs in order to become empowered. (Elloy 2012, 630.) Empowerment will also lead to the increased satisfaction since it provides positive job experiences to employees by involving them into decision making (Chang, Chiu & Chen 2010, 1309). Giving more power to employees increases their satisfaction and motivation regarding to the quality culture change. Feeling control over the work tasks motivates employees which in turn has positive effect on adopting new quality culture. Employees need to feel that they have some control over the change process that is mostly out of their control. (Kappelman & Prybutok 1995, 14-15.) Empowerment has impact on employees' self-esteem; when employees feel pride in their work, they tend to respond more positively to involvement actions (Greasley et al. 2005, 364). Continuous improvement and increasing customer satisfaction have a positive effect on employees' self-esteem and pride in serving customers (Abdullah, Uli & Tarí 2008, 447). Working in

autonomous teams in organization where power is decentralized among managers and employees increases team effectiveness so empowerment has positive impact on the team performance. Participative leadership also strengthens team autonomy and gives teams resources to manage their work independently which will lead to increased effectiveness. (Escribá-Moreno, Canet-Giner & Moreno-Luzón 2008, 56.)
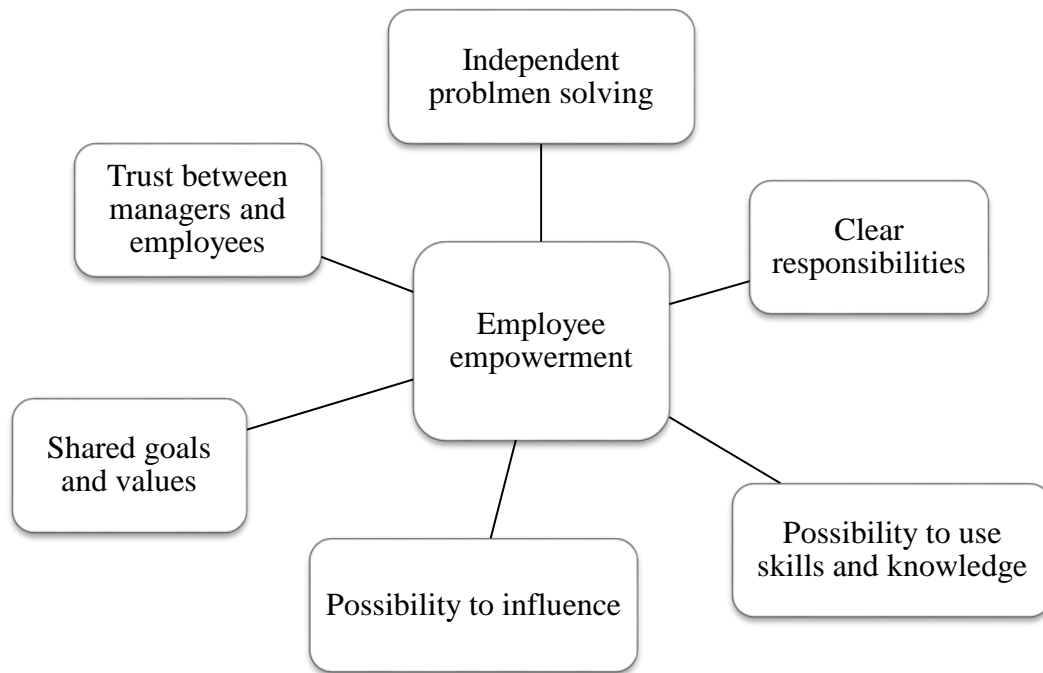


Figure 9          Factors increasing employee empowerment

The figure 9 presents factors that have positive impact on employee empowerment. There should be mutual trust between managers and employees together with clear understanding of responsibilities in order to effectively empower employees. In addition, employees should share organization's goals and values. Empowerment should improve employees' possibilities to influence their work and also allow them to solve problems independently. Moreover empowered employees should have wider range of possibilities to utilize their skills and knowledge.

## 4.2     Employees' perceptions

Mills et al. (2009, 115) emphasize the importance of shared vision among whole organization. The success of six sigma is strongly dependent on recognition of the need for quality improvements among managers and employees. Shared vision about the current situation and the change facilitates the adoption of six sigma. (Mills et al 2009, 115.) Employees need to have clear understanding about their responsibilities and the quality

policies so that they know how intensive involvement six sigma will require. Understanding may help employees to become emotionally involved with their work which in turn increase their commitment to the quality issues. (London 2005, 275.) Employees tend to focus more on accomplishing their individual-task while managers are more interested about collaboration among employees for achieving organization's goals (Patti et al. 2004, 228). Changing behavior is dependent on the understanding of the new quality culture because understanding six sigma is needed prior the attitudinal change (Hur 2009, 859). Organizational commitment, perceived benefits of the change and involvement in the change process prevent resistance to change. The organization can diminish the resistance by trying to influence employees' attitudes towards the change and developing stronger organizational commitment. Employee involvement can be enhanced by taking employees' interest into account in the change process. (Peccei et al. 2011, 198-199.)

Employees' perceptions towards six sigma are higher immediately after training but they decrease over time especially if employees have not possibilities to use their new skills in practice. Especially employees who do not participate in the improvement projects have low expectancies of six sigma success. Resistance to change is related to attitudes towards six sigma success. If six sigma seems to be inefficient and fruitless employees may not be willing to change their behavior. In this situation managers should provide training and communication in order to prevent employees' negative attitudes. (Buch & Tolentino 2006, 33.) Attitudes are related to the feeling of usefulness: if employees find that six sigma is useful method, they have more positive view about implementation (Wood & Peccei 1995, 60). Perceived benefits from the quality improvement projects increase willingness to participate in improvement projects in the future. Especially if employees do not see benefits in the early stage of implementation, the attractiveness of participation will decrease. (Coyle-Shapiro 1999, 451-452.) Attitudes towards six sigma are positive if employees feel that six sigma can bridge the gap between organization's current and desired situations (Meirovich et al. 2006, 82.) In order to involve in the six sigma activities in the long-term employees are looking for fulfillment of their expectations. They expect benefits such as job security and monetary compensation from six sigma. (Glover 2000, 137.) It has been studied that teamwork has positive influence on employees' perceptions. Training and management support are related to positive perceptions trough teamwork and thus the positive perceptions are related to employee involvement. (Daily & Bishop 2003, 407.) Working experience has impact on employees' attitudes towards the change: Employees who have long working-history in the organization tend to react more suspiciously to the change while employees who have worked in the organization less than two years find the changes to be less dramatic or less undesirable. (Lam 1996, 44.)

Employees who are committed to the organization are more open to organizational change. Since they share the organization's values and goals they are more willing to

allocate their time and resources to achieving these goals. (Iverson 1996, 141.) Affective commitment increases the probability of employee involvement (Shadur et al. 1999, 498). On the other hand Coyle-Shapiro (1999, 451) has studied that employee participation does not increase employees' commitment towards the organization. In changing situations employees' commitment to learning is the key step since it will result in willingness to expand their work responsibilities and participation (Sony & Naik 2012, 812). Participation increases employees' trust in management and their positive perceptions towards the change and involvement (Weber & Weber 2001, 296). Organizational commitment is also related to job satisfaction and job motivation which in turn affect the adoption of the change. (Iverson 1996, 141.) Employee empowerment and teamwork have strong influence on job satisfaction, organizational commitment and job involvement. Empowerment should be reinforced in order to enhance employees' positive perceptions towards the organization. (Karia & Asaari 2006, 41.) Teamwork has significant impact on positive attitudes towards involvement (Boon et al. 2007b, 955). Especially among production workers teamwork has significant role in job satisfaction which emphasizes the importance of collaboration between employees (Boon et al. 2008, 923-924). Employees need acknowledgement and support from the organization and from their co-workers so that they can successfully adopt new quality culture (Joiner 2007, 625). Lam (1995, 77) argues that empowerment may reduce job satisfaction since new quality culture increases employees' responsibilities but in the same time limits their independence without meaningful change in their compensation, job security or promotional opportunities.

Job satisfaction has strong influence on loyalty to the organization and the loyalty in turn affects employees' involvement in goal setting and decision making (Chang et al. 2010, 1309). Empowerment has strong, positive relationship with job satisfaction especially in terms of employee participation (Ugboro & Obeng 2000, 258). But the importance of job satisfaction has been studied to be weaker than commitment in employee involvement (Shadur et al. 1999, 498). There is significant relationship between job satisfaction and employees' perceptions towards quality practices; it has been studied that implementing total quality management program has positive outcomes regarding to job satisfaction (Boon et al. 2007a, 72). However, Menezes (2012, 322) came into opposite conclusion: quality management and job satisfaction are not related to each other. Improving quality should include both improving the quality of processes and product and the quality of employees' working life. Job satisfaction cannot be neglect in managing the change. (Lam 1996, 45.) Employees' perceptions may change after implementation if their expectancies do not meet the benefits of six sigma. If they have expected more than six sigma can give they may not be willing to participate in improvement projects in the future. (Coyle-Shapiro 1999, 452.) The perceptions towards the six sigma adoption may become less positive if the initial concept given by management and the actual actions and implications do not correspond. Employees may react with frustration and cynicism

if the promises and actions do not meet. (Edwards & Sohal 2003, 565.) Employees' commitment is also related to management commitment; if employees do not feel commitment from managers' side, they may not be willing to involve either in the quality improvements (London 2005, 276).

Employees' capabilities increase positive attitudes towards the six sigma involvement. Capabilities to execute quality program increases employees' confidence to involve in the quality programs. (Tang et al. 2010, 1252.) Training and education have positive impact on employees' capabilities which contribute to involvement in the six sigma activities. If employees perceive that they have necessary skills and capabilities to perform quality activities, the adoption of six sigma will be easier. (Yeh 2003, 263.) The aim of the quality improvement project is that employees will work smarter, not necessarily harder which should be emphasized by the managers (Oliver 2009, 558). According to Losonci, Demeter and Jenei (2011, 37) perceptions are affected by belief, commitment, work method and communication. The feeling of success is related to the outcomes of the change. For example, better working methods increase the feeling of success which results in stronger involvement and commitment. If employees have time to familiarize themselves with the new practices and they have necessary knowledge and skills to perform new tasks the feeling of success increases. Managers have to understand this feeling of success and the possibilities to affect it by training and ongoing participation. (Buch & Tolentino 2006, 36.)
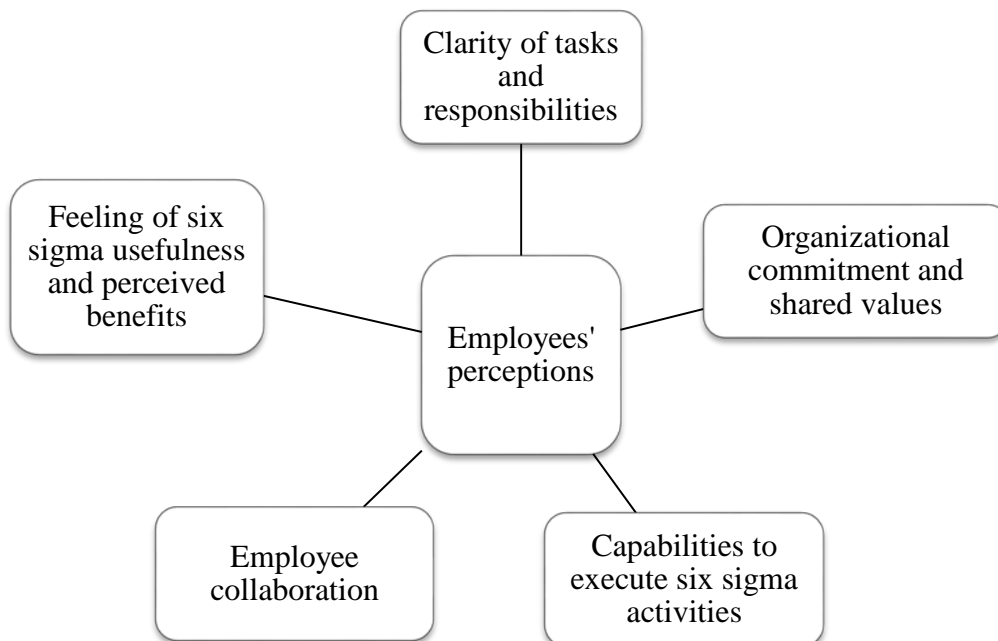


Figure 10      Influencing factors on six sigma perceptions

Factors influencing employees' perceptions are illustrated in the figure 10. Perceptions are driven by the feeling of six sigma usefulness and perceived benefits of it. If employees find six sigma useful and see benefits of it, they will have more positive perceptions towards it. Also clarity of task and responsibilities together with organizational commitment and shared values impacts positively on employees' perceptions. Employees who have capabilities to execute six sigma activities tend to have more positive perceptions towards six sigma. Moreover, collaboration and teamwork among employees effect positively on perceptions.

## 4.3    Personal development

Training is seen as a crucial factor in implementing quality programs (Blackburn & Rosen 1993, 55). But merely training does not guarantee that the quality program will succeed. It has to be connected to the work processes in order to enhance six sigma adoption. (Kassicieh & Yourstone 1998, 37.) Kappelman and Prybutok (1995, 15) have found similar relationship: training has not direct contribution to the success of six sigma, rather it increases employees' level of understanding and motivation which have influence on the success of quality management program. Even though training does not directly influence quality practices the role of training cannot be neglected. It has an effect on the institutionalization of six sigma by developing employees' skills and capabilities. (Yeh 2003, 263.) Training and development are one of the most important human resource factors in adopting quality practices (Abu-Doleh 2012, 230). Training has positive impact on employees' commitment to the quality strategy and the improvement activities (Palo & Padhi 2003, 213). It also influences perceptions of leadership and organizational commitment (Davison & Al-Shaghana 2007, 258). However it has been studied that training does not have great effect on employees' job involvement in the short term. Even though training does not contribute immediately the importance of training should not be ignored. It is a long term process and management should ensure that continuous training and development are provided to employees in order to successfully implement quality practices. (Boon et al. 2007b, 956.) By providing continuous training managers can ensure that employees' problem identification and problem solving abilities are improved with regularity (Abdullah et al. 2008, 447).

Even though training increases employees' confidence to execute successfully improvement activities the relationship between training and employee involvement remains weak. Since training and the quality practices increase employees' workload, attitudes towards training can be negative. Participating in training and quality improvement program seems unattractive option which may result in reluctance to adopt the six sigma practices. (Yeh 2003, 263.) If training has been carried out carefully and widely it can

have positive impact on expectancies of six sigma success (Buch & Tolentino 2006, 35). Mere training does not achieve the cultural change and the management cannot solely rely on providing training and expecting employees to adopt the new quality practices (Edwards & Sohal 2003, 565). Training provides necessary skills that are related to organizations' beliefs and values to employees so that they are capable of changing organizational culture towards more quality-oriented (Rad 2006, 620). It has been also studied that training has negative impact on employee satisfaction which can be due to the time and the effort required by the training sessions (Chang et al. 2010, 1310). Lam (1996, 42) concluded that training does not necessary increase employees' job satisfaction even though trained employees enhance customer satisfaction. It seems that employees do not feel that training improve their work and satisfy their work related expectations because they are treated as "tools" of the quality improvement rather than independent workers. (Lam 1996, 42.) Training does not reduce occupational stress related to the quality culture change. Even though employees receive training about quality issues their stress level regarding to the quality culture implementation does not diminish. (Palo & Padhi 2003, 213.) Because work may become more demanding due to six sigma, training should provide employees necessary methods to handle their work duties more efficient manner so that employees are motivated to participate in quality improvements (Lam 1995, 77).

Together with training it is important to provide necessary methods for sharing knowledge in the organization and improvement teams otherwise the improvement projects will not succeed (Arumugam et al. 2013, 399). Training activities cannot be solely manager's responsibility since employees should share their knowledge and assistant others to adopt the six sigma culture (Larson 2003, 18). It should include theory as well as practical experimentation so that employees have knowledge and skills to carry out the six sigma projects (Henderson & Evans 2000, 273). Blackburn and Rosen (1993, 56) suggest that training should provide the tools for identifying faulty processes, defining problems and executing solutions. It should include both techniques such as statistical methods and managerial skills like decision making, leadership and team building (Sun et al. 2000, 353). In addition to statistics and other six sigma tools training should provide project management and communication skills. Managers need also change management training and other employees training about problem solving skills. (Davison & Al-Shaghana 2007, 258.) Empowering employees requires improving employees' interactive skills as well as their technical skills so that they can work independently. Interactive skills such as communication, effective meeting and leadership skills should also be provided in training because providing only training of technical skills is not sufficient for ensuring effective empowerment. (Abdullah et al. 2008, 447.) Training should be provided to employees in order to encourage learning and continuous improvement (Savolainen & Haikonen 2007, 15).

Karia and Asaari (2006, 41) suggest that training should be provided to employees continuously because training influences positively employees' organizational commitment, job satisfaction and job involvement. Continuous training enables employees to develop their skills which in turn has effect on their job-related attitudes. In order to maintain improvements, employees need training continuously so that quality will be improved over time (Laosirihongthong et al. 2006, 317). Managers should carefully examine the factors affecting employee participation and develop training plan for answering to the questions "who needs what and when". Especially there is a need to explore the relationship between training, involvement and employees' expectations of success in order to develop training to contribute employees' positive expectations. (Buch & Tolentino 2006, 35-36). Training should be tailored to meet organizations' needs and targets and to provide necessary skills to employees not only in the implementation phase but in continuous manner (Goffin & Szwejczewski 1996, 30). Continuous learning and improvement should be encouraged to employees because it supports the long-term adoption of six sigma (Rad 2006, 620). Training together with teamwork, communication and empowerment should provide employees skills to improve continuously organization's capability. One outcome of training should be employees' clear understanding of the continuous improvement philosophy. (Parumasur & Govender 2013, 649.) According to Daily and Bishop (2003, 407) training has significant effect on employee involvement only indirectly through teamwork. Managers should develop the organizational culture towards collaborative so that full advantage of training can be achieved. Employees' skills and knowledge should be monitored so that training program can be modified and developed to meet the organization's needs (Antony et al. 2012, 47). Larson (2003, 18) emphasizes the importance of providing the necessary skills and knowledge to everyone in the organization. Extensive training should be provided to all employees in order to ensure the understanding of the quality issues (Hansson et al. 2003, 1002). The aim of training is develop employees' capabilities so that they can be more successful in their work tasks. That goal should be supported by encouraging employees to participate improvement teams and developing reward practices. (Zu et al. 2010, 97.) Managers need training especially about the quality management principles and techniques so that they are able to carry out the adoption of the new quality culture. They may need to develop their leadership skills in order to change the organization culture successfully. (Sohal & Terziovski 2000, 166.)

It is important for employees to have opportunities to use their new skills and knowledge as well as receive rewards for their good performance. This is related to employee empowerment: employees should have ownership over their work tasks so they can solve quality problems independently. (Blackburn & Rosen 1993, 56.) Empowerment should been taken into account in training so that employees are encouraged to control

and manage issues related to their work (Karia & Asaari 2006, 41). Training should facilitate self-development so that employees can utilize their full potential and creativity (Parumasur & Govender 2013, 649). Individual learning should be encouraged because it forms a basis for organizational improvement (Kovach & Fredendall 2013, 15). Even though training does not directly increase employee involvement, it has indirect effect through employees' skills and capabilities to participate in the quality improvement projects. Employees are more likely to involve in quality projects if they are confident about their skills and abilities to perform well in these projects. Since employees learn more skills and expand their knowledge during the trainings, education contributes to the institutionalization of the quality programs. (Yeh 2003, 263.) Training should be developed so that it will support the organizations' goals. For example the use of necessary problem-solving tools and methods should be included in training in order that employees can successfully perform the quality improvement activities. (Linderman et al. 2006, 787.) When developing training plans, potential benefits to employee participation should be emphasized. Since the perceived benefits have strong relationship with employee involvement, positive outcomes of six sigma should be highlighted in training (Tang et al. 2010, 1252). Training contributes learning to perform activities right way in the first time and monitoring performance supports these effects of training (Palo & Padhi 2003, 214). The full potential of training can be achieved if training is aligned with performance evaluations. Training and work processes have to be related to each other and to quality outcomes in order to successfully institutionalize the quality culture change. (Kassicieh & Yourstone 1998, 37.) Buch and Tolentino (2006, 36) suggest that it is useful to provide training in just-in-time basis by combining learning and employees' first six sigma project. This training method allows employees to develop their skills in a real-life improvement project. (Buch & Tolentino 2006, 36.) Training and rewarding should be in line with each other and they should reflect the values and desired outcomes of six sigma. All other elements of the cultural change (like management style, communication and organizational structure) should be coherent with training and reward practices so that employees have clear understanding about the cultural change. (Rad 2006, 620.)
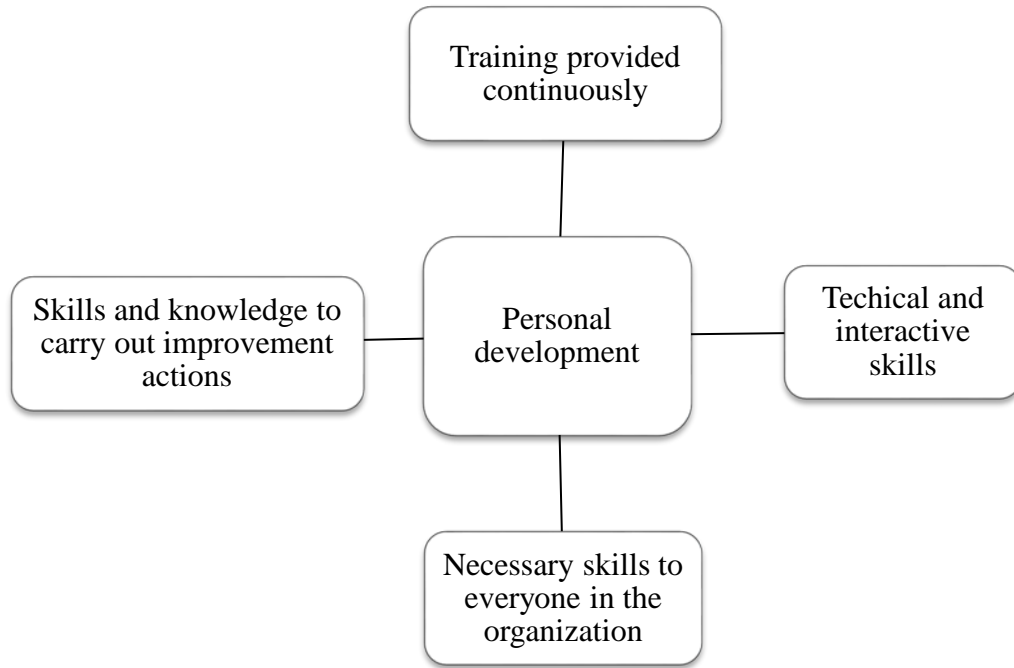
Figure 11        Personal development in six sigma

Six sigma training practices are illustrated in the figure 11. Training should be provided to all employees so that everyone have skills to participate in six sigma activities. In addition it should be provided on a continuous basis. Six sigma training should contain both technical and social skills so that employees are capable to use statistical methods but also share information and work as a team.

# 5 FACTORS INFLUENCING EMPLOYEE INVOLVEMENT IN SIX SIGMA ACTIVITIES

## 5.1 Basis of the framework

Employee involvement framework is created in order to represent together factors influencing employee involvement in six sigma. The aim of the framework is to provide a theoretical basis of the issues that are related to employees' participation in the six sigma activities. The employee involvement framework supports empirical research process by providing knowledge about the issues behind employee involvement. It is also created for representing the influencing factors and for understanding linkages between them.

Based on previous studies influencing factors are identified and factors grouped into same category according to their nature: for example factors related to management actions are grouped into category "leadership style". Factors are closely related form one category but single factors can also belong to several categories. For example organization wide participation is related to organizational culture, employee involvement and goal setting which is why the factors cannot be classified under only one category. Categories are also overlapping; each category includes factors that are related to another categories as well.

## 5.2 Employee involvement framework

Factors found from the previous studies have been collected into wider categories in order to display the most significant factors related to employees' participation in six sigma. The framework combines six sigma, quality management and employee involvement studies since most the of the previous studies focus on narrow subjects such as rewarding in the six sigma context. Categorization of the factors is based on the nature of these factors and categories have been created to represent the findings of the previous studies in general instead of detailed descriptions of each influencing factor.

**Managerial commitment**

- Clear vision, need and plan (Breyfogle III 1999, 4; Oakland & Tanner 2007, 582)
- Convincing employees about the need for the change (Mills et al. 2009, 115)
- Visual leadership, personal involvement and enthusiasm (Kotter 1995, 64; Pun & Gill 2002, 456; Ho et al. 2008, 268)
- Willingness to share responsibilities (Hill & Huq 2004, 1039)
- Allocation of resources to quality improvement projects (Anderson & Adams 1997, 5; Ho et al. 2008, 268)
- Spreading the six sigma philosophy to the entire organization (Terziovski et al. 1999, 925; Ho et al. 2008, 268)

**Organizational culture**

- Collaboration and communication (Sim & Rogers 2009, 45; Kovach & Fredendall 2013, 15)

Elimination of barriers (Huq et al. 2010, 117-118; Antony & Banuelas 2002, 25)

Learning and development (Shadur et al. 1999, 496; Rad 2006, 620; Kovach & Fredendall 2013, 15)

Clarity of tasks and responsibilities (Yeah 2003, 263-264)

**Employees' perceptions**

- Attitudes towards six sigma (Coyle-Shapiro 1999, 452)
- Feeling of usefulness (perceived benefits from six sigma) (Wood & Peccei 1995, 60; Coyle-Shapiro 1999, 452)
- Commitment towards the organization (Peccei et al. 2011, 198-199)
- Discrepancy between presumptions and the outcome (Coyle-Shapiro 1999, 452)
- Capability to perform six sigma activities (Tang et al. 2010, 1252)

Trust between managers and employees (Tang et al. 2010, 1253)

**Leadership style**

- Continuous review about the change (Oakland & Tanner 2007, 583)
- Optimism (Svesson & Wood 2005, 147)
- Focus on soft factors (Abdullah et al. 2008, 447)

Autonomy (Greasley et al. 2005, 362-363; Tang et al. 2010, 1253)

Shared goals and values (Yeah 2003, 264; Joiner 2007, 624; Paramasur & Govender 2013, 649)

Supports change (Yeh 2003, 263-264; Buch & Tolentino 2006, 364; Oakland & Tanner 2007, 583)

Appreciation of employees (Sim & Rogers 2009, 45)

Organization wide participation (Sohal & Terziovski 2000, 166; Sim & Rogers 2009, 45; Kovach & Fredendall 2013, 15)

**Communication**

- Open and honest (Blackburn & Rosen 1993, 52)
- Feedback is given (Losonci et al. 2011, 37)
- Horizontal and vertical (Blackburn & Rosen 1993, 52; Boon et al. 2007b, 955; Oliver 2012, 17-18)
- Possibility to express ideas from all organizational levels (Blackburn & Rosen 1993, 53 & 64)
- Face-to-face and comprehensive communication (Blackburn & Rosen 1993, 52)

**Employee empowerment**

- Possibility to focus on quality improvements (Blackburn & Rosen 1993, 54; Boon et al. 2006, 537)

Sharing information and knowledge (Blackburn & Rosen 1993, 52; Abdullah et al. 2008, 447)

Possibilities to use skills and knowledge (Blackburn & Rosen 1993, 56)

Tools and methods to improve quality (Linderman et al. 2006, 787)

**Goals**

- Not too ambitious (Linderman et al. 2003, 201)
- Easy to understand clearly (Oliver 2009, 558)
- Highlights the importance of six sigma (Oliver 2009, 558)
- Both long- and short-term goals (Welikala & Sohal 2008, 640)
- Collaborative goal-setting (Anderson & Adams 1997, 6; Oliver 2009, 558)

Quality and six sigma based (Davidson & Al-Shaghana 2007, 259; Ho et al. 2008, 269, Zu et al. 2010, 97)

**Training**

- Related to work processes (Goffin & Szwejczewski 1996, 30)
- Theory and practice (Henderson & Evans 2000, 273)
- Provided continuously to all employees (Hanson et al. 2003, 1002; Larson 2003, 19, Karia & Asaari 2006, 41)
- Tailored to meet the organization's goals (Goffin & Szwejczewski 1996, 30)

**Performance measurement**

- In line with six sigma goals (Davidson & Al-Shaghana 2007, 259; Ho et al. 2008, 269, Zu et al. 2010, 97)
- Especially non-financial measurements (Buch & Tolentino 2006, 362-363)

**Incentives**

- Especially social rewards (Allen & Kilmann 2001b, 128; Buch & Tolentino 2006, 364)
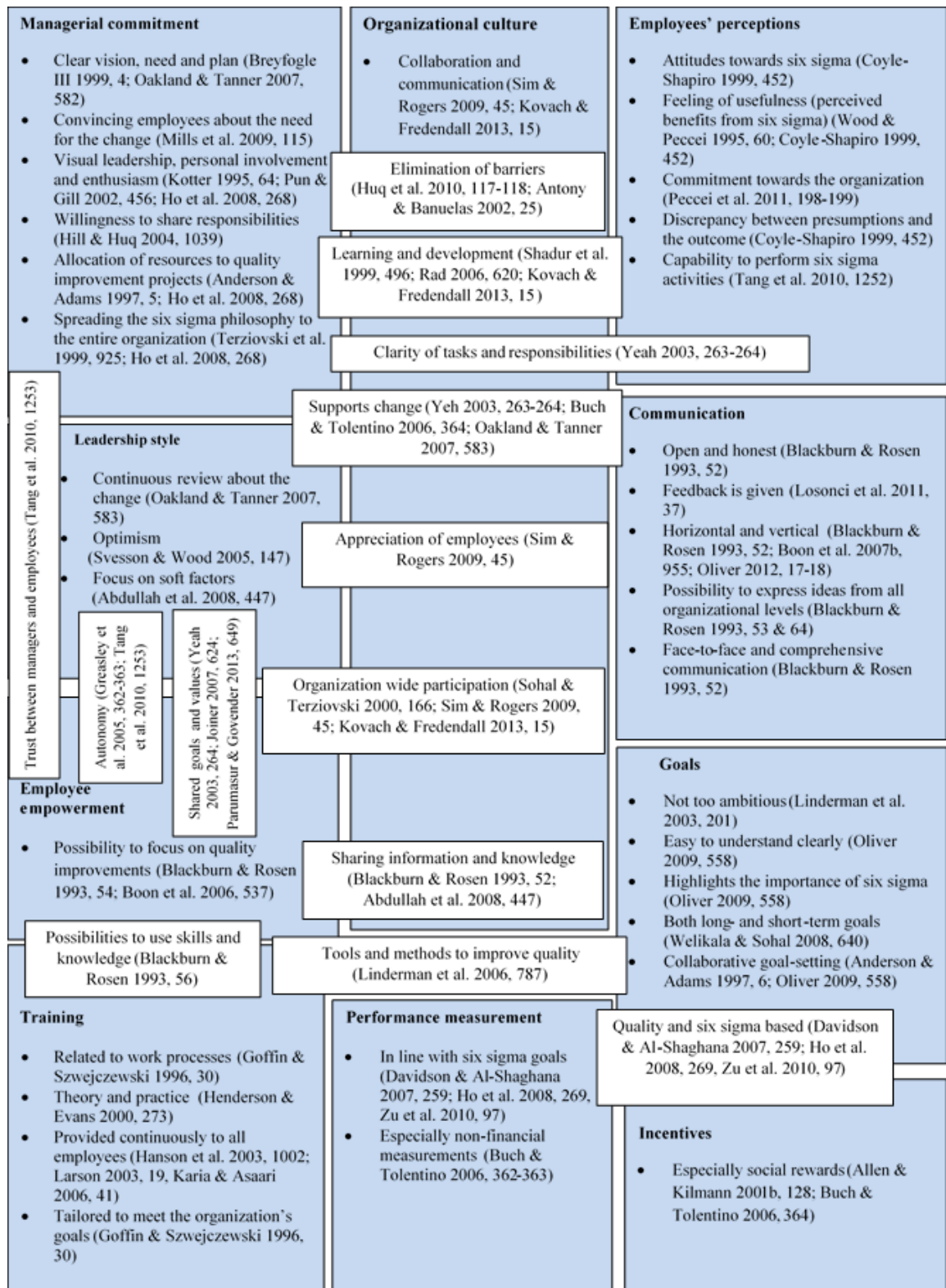
Figure 12          Employee involvement framework

The figure 12 illustrates which kind of different factors influence employees' involvement in the six sigma activities. The factors can be placed in ten categories:

- organizational culture

- managerial commitment
- leadership style
- employee empowerment
- employees' perceptions
- communication
- goals
- training
- performance measurement
- incentives

These categories are not separate from each other; rather they overlap and consist of similar factors. It can be seen from the figure that many of the factors from organizational culture are related to another category as well. Employee involvement is not related only to the employee itself but also managers and organization's capabilities to encourage employees to participate in the six sigma activities. Motivation of employees is not solely sufficient, it is also important to create possibilities for employees to actually participate in the quality improvement activities (Boon et al. 2008, 919-920). It can be seen that employee involvement is not dependent only on one or couple of factors, it is related to employee's attitudes and feelings but also circumstances that are created by managers and organization's environment in general. In following paragraphs the key categories affecting employee involvement are presented.

Organizational culture can be seen as supportive function that creates favorable circumstances for involvement (Yeh 2003, 263-264; Buch & Tolentino 2006, 364; Oakland & Tanner 2007, 583). In order to further employee involvement the organizational culture has to support the quality culture change by emphasizing learning and development, information and knowledge sharing and organization-wide participation (Shadur et al. 1999, 496; Sohal & Terziovski 2000, 166; Rad 2006, 620; Sim & Rogers 2009, 45; Kovach & Fredendall 2013, 15). Any cultural barriers that might prevent the change need to be eliminated (Huq et al. 2010, 117-118). This also concerns possible resistance from management side (Antony & Banuelas 2002, 25). Aligning the organizational culture and structure with the six sigma principles helps employees to understand their tasks and roles in the new quality culture (Yeah 2003, 263-264). In order to facilitate six sigma adoption, the organizational culture should be based on collaboration, communication and appreciation of employees (Sim & Rogers 2009, 45; Kovach & Fredendall 2013, 15).

The role of managers in the six sigma adoption is to ensure that six sigma will be spread throughout the entire organization and to behave as an example in adopting the six sigma principles (Kotter 1995, 64; Terziovski et al. 1999, 925; Pun & Gill 2002, 456; Ho et al. 2008, 268). They have to convince employees about the need for the change and allocate necessary resources to the quality improvement projects (Ho et al. 2008, 268; Mills et al. 2009, 115). Managers should personally participate in the six sigma related

activities in order to show their commitment towards the quality improvements (Ho et al. 2008, 268). In addition, they have to be willing to share their responsibilities by empowering employees and trusting that employees are capable to work independently (Hill & Huq 2004, 1039; Greasley et al. 2005, 362-363; Tang et al. 2010, 1253). Leadership style is closely related to managerial commitment and organizational culture. The factors related to leadership style focus mainly on managers' contribution to give more power to employees to manage their work independently. Managers have to motivate employees to adopt the organization's goals and values and create mutual trust between them and employees (Joiner 2007, 624, Parumasur & Govender 2013, 649). Optimism and continuous review about the successfulness of the change facilitates the long-term adoption of six sigma (Svesson & Wood 2005, 147; Oakland & Tanner 2007, 583).

Employee empowerment consists of employees' autonomy to make quality improvements and possibility to focus on improvement projects (Blackburn & Rosen 1993, 54; Boon et al. 2006, 537). Managers have to trust employees and allow them to manage their work without strict supervision (Tang et al. 2010, 1253) Sharing values and goals with the organization facilitates the six sigma adoption (Yeah 2003, 264). Possibility to use skills and knowledge is related to training; employees have to be able to utilize their skills in their work. Furthermore, training must provide employees necessary skills and knowledge to participate in the quality improvement projects. (Blackburn & Rosen 1993, 56.) Employees' perceptions are related to attitudes towards six sigma, perceived benefits from six sigma, commitment towards the organization and capabilities to perform the six sigma related activities. Perceptions are influenced by employees' expectations about six sigma and the outcomes of the six sigma implementation (Wood & Peccei 1995, 60; Coyle-Shapiro 1999, 452). The clarity of tasks and the organizational structure have an effect on the perceptions since they illustrate what kind of actions or involvement managers expect from employees (Yeah 2003, 264). Strong organizational commitment prevents resistance to change among employees (Peccei et al. 2011, 198-199).

Communication is supportive element in six sigma adoption, it enables both employees and managers to share information, express their ideas and receive feedback between different organizational levels and between people in the same organizational level (Blackburn & Rosen 1993, 52; Boon et al. 2007b, 955; Oliver 2012, 17-18). In order to facilitate six sigma involvement communication should be open, honest and comprehensive. Face-to-face communication should not be neglected either. (Blackburn & Rosen 1993, 52.) Training, goals, performance measurement and incentives should all be in line with each other but also with the six sigma philosophy. Training provides employees necessary skills to make quality improvements but also to share their knowledge with their fellow workers (Blackburn & Rosen 1993, 52; Abdullah et al. 2008, 447). It is important that training is related to work processes and tailored to meet the organization's

goals (Goffin & Szwejczewski 1996, 30). It should be provided to all employees in continuous basis in order to ensure the successful adoption of six sigma (Hanson et al. 2003, 1002; Larson 2003, 19, Karia & Asaari 2006, 41). The goals should highlight the importance of six sigma and be set in collaboration with employees (Anderson & Adams 1997, 6; Oliver 2009, 558). There should be both short- and long-term targets in order to motivate employees (Welikala & Sohal 2008, 640). Employees should easily understand the goals and they need to be familiar with necessary tools and methods to achieve these targets (Linderman et al. 2006, 787; Oliver 2009, 558). Too ambitious goals rather decrease employees' commitment than encourages employees to work harder (Linderman et al. 2003, 201). Performance measurement and incentives should be based on six sigma; they should reward employees for their actions towards the better quality and encourage employees to participate in improvement activities (Davidson & Al-Shaghana 2007, 259; Ho et al. 2008, 269, Zu et al. 2010, 97). Performance measurement system should focus more on the non-financial measures such as customer satisfaction than financial measures (Buch & Tolentino 2006, 362-363). Social rewards and other non-monetary incentives are found to be effective in the six sigma context (Allen & Kilmann 2001b, 128; Buch & Tolentino 2006, 364).

## 5.3    Limitations of the framework

The framework offers foundation for employee involvement. However, it has certain limitations which have to be taken into account when discussing the topic. First, the different factors in the framework are not separate; rather they are more or less related to each other. It might be difficult to draw a line between different categories because they are closely linked to each other. Managers facilitate majority of the factors even though those factors are not directly related to managerial commitment or leadership style Instead of focusing on separate categories the framework should be studied as a whole.

The second limitation is related to the lack of previous research about the involvement in the six sigma context. Addition to the six sigma studies the total quality management studies have been used as a basis of the employee involvement framework. There might be some issues regarding to the applicability of the total quality management methods to six sigma. The third limitation is generalization: the factors have been created by combining similar aspect mentioned in the previous studies. It should be kept in mind that these factors are broad concepts and they illustrate the nature of different aspects impacting on involvement. The framework provides a general view about the issues related to employee involvement and is not a detailed description of all the aspects that affect employees' participation.

# 6    RESEARCH METHODOLOGY

## 6.1    Research strategy

A case study research method is suitable when "how" and "why" questions are being asked and when the researcher has little or no control over the events that are researched (Yin 2003, 9). It is also characteristic for the case study to focus on contemporary set of events with real-life context. Furthermore, the case study research method is suitable when there are not clear boundaries between the phenomenon and the context. (Yin 2003, 13.) Explanatory study aims at finding explanation for the phenomenon studied. Usually it is used to identify cause and effect relationships and the factors behind the phenomenon. (Hirsjärvi, Remes & Sajavaara 2000, 128). This study aims at understanding the factors influencing employee involvement, especially the negative factors that discourage employees to participate in the six sigma activities. The phenomenon studied – employee involvement – is a broad concept and it is difficult to draw a line between the involvement and the surrounding context which favors the application of the case study method. The phenomenon is studied in the real-life context where the researcher has no control over the events. The main focus in the study is to explore the cause and effect relationships in employee involvement by examining the factors affecting involvement. Besides finding the impacting factors, the study aims at finding methods how to bridge the gaps in involving Black Belts in six sigma. In other words the study aims at explaining the current situation and providing improvement suggestions.

A single case study is suitable in five research settings: 1) when the case represents critical case for testing a well-formulated theory, 2) when the case is unique or extreme, 3) when the case is typical or representative case, 4) when the case is revelatory case or 5) when the study is longitudinal (Yin 2003, 45-46). The intensive case study aims at understanding the case with holistic view by providing contextualized and wide description from the inside point of view. The intensive case study tries to understand how the case works instead of providing knowledge that can be generalized. It focuses on one unique case and aims at exploring the case widely in order to provide interpretations. (Eriksson & Kovalainen 2008, 118-121.) This study examines a single company and tries to understand phenomenon in this particular context. Furthermore the study aims at developing methods to improve employee involvement in this case company instead of generalizing the results to wider use. However the case studied can be considered as typical case which why the results of the study may be applicable in organizations facing similar problems. The main goal of the study is to understand the employee involvement in the six sigma context and especially the negative factors affecting the involvement. Since the phenomenon is wide concept and related to human behavior it requires holistic approach

so that all affecting issues are taken into account. It is difficult to separate the gaps in employee involvement from the broader organizational environment since the involvement is affected by multiple factors and conditions. The inside point of view is needed because involvement is highly dependent on personal experience and human behavior.

The critical incident technique is also used in the research. The technique helps to collect direct observations of human behavior and facilitates the solving process of practical problems (Flanagan 1954, 327). It is designed for collecting important facts about human behavior in certain situations (Flanagan 1954, 335). It has been studied that this technique is valuable supplementary tool for studying attitudes (Flanagan 1954, 353). Since this study is closely related to the attitudes and human behavior the technique is applied to certain extent, mainly in the data collection but also in analyzing the data. The critical incident technique provides a useful tool for collecting information about human behavior by interviewing people in certain manner which is why the technique is used especially in data collection. The technique is used as supplementary method in interviewing people but also other interviewing techniques is used. The main idea behind the interviews in the critical incidence technique is to let interviewees tell in their own words about the phenomenon. In order to help interviewees to tell about the phenomenon also more detailed questions about certain factors are used.

Scientific knowledge can be achieved through three models; deduction, induction and abduction. Deduction stands for the idea that theoretical knowledge enables formulation of the hypothesis for testing the phenomenon in empirical research. Induction aims at formulating theories based on empirical research. The third model, abduction, can be described as a combination of inductive and deductive reasoning. It is common to use both inductive and deductive reasoning in the research in iterative manner. Abduction can be described as a process of moving from everyday descriptions and meanings to concepts and categories for creating the basis of an understanding for the phenomenon studied. (Eriksson & Kovalainen 2008, 21-23.) In thesis the abduction logic is used by examining empirical and theoretical data in iterative manner. Due to the nature of research question being closely related to perceptions of the case company personnel the empirical findings could not be questioned with the theoretical implications but the literature is used as a support to the empirical findings. Matching of theoretical and empirical findings were conducted in iterative manner by cross-referencing the data in several review rounds.

## 6.2    Research design

### *6.2.1    Research process*

It is typical for qualitative research that research strategy develops during research process since the research process is influenced by circumstances and it cannot be completely determined beforehand (Hirsjärvi et al. 2000, 155). The research process in this thesis began with a literature review which can be divided into two sections: six sigma familiarization and more detailed review of the issues affecting employee involvement. Due to the lack of previous studies about employee engagement in six sigma specifically, also other quality management philosophies were reviewed. Several common factors for employee involvement were found in the literature review. It was also noticed that the factors are not discrete from each other, rather they are closely related and are representing various aspects of the same issue. The most frequent factors were categorized and aggregated so that broader concepts could be found. The framework for employee involvement was created on the basis of the most common factors and their categorization.

Due to the nature of the research question case study research method was chosen. In addition, interviewees were found to be the most efficient form of data collection in order to understand the phenomenon from the employees' point of view. By interviewing employees the aim was to identify factors encouraging or discouraging employees to use six sigma or participate in six sigma activities. Together with the factors possible ways to improve employees' participation were expected to be found. After the interviewees the responses of the interviewees were analyzed and the results were categorized into broader concepts in order to better understand the phenomenon.

After analyzing empirical data the literature was reviewed in order to find similarities and supportive factors for the empirical findings. The factors found from the empirical data and literature were combined into framework for Black Belt involvement. The aim of the framework is to group the findings under broader concepts and describe current situation in the case company. The aim of the framework sis also to help to understand underlying drivers behind detailed descriptions of discouraging factors in the case company. Furthermore, the framework was created to combine the case company factors with the findings from the literature which serves as a basis of gaps identification and suggestive actions creation in the thesis. Gaps in the case company were identified based on the detailed descriptions of current situation in the case company. During identification process different views of the interviewees were taking into account. Moreover, perceptions about importance of different factors were considered. Suggestions were defined by studying previous researches and their findings. Moreover, the suggestions given by the interviewees were utilized also.

### 6.2.2   *Data collection*

It is typical for case study that multiple sources of evidence are used (Yin 2003, 14). The six most commonly used sources of evidence are documentation, archival records, interviews, direct observation, participant-observation and physical artifacts. All of them have strengths and weaknesses thus they complement each other. In case study it is useful to have different sources of evidence. (Yin 2003, 85-86.) This study relies mostly on interviews since the nature of the research question requires personal insight and holistic view about the phenomenon which are difficult to examine by using documents and observation. Interviewing is found to be the most effective data collection method to get the needed information and inside point of view.

Interviews are one of the most important sources of information in case study. Compared to structured queries, interviews are more like guided conversations than a set of detailed questions. (Yin 2003, 89.) Interviews can be classified into three types: *Open-ended* interviews allows respondent to tell about the facts of the matter or own insights about the events. (Yin 2003, 90.) They are informal discussions between the interviewer and the interviewee without strict framework for guiding the interview (Hirsjärvi et al. 2000, 195). *Focused* interviews are more related to specific topic and have more detailed questions (Yin 2003, 90). Focused interview, also known as theme interview, includes techniques from both structured and open interviews. In this interview type, interview themes are defined but questions are not determined beforehand. (Hirsjärvi et al. 2000, 196-197.) However, according to Yin (2003, 90) in this type of interview the questions are more likely determined beforehand even though the nature of the interview is conversational. In order to focus on specific theme interview follows a certain set of questions that will guide the conversation. The third interview type, *survey,* contains more structured questions. (Yin 2003, 91). It is very formal interview; all questions and their order have been determined beforehand. (Hirsjärvi et al. 2000, 195.) Due to the nature of the phenomenon studied interviews are designed to be open-ended but focused as well. The interview questions are defined to be open-ended allowing the interviewees to tell about relevant issues related to the phenomenon. There are also questions that focus more on certain themes so that the researcher can complement the narration of the interviewee by asking more detailed questions. The interview questions were reviewed after the first three interviews and one question (the question number 7 in the appendix 2) was added to complement the existing question and to get more detailed information about interviewees' possibilities to improve six sigma usage.

Qualitative interviews can be described as everyday conversations where the roles of the interviewer and the interviewee are not distinctively different. However, the aim of the interview is to provide empirical data for the research which why the interview is focused on specific issues. (Eriksson & Kovalainen 2008, 78.) Interviewees can be seen

more as informant than respondent since they provide not only facts but their opinions as well. They can also suggest other persons to be interviewed and other sources of evidence to the researcher. (Yin 2003, 90.) Interviews are used especially when the study aims at understanding meanings created by people (Hirsjärvi et al. 2000, 192). This study aims at finding out what kind of factors influence employees' involvement and their behavior. Due to the nature of the research question interviews are found to be the most effective way to examine this phenomenon. There are some weaknesses related to the interviews: bias caused by poorly constructed questions, response bias, and inaccuracies due to poor recall. There might also appear reflexivity which means that the interviewee gives answers that the interviewer wants to hear. (Yin 2003, 86.)

In data collection the principles of critical incident technique are used in order to examine human behavior. By using this technique interviewees are encouraged to tell about the phenomenon without leading questions from the researcher. For example, interviewees can be asked to describe the most recent incident and tell about behaviors that influence this incident. The aim is to let the interviewee bring out all relevant details about the phenomenon instead of stating structured or leading questions. The aim is to reveal also details that the researcher has not even understood to ask. The nature of the interview is conversational rather than structural. (Flanagan 1954, 341-342.) In this study interviewees have been asked first to describe a six sigma activity in which they have participated and also describe the reasons of participation. Since the phenomenon is closely related to human behavior and thus personal, the researcher may not understand all the issues related to involvement which is why interviewees are asked to describe situation in their own words and do most of the talking. After casual storytelling interviewees have been asked about more specific questions related to the involvement framework.

All interviews were conducted in Finnish, in the native language of interviewees. The interview forms (see appendices 1 and 2) are translated into English from the original versions. All interviews were held at the premises of the case company. Permission for recording interviews was asked in advance and all except one interview were given permission for recording. The interviews were not only recorded but also detailed notes were made during the interviews. For the one interview which was not recorded detailed notes were taken during the discussion. The questions were not given beforehand so that the interviewees would not formulate their answers in advance but also to avoid discussion about the questions and suitable answers.

Table 2          The interview schedule

| Position | Interview date | Interview form |
|---|---|---|
| Quality Manager | 8.9.2015 | A |
| Project Manager | 8.9.2015 | A |
| Project Manager | 8.9.2015 | A |
| Quality Manager | 14.9.2015 | B |
| Sourcing Manager | 14.9.2015 | B |
| Quality Manager | 14.9.2015 | B |
| Project Manager | 14.9.2015 | B |
| Quality Manager | 14.9.2015 | B |
| Sourcing Manager | 17.9.2015 | B |
| Quality Manager | 17.9.2015 | B |
| Project Manager | 17.9.2015 | B |

The table 2 presents the interview schedule: the interviews were conducted in three days and several interviews were held in each day. After the first three interviews one question was added to the form. The positions of the interviewees can be grouped into three groups: There are five Quality Managers, four Project Managers and two Sourcing Managers.

### 6.2.3    Analysis methods

According to Yin (2003, 111) there are three general strategies for analyzing case study evidence. The most common strategy is to rely on theoretical propositions so that propositions guide data collection and analysis. The propositions influence case study design, research questions, literature review and new hypotheses or propositions. Another analytic strategy is thinking about rival explanations. In this strategy rival explanations are defined and tested in order to find out if some other influences than the original propositions have impact on observed outcomes. Third strategy focuses on developing a descriptive framework for understanding the case study. (Yin 2003, 111-114.) In this study the theoretical propositions guided the formulation of interview question in a certain extent so that different aspects of the employee involvement will be taken into account. However, the interviews were analyzed and factors categorized independently so that the theoretical framework will not strongly guide categorization process.

According to Miles and Huberman (1994, 10) data analysis includes three concurrent flows of activity: data reduction, data display and conclusion drawing and verification. Data reduction means selecting, abstracting and transforming the data. It is an ongoing process during qualitative research. (Miles & Huberman 1994, 10.) In the critical incident

technique analyzing the data consists of summarizing and describing the data in such manner that the usefulness of it is maximized but also the comprehensiveness, specificity and validity is preserved. Defining suitable framework helps describing incidents and categorizing them into similar groups. Analyzing phase includes generalization of the findings and defining the level of generalization. (Flanagan 1954, 344–345.) In this study the data was analyzed by categorizing the affecting factors into similar groups so that generalization among interviewees' responses could be made. Data was categorized by first identifying possible factors from interviewees' responses. Identification was conducted in a detailed level in order to form a picture of challenges faced in the case company. After identifying challenges perceived by the interviewees data was further analyzed and similar challenges and factors caused the challenges was grouped together. In order to capture the differences among responses the data was not extensively summarized during categorization. After data categorization it was analyzed in more detail and similarities combined. The differences among responses were also taken into account and given importance because they represent personal perceptions and thus are relevant to the research problem.

Data display aims at presenting the data in compact form so that it enables seeing what is happening and drawing conclusions (Miles & Huberman 1994, 11). Conclusion drawing and verification is an ongoing process during research because the researcher gives meanings to the information by noting patterns, causal flows and explanations in the different stages of the research process. Conclusions need to be verified and the verification process can vary from taking another look to the field notes to replicating the findings with another data set. (Miles & Huberman 1994, 11.) In this thesis there were presumptions already before the empirical research process but the interviewees of the case company personnel advanced certain presumptions and diminish the relevance of other assumptions. Data verification was conducted by comparing responses of the interviewees but also the findings from the empirical study with the literature to a certain extent.

## 6.3    Reliability and validity

Reliability measures the ability to replicate the study by an external observer and conclude the same findings and conclusions as in the original study. It can be increased by documenting the procedures in detail and taking multiple steps instead of short cuts in the research process. Reliability aims at minimizing errors and biases in the case study. (Yin 2003, 37-38.) It is important to describe data collection process and bring out the circumstances and the possible distractions that may influence the data and the outcomes of the research. The researcher has also to describe why the data has been categorized in the

certain way which means explaining the basis of the category formation and the data interpretation. Detailed documentation and description ensures that the link between the data and the research conclusions can be seen by the external observer. (Hirsijärvi et al. 2000, 214-215.) This research has been conducted as a case study in one organization which makes the research environment to be unique by nature. Due to the uniqueness of research environment it is unlikely that the research can be replicated in future. However, the steps in the research process were carefully documented which enables the external observer to follow through the research logic from the research question to the conclusions.

Validity measures the ability of the research conclusions to describe or explain accurately the phenomenon researched. It stands for that findings are based on evidence. (Eriksson & Kovalainen 2008, 292.) Validity also means the ability of the research method to measure what it should be measured; the research method should provide answers to the questions asked (Hirsjärvi et al. 2000, 213-214). The validity can be divided into three categories: construct validity, internal validity and external validity (Yin 2003, 34). According to Judd, Smith and Kidder (1991, 29) *construct validity* means the extent to which the constructs of the theoretical interest are successfully operationalized in the research. Yin (2003, 97) has described three principles of data collection for improving construct validity and reliability of the case study. The first principle is to use multiple sources of evidence for corroborating the phenomenon which is called triangulation (Yin 2003, 99). This technique means using multiple perspectives to refine and clarify the research findings so that the phenomenon is studied from different viewpoints. (Eriksson & Kovalainen 2008, 292-293). In this thesis triangulation was conducted by using multiple sources of literature as a theoretical data and multiple interviewees as empirical data. The second principle is to create a case study database for raw data used in the study. The database allows independent inspection of the study because the data can be found also outside the study report. (Yin 2003, 101-102.) The third principle is related to maintaining the chain of evidence in order to increase the reliability in the case study. The chain of evidence should allow the external observer to trace the research actions and the evidences from the conclusions to the research questions and vice versa. In data collection all evidences should be taken into account so that not a single original evidence has been lost and not considered and analyzed in the study. (Yin 2003, 105.) During data collection the responses of the interviewees were captured in a carful manner and not generalized during data categorization. The differences and similarities of the responses were taking into account and presented in this thesis.

*Internal validity* means the extent to which the research design permits readers to reach causal conclusions about the effect of the independent variable on the dependent variable (Judd, Smith & Kidder 1991, 29). In other words the study aims at examining whether event $x$ lead to event $y$ or is there some third factor that impact on the relationship between

these events. Internal validity can be enhanced by using pattern matching, explanation building, addressing rival explanations and using logic models. (Yin 2003, 36.) Pattern matching can be described as comparing empirically found patterns with the patterns defined prior to collecting the empirical data (Yin 2003, 116). In explanation building the researcher analyses the data by building an explanation and determining a set of causal links about the phenomenon studied (Yin 2003, 120). The third method of improving internal validity is thinking about rival explanations and rejecting their influence to the outcomes studied (Yin 2003, 112). Logic models have similarities with pattern matching: by using logic models the researcher aims at matching empirically found events with theoretically predicted events and finding repeated cause-effect patterns (Yin 2003, 127). In this thesis internal validity is enhanced by making comparison between the findings from the literature review and the findings from the empirical research. Also the causal links between the phenomenon in question and the data gathered from the interviewees have been studied and presented.

*External validity* is defined by Judd, Smith and Kidder (1991, 28) as the extent to which the research findings can be generalized. In the case study generalization is applied to the particular set of results that are tried to extrapolate to some broader theory (Yin 2003, 37). In this thesis the aim is to explain the phenomenon in the case company context which why wide generalization has not been the aim of this thesis. Even though the thesis does not aim for wide generalizations the findings and the gaps can be applied to certain extent. However, generalization should be made with caution and understanding the differences between environment in this case study and environment where the results are applied to.

## 6.4    The case company: ABB Oy, Drives and Controls business unit

The case company in the study is ABB Oy and more precisely the Drives and Controls business unit in the Pitäjänmäki factory. As a multinational company, with headquarters based in Switzerland, ABB supplies industrial motors and drives, generators, power grids and other power and automation technologies. Around the globe ABB employs 140 000 people in 100 countries. (ABB 2015a.) In Finland the company (ABB Oy) operates in 21 towns and has factories in Helsinki (Pitäjänmäki and Vuosaari), Vaasa and Porvoo. In Finland ABB Oy is one of the largest industrial employers having approximately 5 200 employees. In 2014 ABB Oy turned in a revenue of 2.1 billion euros. (ABB 2015b.)

ABB is organized into five global divisions: power products, power systems, discrete automation and motion, low voltage products and process automation (ABB 2015c). The Drives and Controls business unit as a part of the discrete automation and motion division develops and manufactures low voltage AC and DC drives and medium voltage AC drives

for industrial use and software tools for them (ABB 2015d). In global 5000 employees are working in the Drives and Controls business unit over 80 countries. In Pitäjänmäki, Helsinki the business unit employs approximately 1300 people of who approximately one third is working in research and development functions. (ABB 2015e.)

In Drives and Controls business unit the six sigma trainings have been offered from the year 2008 onwards. Altogether 37 employees have participated Black Belt trainings since 2008. One person has also participated in Master Black Belt training. In addition to the Black Belt training, Green Belt training has been offered and approximately 10 employees have taken the Green Belt course. (Hyvärinen, email reply 1.10.2015)

# 7 SIX SIGMA IN THE CASE COMPANY

## 7.1 The aim of the chapter

Chapter seven presents and discuss findings based on the case study. The aim of the chapter is to explain current situation in ABB Drives and Controls regarding to six sigma usage. It focuses on the challenges perceived by the interviewed Black Belts in order to understand issues hindering six sigma utilization. The chapter consists of two sections: First, organizational environment is presented and the nature of it in terms of six sigma is discussed. Then the issues related to six sigma encouragement and six sigma facilitation are discussed.

## 7.2 Organizational environment

### 7.2.1 4Q – six sigma in ABB's way

The ABB Group has developed own six sigma program, 4Q, which can be described as ABB's way to use six sigma. In 4Q and six sigma there are similar tools and methods to execute improvement projects in the organization. Both philosophies highlight the importance of documentation and statistical methods but they use different terminology. (Project Manager.) Due to close similarity employees might find it confusing to differentiate six sigma from 4Q. To ease the situation, the difference between six sigma and 4Q should be clarified especially to the employees who are going to participate in Black Belt training. (Sourcing Manager.) The ABB Group promotes 4Q actively and strongly to the organization and also monitors its usage and how the personnel is trained to 4Q. (Quality Manager; Sourcing Manager). Because 4Q is pushed through from the corporate level it is also better known in Drives and Controls business unit than six sigma (Project Manager). Even though employees are more familiar with 4Q it is not discussed in very detailed level, rather broader topics such as analysis and root causes are covered in the daily conversations (Quality Manager).

Similar to six sigma trainings also in 4Q training participants have to execute a project in order to pass the training and be granted 4Q certificate (Project Manager). Employees are encouraged to participate in the training but there is not systematic follow up by their managers. Even though employees participate in the training, they do not necessarily finalize their 4Q projects. (Quality Manager; Project Manager.) This phenomenon can be also due to the lack of interest and capabilities among employees; not all of them are

willing or able to lead a development project independently. In order to train majority of the employees to 4Q philosophy in all organizational levels the trainers should ensure that the requirements of project work are not too demanding so that all employees can finalize it. (Quality Manager.) Also managers need to support their subordinates in the training and in 4Q project so that employees will finalize the projects and complete the course. The poor managerial support might be due to the lack of knowledge and training related to six sigma or 4Q which why managers feel uncomfortable to show their unawareness related to 4Q methods. (Project Manager.)

### 7.2.2 *Six sigma familiarity*

Even though six sigma is nowadays more visible in the Drives and Controls business unit, it is still relatively unknown across the organization. Employees recognize the term six sigma but the content of it is not entirely familiar to them. Six sigma is often perceived to represent variance or the sigma levels in the normal distribution. (Two Sourcing Managers.) Defining six sigma might be challenging event for Black Belts, or others who have participated six sigma trainings, which why people have different views of what can be classified as a six sigma related activity (Sourcing Manager). Because six sigma can be described as umbrella of different methods such as tools, problem solving process and management philosophy the concept of it might be difficult to comprehend for employees who do not have prior six sigma knowledge. Depending on person there are various definitions of six sigma. Usually it is not seen as a comprehensive philosophy, rather it is perceived as single method such as statistical tool or DMAIC problem solving process. (Quality Manager.) Employees recognize some of the methods and terms but the six sigma as a broader philosophy is not usually known (Project Manager). There are differences in six sigma familiarity among the functions; for example six sigma is in general more un-known in the production than in the other functions which have more six sigma trained employees (Project Manager; Quality Manager).

On the daily communication six sigma is not often represented in terms of concept, terminology or mindset (Project Manager). Due to the lack of knowledge in the organization six sigma related issues are not discussed on a regular basis or the six sigma terminology is not used (Quality Manager; Sourcing Manager). On the other hand, there are also teams where six sigma is well-know and discussed regularly (Project Manager; two Quality Managers; Sourcing Manager). The terminology is not always clear to Black Belts either, if they are not using the terminology on a regular basis they might have difficulties in discussing six sigma issues in a detailed level. Some of the Black Belts said that it might be challenging to follow a conversation if six sigma terminology is heavily used. (Project Manager; Sourcing Manager.) In itself, six sigma terminology is not widely

used rather employees discuss about problems, the possible solutions to them and improvement actions. Some six sigma terminology might be used but the term six sigma is rarely mentioned in discussions. (Quality Manager.) It might be challenging to explain the terminology or certain data visualization to employees who are not familiar with six sigma which might explain the rare use of the terminology. On the other hand the use of six sigma terminology could have positive outcomes: it might inspire employees to familiarize themselves with six sigma in order to understand better development projects. (Quality Manager.)

It is important to communicate six sigma related issues in a way that it is easily understood among employees. Because six sigma is relatively un-known concept its terminology should be used very carefully. Message should be adjusted to the listeners so that everybody can understand it. Instead of using correct terms it is more important to transfer the message into everyday language so that the meaning of it will be understood. (Quality Manager.) In order to spread six sigma knowledge and mindset the Black Belts should focus on delivering content not terminology. Not all employees or project team members need to know the exact terms although they participate in a six sigma project. Instead of the terminology they should know the basic principles of six sigma and be guided so that they can apply the principles in the project work. (Sourcing Manager.) The management or the Black Belts need to be aware of employees' knowhow regarding six sigma and cannot make assumption that employees in general have knowledge of different statistical methods. The managers and the Black Belts need to be careful when using the six sigma terminology in everyday conversations with employees, especially if employees are not six sigma trained. In order to widen the knowledge and interest towards six sigma the Black Belts should introduce and promote the philosophy in their organization. Employees need to understand the importance and the benefits of solving problems in a six sigma way so that they understand why it should be used. (Quality Manager.)

The interviewees have uniform view that especially in production six sigma could bring benefits if used more widely. Six sigma is relatively unfamiliar concept among production workers and their team leaders which why training should be provided more actively to them (Quality Manager). For example in every production line the person who is responsible of quality should have six sigma knowledge and he or she should be able to utilize six sigma in daily work (Quality Manager). In order to utilize six sigma better in the production it should be introduced to all employees. Currently six sigma is not known and employees as well as team leaders do not know the possible benefits of its usage. (Project Manager.) Green or Black Belt training and tools should be provided to process owners in order to encourage them to use six sigma in their work. If they are not trained it cannot be expected that they would apply six sigma principles. (Quality Manager.) In general statistical methods should be used more actively in all functions across the organization. In addition to production also research and development and product

design could benefit from systematic use of six sigma philosophy. It should come down from the management to lower levels in the organization in order to be taken into use. Also top management should apply six sigma mindset in their work and not only demand that employees use it. (Sourcing Manager.) Six sigma is also perceived to be technical method and it is not seen as philosophy that could be used in all functions in the organization not only in production or in quality control (Project Manager).

### 7.2.3 Six sigma training provided

All the interviewees are Black Belts; they have gone through 6 weeks training and executed Black Belt –project as a mandatory part of the training. In addition to the Black Belt course, some of them have participated in also various other six sigma trainings such as Green Belt, Master Black Belt, ASQ six sigma training and ABB own six sigma training, 4Q. In general Black Belt training was found useful. (Four Project Managers; five Quality Managers; two Sourcing Managers.)

There are various reasons to participate in the Black Belt training. General interest and positive feedback from colleagues who have taken the course have let to decision to apply for some interviewees (Project Manager; Quality Manager; Sourcing Manager). Mainly the initiative has come from their managers who found the course to be useful for the employee. There has been common practice to send several employees to Black Belt course yearly. Not always the initiative comes from the employee itself, his or her manager might see the benefits of the training to the employee and send him or her to the training. (Two Quality Managers; Project Manager.) There were also interviewees who had very strong aim to participate in the Black Belt training. Their interest was driven by the perceived benefits of the Black Belt course and the possibility to improve their work. They find that Black Belt training could support and further their professional growth and improve their capabilities to work better. (Two Quality Managers; Sourcing Manager.) Some interviewees had participated in Green Belt training and were already familiar with six sigma. They had also seen the benefits of six sigma method and tools in their work and found it useful to study more. (Project Manager; Quality Manager.)

Black Belt training is intensive course which requires lot of independent study and work. It is important that the person applying to the training is highly motivated and have time to focus on the training. (Two Quality Managers.) Employee's workload and daily task should be reduced so that he or she has enough time to study and do the Black Belt project (Project Manager). In order to take the full advantage of the training employee should have enough time become familiar with the tools and their usage. Otherwise it might be difficult to use the six sigma tools independently after training. (Quality Manager.) The importance of preliminary knowledge before training was also highlighted

during the interviews. The Black Belt course is intensive and it might be difficult to keep up with the training if the employee has not familiarized himself or herself with six sigma terminology and philosophy beforehand. (Quality Manager.) On the other hand the requirements of passing the course should be in line with the overall aim of the course: it is far more important that the participants can use effectively the six sigma tools than that they can write a perfect report. It is not valuable to use the limited time to fine-tuning the written report instead the participants should focus on learning how to take full advantage of six sigma tools. (Quality Manager).

Six sigma trainings should be offered to all employees that could have possibilities to utilize six sigma in their work (Sourcing Manager). Especially employees in development functions should participate in six sigma trainings in order to have sufficient knowledge to succeed in their work (Sourcing Manager). In the Black Belt training they would learn about change management, data analyzing and problem solving skills which all are essential part of development (Sourcing Manager). Currently there are not harmonious pre-training requirements related to certain positions but the perquisites are needed; for example all the process owners should have completed Green Belt training so that they have sufficient knowledge for their position. In addition 4Q training should be mandatory for all managers and team leaders. (Quality Manager.) For the employees working in the development teams the Black Belt training is not necessarily needed, Green Belt training would be sufficient for them (Quality Manager).

### 7.2.4    Black Belt project

As a part of Black Belt training the participants have to carry out a six sigma project in their organization. Even though most of the interviewees have accomplished to finish their projects in the scope of the Black Belt training for some interviewees the project took longer than expected or is still in progress. (Two Project Managers; Quality Manager; Sourcing Manager.) The long duration of the project finalization is partly due to challenges in data gathering or the lack of data available but it is also strongly related to the employees' motivation and interest to find time to finalize it (Project Manager; Quality Manager; Sourcing Manager). In addition to the foregoing the weak support and pressure from the management side does not further employees' motivation to finalize their projects. If their managers do not see the benefits of the projects they might not actively push the employees to follow through the projects. (Project Manager.)

A project team is mandatory part of the Black Belt training (Quality Manager). The team structure and responsibilities can vary from project to project: it can be very organized and have regular meetings but it can also be more nominal and the team members do not actively participate in project work (Project Manager). The nature of six sigma

projects is not necessarily highlighted in the team meetings; it might happen that the team members do not even realize that they are participating in six sigma project (Project Manager; two Quality Managers; Sourcing Manager). The reason for having these projects is the learning process of Black Belt candidates which is why their role in the project work is emphasized. The candidates usually takes great responsibility to solve the problem and apply the six sigma tools instead of acting as a project manager and organize the project team to solve the issue (Quality Manager.) It can be also due to the lack of six sigma knowledge among employees which why six sigma is not properly introduced and the terminology is not used. It might be challenging to explain the terminology or certain data visualization to employees who are not familiar with six sigma. (Project Manager.)

## 7.3 Organizational encouragement

### 7.3.1 *Organizational support*

In general in the Drives and Controls business unit the use of the six sigma tools and mindset cannot be seen as established practices which why there is not strong organizational support to use it. Because it is not common to use six sigma there is not natural encouragement or pressure to apply six sigma principles in work. (Two Project Managers; Quality Manager.) Some interviewees find that the culture in the organization does not facilitate collaboration and building horizontal project teams across several functions (Quality Manager; Sourcing Manager). Due to the silo structure in the organization it might be challenging for employees to participate in projects outside their own function. However, there is informal collaboration between different functions; employees coach and support each other across the silos in an unofficial way. (Sourcing Manager.) The lack of collaboration between different functions can be also related to the nature of the work itself. For some teams it is difficult to find help and support from outside the function because their expertise is very specific. (Quality Manager.) Even though the culture is not supporting information and knowledge sharing the organizational structure has been found to facilitate it. By being relatively flat and not having strict hierarchy it enables cross-functionality and taking off employees from their daily work to participate in development projects. (Quality Manager.)

Even though that some interviewees felt that the organizational culture is very silo-minded the others have not faced any challenges when building cross-functional teams. If there is a need for multifunctional team to solve a problem the team can be built over functional and geographical borders. (Two Quality Managers.) Cross-functionality is not automatic step that would happen in every situation but the culture does not restrict the

use of multifunctional teams if the need is justified (Quality Manager). The lack of collaboration is not due to the lack of interest among employees it is rather due to the lack of time (Project Manager; Quality Manager). Especially if a problem needs to be solved within very short time frame it might be challenging to find team members that would have time and commitment to participate in the project. Furthermore, long-term commitment is difficult to find because the project takes time from daily task which need to be executed as well. (Project Manager; Quality Manager.) Although some interviewees argue that the lack of time is only an excuse. Rather it is matter of prioritization and resource allocation to have people from different functions in six sigma project. (Project Manager; Sourcing Manager). Resource allocation is highly dependent on the employee and especially the manager whether he or she will consider the six sigma project to be useful (Project Manager). In general the attitude towards development is not negative or pessimistic, employees are interested in improvements and they are willing to participate if they find the project useful (Quality Manager).

Six sigma philosophy requires certain level of formality and systematic approach in projects, it is more than using the statistical tools in work. Systematic way of solving problems and documenting it has not been widely embedded in the organization which results in less systematic problem solving. (Quality Manager.) In the organization it is common to jump to improvement actions without analyzing the problem profundity and finding the root causes (Sourcing Manager). Culture does not encourage employees to launch a six sigma project to solve a problem in a systematic and documented way because the requirement of systematic approach is not embedded into the organizational culture and it is not shared practice among all employees (Quality Manager). Several interviewees stated that six sigma is not used widely and it has not become common practice in the organization (two Project Managers, Quality Manager). Instead of finding a problem and moving on straight to improvement actions employees should focus on how to solve the problem and what kind of expertise is needed in the problem solving process (Quality Manager). The importance of systematic and documented way should be highlighted due to the fact that the documented process can be studied, analyzed and recreated in the future if needed (Sourcing Manager). Employees might find the six sigma philosophy useless in problem solving because they can tackle tasks also without formal approach (Quality Manager). It is important to notice that six sigma is not the solution to a problem, rather it is a method to solve it better and more systematic way but solutions can be found also without six sigma (Sourcing Manager). Sometimes it is challenging even for Black Belts to identify potential six sigma projects at the time of launching a new development project because six sigma is not widely used in the organization. (Quality Manager.)
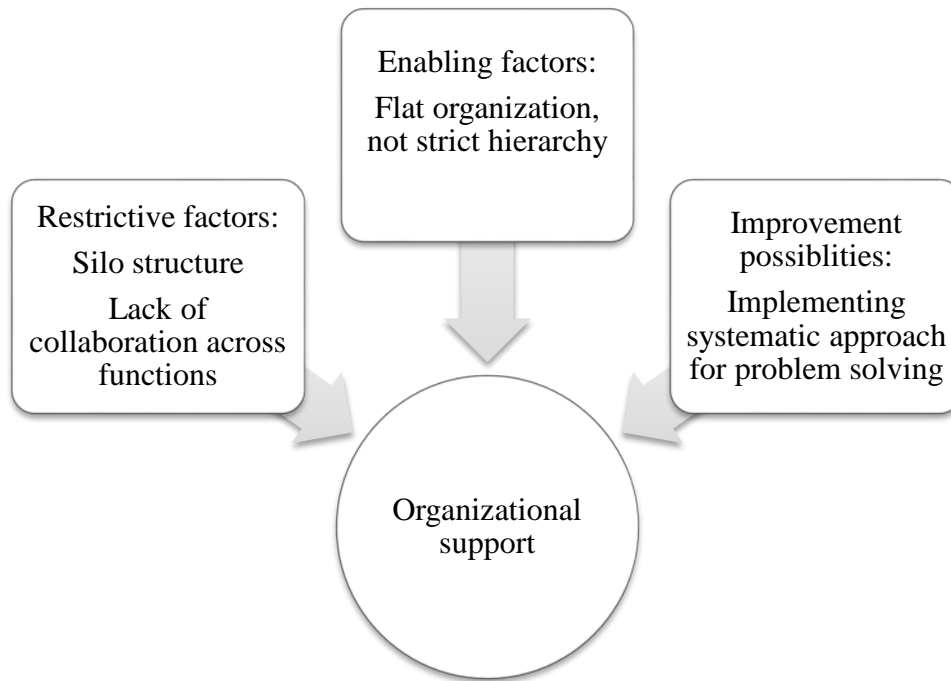
Figure 13      Restrictive and enabling factors in organizational support

Restricting and enabling factors in organizational support can be seen from the figure 13. Due to the silo structure there is not cross-functional collaboration in the organization which is limiting possibilities to use Black Belts' skills and knowledge also in functions which do not have six sigma trained personnel. On the other hand the organizational structure is relatively flat and there is not strict hierarchy to hinder building project teams which have members from different functions or organizational levels. Six sigma philosophy and problem solving method is not embedded in the organization thus the natural encouragement and support for its usage is missing. The systematic approach in problem solving should be embedded to be the common practice in the organization in order to increase its utilization.

### 7.3.2    *Management support*

In general managers are not actively encouraging or supporting their subordinates to use six sigma. They do not resist it but they do not push it either. (Two Quality Managers; Sourcing Manager.) However, several interviewees said that they have managers who supports them in six sigma related issues and encourages them to use their skills and knowledge. Not all of these managers have six sigma trained but they understand the benefits of approaching issues in six sigma way. (Three Project Managers; three Quality Managers.) The interviewees expect that their managers encourage them to use six sigma and some of them stated that managers could require more actively that six sigma needs

to be used. (Project Manager; Quality Manager; Sourcing Manager). The managers could demand and encourage six sigma usage by setting soft performance measurements for it (Quality Manager). The Black Belts especially should have the responsibility to use six sigma knowledge in their work and their managers could actively demand that (Sourcing Manager). Supportive managers usually have basic understanding of six sigma tools of the benefits of using them (Project Manager). However, it is not sufficient that managers only encourage employees to use six sigma because they should also enable it by providing necessary tools or resources to employees (Project Manager).

Cultural change should start from the top levels of the organization and then expand to all organizational levels with the help of managerial commitment (Quality Manager). All managers, especially in the top level, should be familiar with six sigma basic principles and understand why six sigma trainings are offered to employees. They should also see and understand the benefits of using six sigma approach in order to encourage employees to use it. (Project Manager.) For furthering six sigma in the organization managers need training otherwise it might be challenging for them to motivate their subordinates to utilize six sigma in everyday work (Quality Manager). Not all managers have to Black Belts as long as they have basic knowledge of six sigma and can support their team in six sigma related issues (two Project Managers). The lack of understanding in the top management side leads to situation where it is challenging to convince lower level managers of six sigma benefits and have their support to six sigma projects. (Quality Manager). Managers without six sigma knowledge might not encourage employees to participate in six sigma trainings. Also they might not understand the benefits of training and see only the negative issues such as the time-consuming training schedule. (Project Manager.)

Managerial commitment and support is essential for motivating employees. Managers have to show visible commitment for example by monitoring development projects and their progress. A habit of suspending projects decreases employees' motivation to participate projects in the future and also erodes their trust in managerial commitment. (Project Manager.) In addition to commitment, managers should also improve communication of the development projects. It is common that no-one in the organization except the project team knows that a certain project has been launched. (Quality Manager.) More efficient communication over the function and country boundaries would further collaboration and help to avoid situation where multiple functions are trying to solve similar problem (Quality Manager).

Also managers need support from their sponsors. Guidelines and motivation should come from the top level in order to involve all managers. They should be convinced that six sigma approach is not time-consuming way instead it improve documentation, the reliability of results and also systematic and analytic approach. Especially top management should focus on inspiring team leaders to implement six sigma methods in their teams. (Project Manager.) All in all management needs to show visible commitment to

systematic thinking in order to highlight the importance to employees (Sourcing Manager). People tend to have bias against new methods which why it is essential that managers promote the change and do not resist six sigma. (Project Manager).
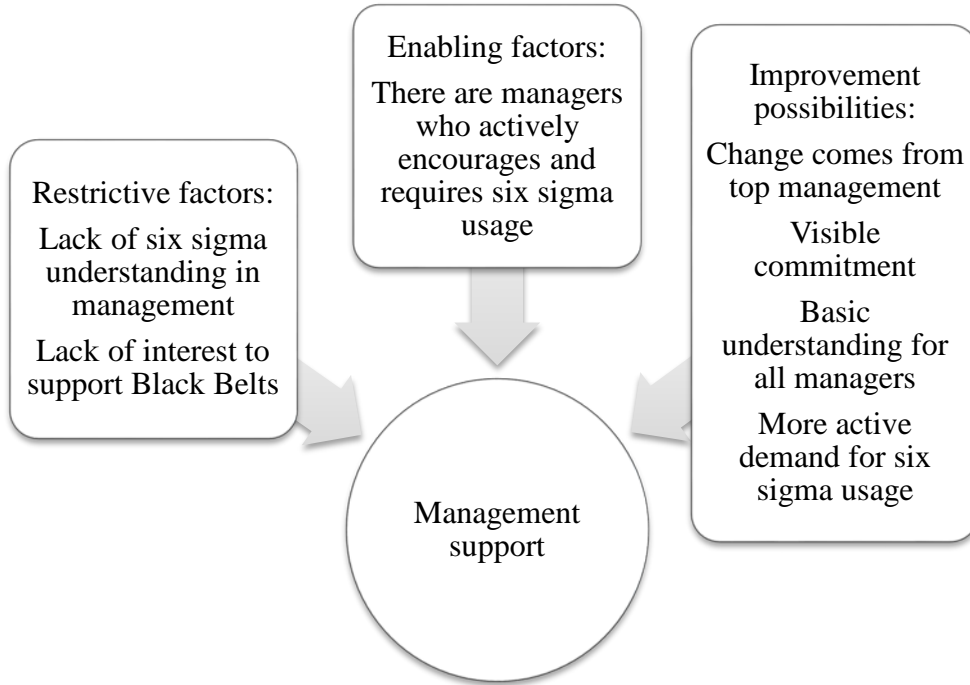


Figure 14      Restrictive and enabling factors in management support

Restrictive and enabling factors related to management support are illustrated in the figure 14. Management supports is strongly dependent on the understanding of six sigma benefits among the managers in all organizational levels from the top management to the team leaders. Without understanding the basics of six sigma managers might not find six sigma useful and necessary which is why they do not try to promote six sigma in their organization. On the other hand, there are also managers who actively encourage Black Belts to use six sigma and even require its utilization. In order to successfully widen six sigma into the entire organization the cultural change needs to come down from the top management so that the importance of it is understood. All managers should have basic knowledge of six sigma and its benefits so that their reluctance to change is not due to the lack of knowledge. Managers can have great impact if they show visible commitment to six sigma to their subordinates by requiring and monitoring six sigma usage and providing the tools and resources for employees to execute six sigma projects.

### *7.3.3    Target setting*

In general the targets of employees are at the business unit level and they are generic targets for the entire organization. They are mainly monetary goals and are drawn from the financial results. Neither the general targets nor personal targets are tied to the six sigma philosophy. (Two Project Managers; two Quality Managers; Sourcing Manager.) Although there can be personal targets related to development or quality due to the nature of employee's position but they are not either tied to the use if six sigma tools and methods (two Quality Managers). Employees are rewarded for the outcomes such as quality improvements and financial results instead of being rewarded for executing six sigma projects (Quality Manager; Sourcing Manager). It is mainly dependent on the employee what kind of tools or methods he or she will use for achieving the targets since there are not rules or guidelines which tools to use. (Quality Manager). Immediately after the Black Belt training, some six sigma targets might have been set. One of the interviewed Project Managers mentioned that there was a goal to start at least one six sigma project in a year but this target had not been properly followed since and thus was forgotten.

The lack of six sigma targets can be seen in a various ways: On the one hand six sigma targets are not seen value adding in the scope of gaining financial results. The outcome is more important than the method for achieving it. In rewarding employees the focus should be on the achieved results and not the methods used for achieving the results. (Quality Manager.) Six sigma cannot be the goal that guides all activities in the company: it is a means not an end itself (Sourcing Manager). It is important to understand that the Black Belts do not see six sigma as the ultimate tool to achieve set targets rather it is seen as one alternative among other tools (Quality Manager; Sourcing Manager). The interviewees argue that employee should be able to choose the tools by himself or herself and not to be limited to use of six sigma because problems can be approached from several perspectives and six sigma is only one alternative among them. (Quality Manager; Sourcing Manager.) Although the formal approach of six sigma might improve the outcome if the projects would be executed more systematically (Quality Manager).

Instead of six sigma, systematic and analytic approach could be emphasized in the targets setting. It is more useful to focus on systematic and document way of doing than solving problems by following six sigma process. (Quality Manager.) In addition to systematic approach employees should be encouraged to take part in continuous improvement activities by recognizing their improvement ideas (Sourcing Manager). It can be also argued that use of six sigma is not anyone's job description and nobody has been hired to be in a Black Belt role. It might be questionable to measure someone's performance against goals that are not related to his or her daily job since six sigma is a method to achieve the goals not the goal itself. However, if employees' main responsibility is to solve problems then six sigma target could be reasonable. (Sourcing Manager.) It is also

important to inspire employees since their motivation should be driven also from themselves not only set targets or rewards (Quality Manager). Setting targets without management commitment is not fruitful. In order to widen the use of six sigma methods and tools management should show visible commitment to six sigma by using the tools and mindset in their work. (Project Manager.)

On the other hand six sigma related target are seen as positive contributor to the use of six sigma. Measurable six sigma targets such as one six sigma project have to be started in a year make the use of six sigma visible. Having this kind of target is easy to measure which ease the follow up process. (Quality Manager.) However, the concept of six sigma project should be clearly defined in the company level in order to measure employees against the same principles. Otherwise some people might argue that the use of pareto chart makes a project to be six sigma project and for others the definition is much broader. (Project Manager.) Targets related to six sigma projects would emphasize the importance of six sigma and companywide commitment to it. Also the use of six sigma would be followed and the benefits recorded which would further the utilizing six sigma approach. (Project Manager.) It is more likely to use six sigma philosophy in work if six sigma projects have been set to be a target. Otherwise it is easy to forget the philosophy and use other, usually more familiar, method. (Quality Manager.)

It might not be even in personal target, it can be in the team level; for example minimum five six sigma projects have to be executed in the team within a year. It would be team leader's responsibility to monitor that the required number of projects will be launched within the given period and follow up the projects. Together with the Green and Black Belts team leaders should support and facilitate six sigma projects. (Quality Manager.) Projects do not have to be enormous and involve lots of employees, also smaller problems can be solved by using six sigma philosophy (Sourcing Manager). Expanding six sigma targets to be companywide could also help the Black Belts to get support and ideas from functions which do not have many six sigma trained employees (Project Manager). It could facilitate information sharing and use of six sigma because problems would brought to the Green and Black Belts. Currently the Black Belts might face challenges and feel pressure to find a suitable project to practice six sigma methods especially if they cannot find projects within their own function. (Two Project Managers.)

There are also concerns how the targets would work in practice. One of the interviewed Quality Manages argues that the number of six sigma project is too simplified target and is worried that employees would take the path of least resistance and use six sigma to solve easy problems for achieving the bonus target. This might lead to situation where employees focus only simpler cases in six sigma manner and do not use six sigma when solving more difficult issues. (Quality Manager.) It is easy to launch the required number of six sigma projects to meet the target but changing the culture is far more difficult. If the projects have been launched as six sigma project only to meet the targets then the

target setting has failed. (Sourcing Manager.) However another Project Manager disagrees because it is better to use six sigma to solve simple problems than not to use it at all. Even one six sigma project is a starting point to the right direction. (Project Manager.) It also stated that six sigma philosophy and its formal problem solving method may reduce organization's agility: in some situations it is more important to solve the problem quickly than in a systematic and formal manner. Even though formality is useful and benefits the process also agility and ability to solve problems quickly have to be kept in mind. (Quality Manager).
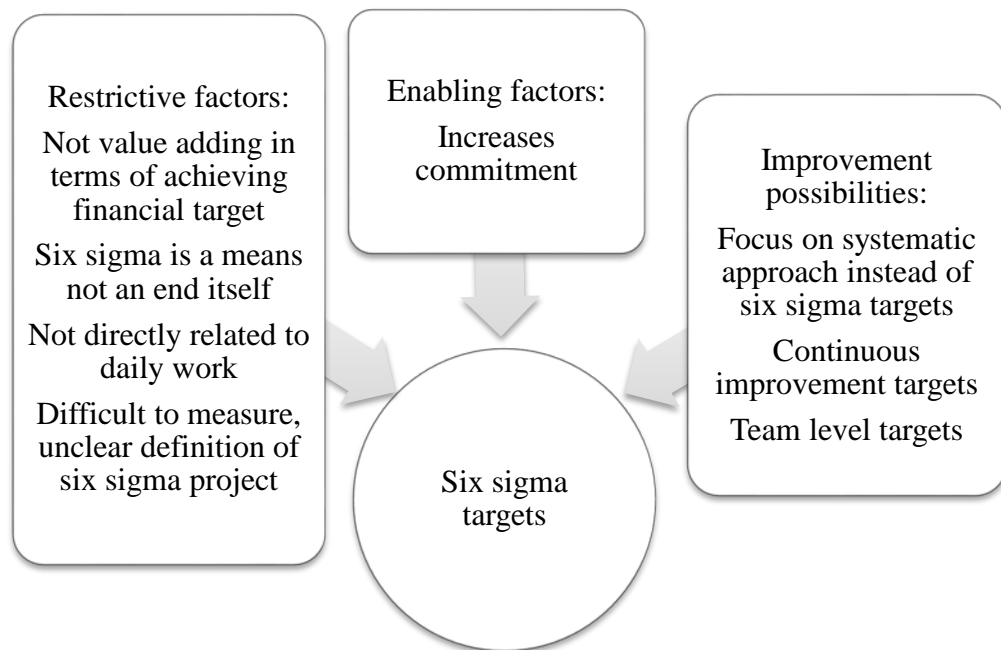
Figure 15     Restrictive and enabling factors of six sigma targets

Figure 15 presents how six sigma targets such as certain number of projects executed within a year are perceived among the Black Belts. In general the targets were found ineffective method for improving six sigma usage in the organization. Since most of the targets are tied to financial measures, six sigma is not seen as value adding targets in terms of financial results. It does not directly bring financial benefits. Six sigma is seen as one method to achieve targets but it should not be the goal itself. Instead of limiting problem solving processes to follow only six sigma methodology, target setting should highlight the importance of systematic approach regardless of the methodology used. In addition continuous improvement should be emphasized. Six sigma should be clearly defined in order to set six sigma targets, there should be uniform understanding how to measure the performance and define six sigma project. Six sigma targets might be difficult to link with the Black Belts' daily work because their job is not to execute six sigma projects. Even though some interviewees found six sigma targets to increase commitment

due to the visibility of six sigma activities, others argue six sigma targets limit employees' possibilities to choose methods to be the most suitable for the problem in question because they have to use six sigma in order to achieve targets. Team level targets could widen the involvement to cover also those employees who do not have six sigma background or have not participated in six sigma training.

### 7.3.4   Tools and data available

There are enormous amount of data available for employees to use (Project Manager). Even though data is gathered in a great extent it is not utilized widely. It has not been clearly determined how to gather data in order it to be unambiguous. (Project Manager.) Not all gathered data is reliable and good quality (Quality Manager). The poor quality of the data limits the possibilities to analyze it with the six sigma methods and tools. Another problem is running the data from ERP-systems so that it can be analyzed statistically. (Project Manager.) Data format usually limits the possibilities to use statistical methods because data is filtered, skew and in various forms. Due to the inconsistency data needs to be manually sorted, edited and categorized which might be difficult and time consuming. This leads to situation where problem finding might be based more on visual perception than data analysis in cases where visual observation is possible. (Quality Manager.) Data sorting and editing takes most of the time in data analyzing process if systematic approach is followed (Project Manager). Not only data editing is challenging also the gathering can be cumbersome: there are multiple data systems for acquiring data and it is not always clear where to gather the needed information. If the required data have to be gathered from multiple systems it might diminish employees' willingness even start data gathering process. (Project Manager.)

Data and information systems need development in order to support the use of six sigma tools and methods. Current systems does not support proactive controlling of processes which why statistical tools are not widely used. (Quality Manager.) The lack of organizational commitment in the system development and availability does not facilitate the use of six sigma and highlight its importance. Tools and data systems should be development in a company level and then provided to functions so that the functions can focus on using the tools not developing them. (Quality Manager.) Toolkit would facilitate six sigma usage in employees' point of view and also it would make the use of six sigma more attractive. By providing ready toolkit to employees the organization could encourage employees to use it and also highlight the importance of the tools. (Project Manager.) It would be useful to have also template of how to execute six sigma or other development projects so that employees would know what is expected to do and which kind of issues they should take into account during the development process. In addition there could be

more guidance how to apply six sigma tools in practice. (Project Manager.) The six sigma tools itself do not require more time than any other tools if employees have capability and knowledge to use them. However, it requires that these tools are available for employees. (Sourcing Manager.) Visibility and tools that are easily available would facilitate the usage and motivate employees to use more efficiently statistical methods in development projects as well as in their daily work (Project Manager; Quality Manager).
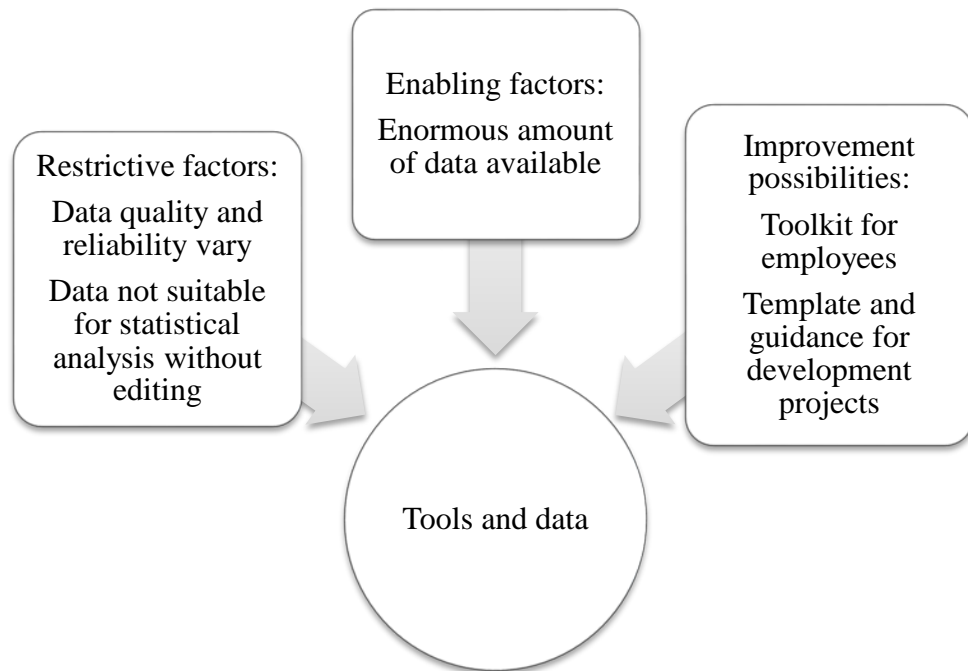


Figure 16        Restrictive and enabling factors of tools and data

Figure 16 illustrates how tools and data are limiting but also enabling the use of six sigma. There is lot of data available but its quality is inconsistent and reliability varies. In most of the cases data needs to be sorted, grouped and edited in order to be able to use statistical methods in data analysis. Data editing is time-consuming process which why data is gathered by observing or using simpler analysis methods instead of using statistical tools. There is not toolkit or template available to assist employees in their development projects. In order to increase the use of statistical tools the organization should provide set of tools to employees so that everyone has similar possibilities to use the tools across the organization. Additionally guidance and instructions should be provided so that employees know how is expected in development projects and what kind of steps there are.

# 8 IMPROVEMENT POSSIBILITIES

## 8.1 The aim of the chapter

The aim of the chapter eight is to describe the possibilities of Black Belts and the organization to improve six sigma utilization. It explains why certain factors hinder six sigma usage and presents possible improvement actions given by the interviewees. The chapter consists of three sections: first the improvement possibilities of Black Belts are discussed and second the possibilities of the organization are reviewed. The third section introduces Black Belt organization, an improvement suggestion given and strongly supported by the interviewees.

## 8.2 Black Belts' possibilities

### 8.2.1 Own capabilities

It applies also in six sigma that learning is happening by doing and by repeating tasks (two Project Managers; Quality Manager; Sourcing Manager). In order to use six sigma efficiently many of the Black Belts would need more practice and possibilities to use six sigma tools and methods in work (three Project Managers). Although they are capable of executing six sigma projects to some extent they are not yet fully at the Black Belt level in terms of skills and knowledge (Quality Manager). The Black Belts face challenges in applying six sigma principles into complex problems, their capabilities to apply the knowledge into practice in a various environments might still be weak (Project Manager). Even thought it might be challenging to use six sigma tools independently the Black Belts said that the mindset and knowledge help them to support their colleagues in development issues (Sourcing Manager). Six sigma principles such as finding the root causes is applied in the daily work although the six sigma tools might not be used (Project Manager). Six sigma mindset is used because it improves own thinking and performance by helping the Black Belts to focus on the normal variation, not on rare exceptions (two Project Managers).

The interviewees have realistic understanding of their capabilities to use six sigma. Most of them stated that they need more practice in order to use six sigma tool and methods independently (two Project Managers; Quality Manager; Sourcing Manager). After the Black Belt training some of them have not regularly used the tools, which is partly due to the lack of time and possibilities (Quality Manager). It also might be due to their

roles which do not require data analysis or improvement activities (Project Manager). A few interviewees stated that they have not deliberately neglect to utilize six sigma if there has been possibility to use it (Project Manager; Quality Manager). The lack of possibilities is the main reason not to use six sigma more often said one of the Project Managers. In general the Black Belts are interested in six sigma issues and they read six sigma literature for getting new perspectives and recalling learning from the training (two Quality Managers).

Many of the interviewees stated that the key learning from the training is the terminology. Being familiar with it gives confidence to discuss quality issues with suppliers and customers. (Two Quality Managers.) The Black Belts understand the importance of statistical methods and demand fact based decision making from themselves and also from their colleagues (Sourcing Manager). They also recognize that they could use more systematic data analysis in their work but the lack of guidance is not enabling it. There is not templates or instructions for development project execution to guide employees in their projects. A common template for development projects would standardize processes and force employees to proceed step by step instead of making rash decisions. (Project Manager.) Additionally there should be a set of tools available for six sigma projects so that employees would know which tools are available and also get instructions how to use them. Regardless of employees capabilities and prior knowledge there should be tools available to employees so that they all have equal possibility to apply six sigma methods and use the tools in their work. (Project Manager.)
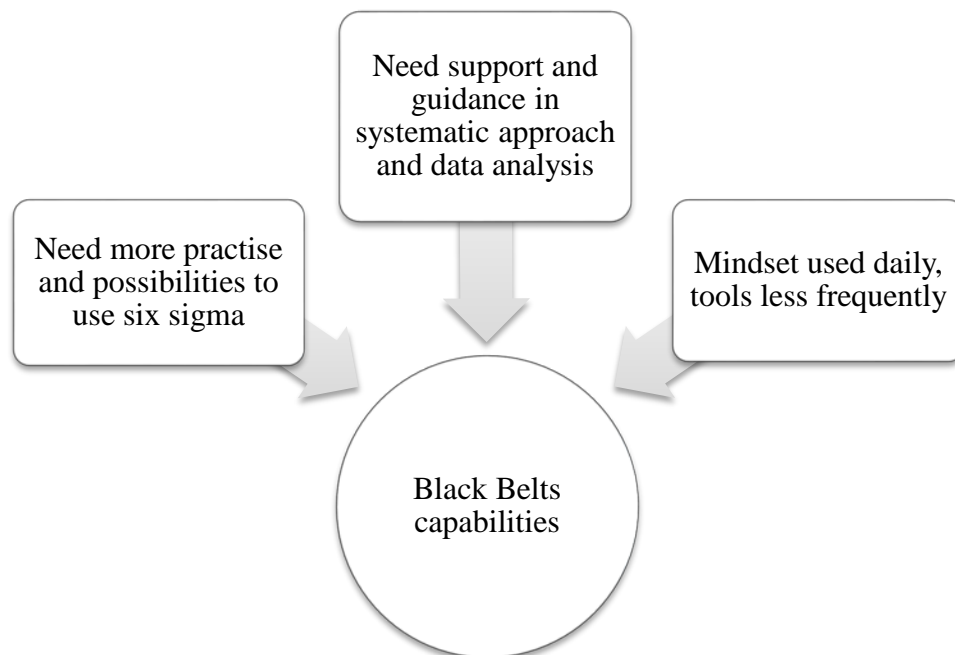


Figure 17       Six sigma capabilities of Black Belts

Figure 17 presents how the Black Belts perceive their own capabilities to execute six sigma projects in their work. Most of them stated that they need more practice to improve their skills to use six sigma independently. However, they might not have possibility to use six sigma in their daily work which is why they would have to seek possibilities also outside their own responsibility areas. In order to work outside their own area or function they need support and permission from their managers. Six sigma is used preliminary as a mindset and guidance to systematic way of doing. The use of tools and statistical data analysis varies greatly among the Black Belts due to the different nature of their job and different possibilities to use them in daily work. In general, it can be stated that six sigma is used one way or the other on a regular basis.

### 8.2.2 *Six sigma utilization in daily work*

Philosophy and mindset are perceived to be the key learning from the Black Belt training. The interviewees described that because of the training they have more analytical approach and deeper understanding of the importance of fact based decision making and finding the root causes (two Project Managers; two Quality Managers; two Sourcing Managers). The Black Belts are applying individual methods in their work rather than the entire six sigma philosophy (Quality Manager; Sourcing Manager). However, statistical tools are not used regularly among majority of the interviewees due to various reasons. First, the use of statistical tools in daily work may not be relevant to because Black Belt's position does not require the use of statistical tools (Project Manager; Sourcing Manager). It can be related to personal interest; the Black Belts might not be interested in numbers and statistics which is why they are in the position where their daily work does not contain data analysis (Project Manager). Second, they might not have possibilities to use six sigma tools due to the lack of available data or due to the poor data format (Project Manager; Quality Manager; Sourcing Manager). The latter does not encourage them to use six sigma tools because filtering and modifying the data into a usable format would be time consuming and difficult process. (Project Manager.) Alternatively the six sigma tools do not bring value to the analysis and thus they are not used for example in forecasting the future price fluctuations (Sourcing Manager). Third, the interviewees stated that the lack of utilization might be due to weak internal pressure. Because six sigma is not embedded into organization the Black Belts are not demanded to use it. (Two Project Managers; Quality Manager.) Some interviewees stated that six sigma usage has not become routine for them which why they are not fully utilizing it, especially the statistical tools (two Project Managers; Quality Manager). It can be also stated that six sigma usage is strongly depended on person's willingness and amount of effort he or she is willing to put to it. Several interviewees stated that there is not specific reason for weak utilization

and admitted that they could have used six sigma tools more actively (two Project Managers; Sourcing Manager). However, many of the Black Belts use six sigma philosophy to guide their thinking and actions. Instead of making rash decisions and jumping into conclusions the six sigma philosophy forces them to proceed one step at a time in a systematic manner (Project Manager; Quality Manager; Sourcing Manager) The underlying philosophy is utilized on a daily basis but six sigma projects are launched rarely (Quality Manager). In order to use six sigma tools the Black Belts might have to seek opportunities also outside their own team and function (Sourcing Manager).

Other factor which does not support the use of six sigma is the lack of six sigma knowledge among employees in general. The Black Belts cannot use six sigma terms to present their findings to their colleagues because the terminology and tools are not always familiar to others. It is time consuming to explain the terms and methods to others which why it is easier to use other, in general more familiar, analyzing methods instead of six sigma tools. (Project Manager.) Managers and especially Black Belt managers could more actively demand that employees are more systematic in data analysis and also more actively promote and discuss six sigma within their teams (Quality Manager). Employees should be challenged to analyze data in more detailed manner and studying also dispersion and variance instead of focusing on the mean value (Sourcing Manager). In manager role the use if six sigma tools might not be relevant but the Black Belts managers should encourage and require their subordinates to use six sigma approach in the daily operations. They should also promote Green and Black Belt trainings in order to expand the knowledge and usage of six sigma. (Quality Manager.) The Black Belt managers could also train their team to be more familiar with six sigma. By training employees they could use their skills and knowledge to improve team's performance. (Quality Manager.) However, not all Black Belts have interest to actively promote six sigma in their working environment; some of them find it more effective to improve their own and thus their team's performance by applying six sigma philosophy in their work instead of trying to convince their peers about the benefits of six sigma (Quality Manager).
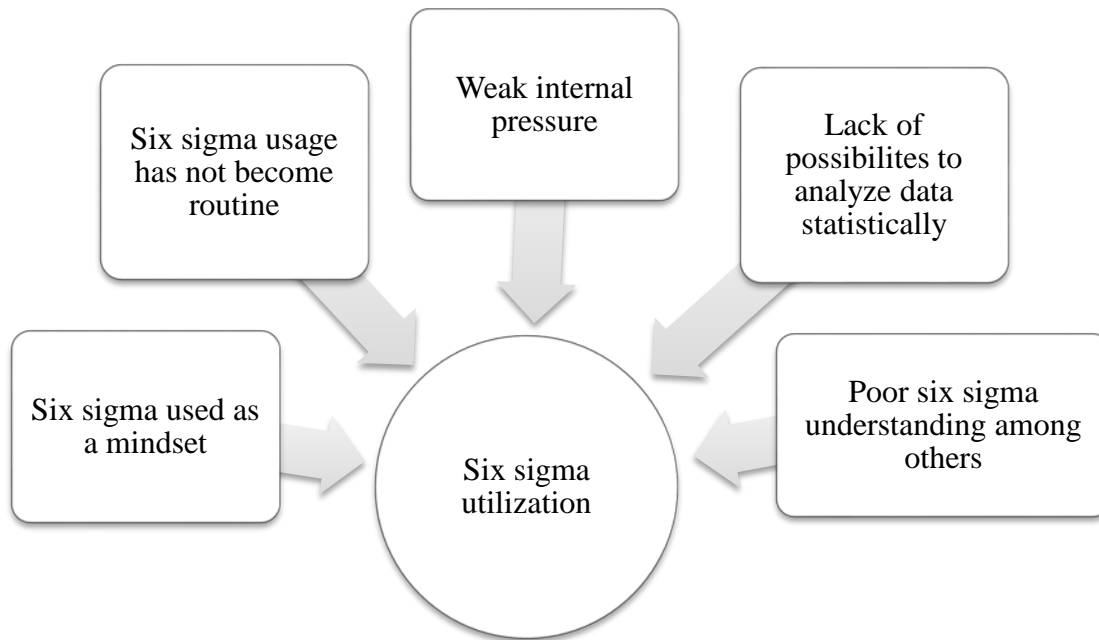
Figure 18      Six sigma utilization in daily work

Six sigma usage in daily work is illustrated in the figure 18. It is used especially as a mindset for systematic approach. Using six sigma philosophy forces the Black Belts to solve problems in a systematic manner instead of making rash decisions and leaping to conclusions. The rare use of statistical data analysis is generally due to the Black Belts' work and the lack of possibilities to analyze data. There might not be data available to be analyzed statistically or the daily tasks do not require data analysis. On the other hand, the Black Belts might not use six sigma in their daily work because six sigma has not become routine for them and the use of six sigma is not automatic step in improvement projects. Thirdly there is weak internal pressure to use six sigma because it has not been embedded into organizational culture. The poor understanding of six sigma among other employees does not facilitate the use of six sigma. It is time-consuming to explain six sigma terminology and the methods to employees. Due to the lack of six sigma familiarity the Black Belts might prefer to use some other data analyzing methods which is more widely understood.

## 8.3    Organizational possibilities

### 8.3.1    Six sigma vision

Currently it is challenging for even the Black Belts to describe six sigma briefly and how it is defined in the Drives and Controls business unit. In order to encourage employees to use six sigma in all organizational levels employees should first have understanding what the definition of six sigma. (Sourcing Manager.) In order to spread six sigma into the entire organization there should be clear consensus what the term "six sigma" means in the organization. Employees need to have uniform conception so that six sigma is understood in the same way across the organization. (Sourcing Manager.) As discussed earlier, six sigma is not well-known in the ABB Drives and Controls business unit: some sees six sigma as broader philosophy and for others it represents only single tool or a set of tools (Quality Manager). In order to transform organizational culture towards more six sigma oriented the vision needs to come from the management (Quality Manager). First of all the organization should be able to state why employees have trained as Black Belts and what kind of benefits the organization expect to gain from the skills and knowledge of these employees (Sourcing Manager). As one of the interviewee stated (Project Manager) the organization is wasting working time and resources if the skills and knowledge of the Black Belts is not actively utilized. Currently not all Black Belts are expected to use six sigma in their work (two Quality Managers; Sourcing Manager). The organization is not recognizing the value of the knowledge nor the possibilities to capitalize the knowledge (Sourcing Manager). In the ABB Drives and Controls there are over thirty Green or Black Belts who have applied the six sigma principles in practice at least in the mandatory project work during the training. However, the utilization after the training is not monitored and each Green and Black Belt are putting the skills into practice in different scope. (Quality Manager.) Without clear vision and aim six sigma will not be successfully spread through the organization (Sourcing Manager). However, it is difficult to managers to promote six sigma if it is completely unfamiliar concept to employees (Quality Manager).

There should be also capability to recognize the potential six sigma projects. In addition there should be time and motivation to solve projects in a systematic and formal way. (Quality Manager.) The projects should be properly set up so that there is a project plan, clear beginning and ending and also team member who can commit to the project. It is also important to state why the project is important in order to motivate team members because they are giving their time to projects instead of doing their daily operations. Having one organization wide development pool would help management to prioritize development projects and allocate resources accordingly. It would also enable to see the bigger

picture and understand to focus on only project which bring actual benefits to the organization. (Quality Manager.)
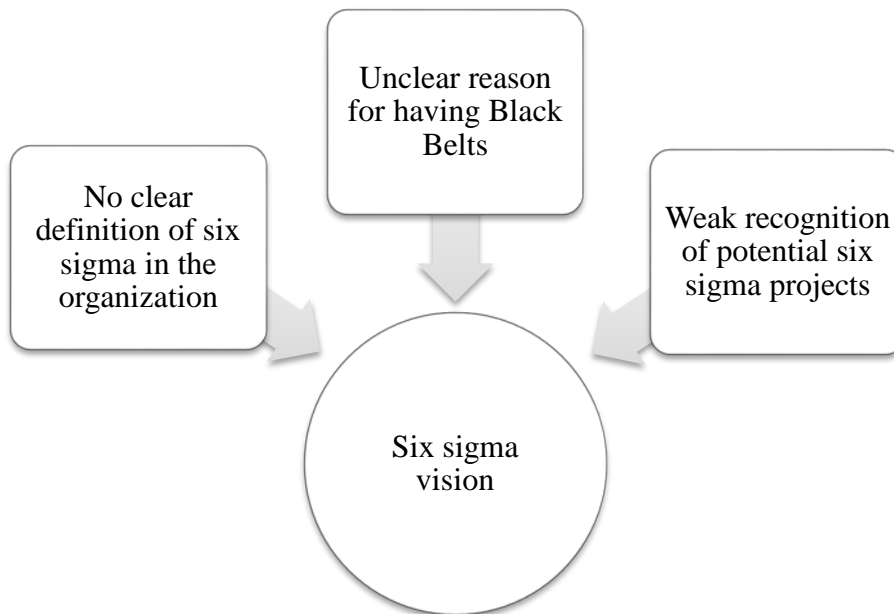


Figure 19        Six sigma vision in the organization

The figure 19 illustrates how the organization's vision of six sigma is perceived among the Black Belts. They state that there is not clear definition for six sigma and the term is interpreted differently depending on the person in question. The clear vision should come down from the top managements so that it is understood similarly across the organization. It is also unclear why people have been trained as Black Belts and how the organization is benefitting their skills and knowledge. Currently the Black Belts are not required use six sigma in their work. Additionally the organization should be able to recognize potential six sigma projects and allocate time and resources so that these projects will be executed and finished properly.

### 8.3.2    Systematic six sigma usage

Currently the Black Belts are working in various roles in different functions and there are only few functions where skills and knowledge of the Black Belts are truly and actively utilized (Sourcing Manager). The Black Belts are not required to use six sigma in their daily work which why it is highly dependent of the person itself whether he or she will use the tools and methods learned in the training (Quality Manager). They also use various levels and elements of six sigma approach in their work: for some Black Belts six sigma is more mindset that guides their work and other use statistical tools in their daily

operations (Quality Manager). It is waste of time and skills not to take advantage of the know-how in an organized way, stated one of the Project Managers. Six sigma philosophy is not actively promoted in the organization and the Black Belts' knowledge is not shared among employees especially if the Black Belts are working as experts and not as managers (Sourcing Manager). In order to change Black Belts' tacit knowledge into more explicit knowledge in the organization strong leadership and push from the management side is needed. (Quality Manager.)

Even though six sigma trainings can provide new skills and perspectives to participants, the Black Belts are not necessarily expected to use these skills in their work after training (Sourcing Manager). There is not a systematic process for capitalize the Black Belts' expertise in the development projects because each Black Belts is primarily focusing on their own tasks and there is not dedicated people only for problem solving and development projects. In order to fully utilize the know-how there could be structured organization for problem solving. Dedicated Black Belts or a small team could enable and support six sigma projects across the organization. (Quality Manager.) The Black Belts knowledge should be more widely utilized also outside the Black Belts' own function so that the know-how will be spread to entire organization. Otherwise their expertise benefits only the functions where they are working. (Project Manager.) The poor utilization of six sigma is not due to lack of formal training or insufficient skills but it is strongly related to management actions and support (Quality Manager).
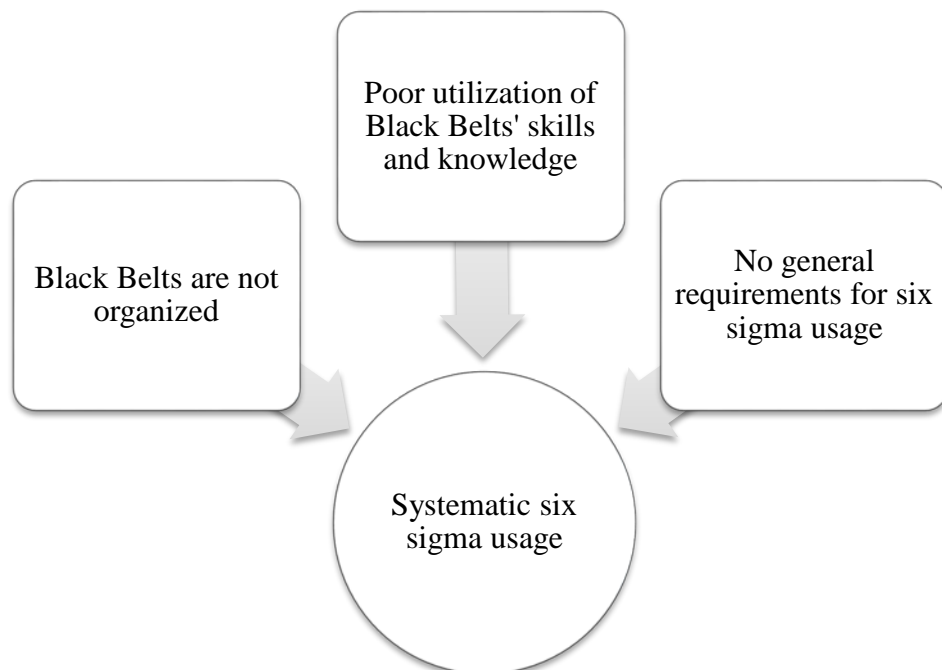


Figure 20      Systematic use of six sigma in the organization

Systematic six sigma usage in the case company is presented in the figure 20. There is not own organization or function for the Black Belts which hinders their possibilities to provide their skills and knowledge for colleagues across the organization. The six sigma knowledge is not shared among employees and the Black Belts' tacit knowledge is not utilized outside their own functions. Due to the lack of universal requirements of six sigma usage, each Black Belt applies six sigma skills and knowledge in different extent.

## 8.4     Black Belt organization

### 8.4.1     *Value adding function*

There is not continuous collaboration among the Black Belts in the Drives and Controls business unit, they have had few meetings in the past but they are not discussing together on a monthly or quarterly basis (Project Manager; Quality Manager). Although Black Belt meetings have been organized there have not been clear outcomes from them. The improvement ideas of six sigma utilization have not been executed due to lack of resources and management support. (Quality Manager; Sourcing Manager.) Instead of having discussions about six sigma involvement the Black Belts should use their time to solve actual problems (Sourcing Manager). One of the interviewees was disappointed that there has not been any Black Belt meetings during the last couple of years which why it is difficult to even know who are the other Black Belts in the organization. If there is not collaboration or network for the Black Belts, employees might not know from whom they could ask help if they are facing difficulties in development projects. (Project Manager.) On the other hand collaboration among the Black Belts needs to be well organized and structured in order to useful. A Black Belt community should not be established if there is not clear vision or aim for the collaboration. (Quality Manager.)

The Black Belts' skills should be recognized and seen as an asset. They have the tools and knowledge to execute complex problem solving problems which should be taken into account when launching development projects. There should be always a Black or Green Belt in a project to guide the process and call for statistical methods and analysis instead of making decisions based on insights and feelings. (Project Manager.) Problems and data could also be brought to the Black Belts who have capabilities, tools and knowhow, to analyze data statistically and systematically (Quality Manager). Horizontally among different functions there could be support person or group to help with the challenging issues and use their expertise to solve problems (Quality Manager). One Quality Manager was wondering why in some companies there are full-time Black Belt project leaders whereas

in the Drives and Controls business unit there is not dedicated person to support development projects. Having a dedicated person or team would enhance the systematic and formal approach in development projects and diminish the risk to make decisions which are not based on systematic analysis of the problem. (Quality Manager.)

There could be a two-tier organization for the Black Belts: smaller active group with three to four members and bigger supporting pool. The active group could take responsibility of developing the organization and ways to utilize better their knowledge whereas the pool could be used for information sharing which would not time consuming. (Sourcing Manager.) Alternatively there could be a resource pool for six sigma projects from where employees could seek advice and help from the Black Belts. Currently there are rare cases when the Black Belt has given full-time support to project outside his or her own function. (Quality Manager.) The Black Belts should be able to manage and prioritize their workload in order to have time to support in development projects (Project Manager). The Black Belt pool could provide solution for time issues because the Black Belts could share the responsibilities among different projects so that a workload per one Black Belt remains manageable (Sourcing Manager). Being part of the resource pool a Black Belt could also allocate his or her time for supporting others; currently they are not able to dedicate their time for helping other teams (Quality Manager). Resource pool needs strong support from management in order to be effective and useful: managers have to give freedom to the Black Belts to go and work outside their own team and function (Quality Manager). The Black Belts could also benefit from pool and having peers to support and help in challenging situations. However, there should not be too challenging goals and unrealistic expectations for the Black Belt organization or pool rather they should be encouraged to utilize their skills and knowledge within the limits of their time. (Sourcing Manager.)
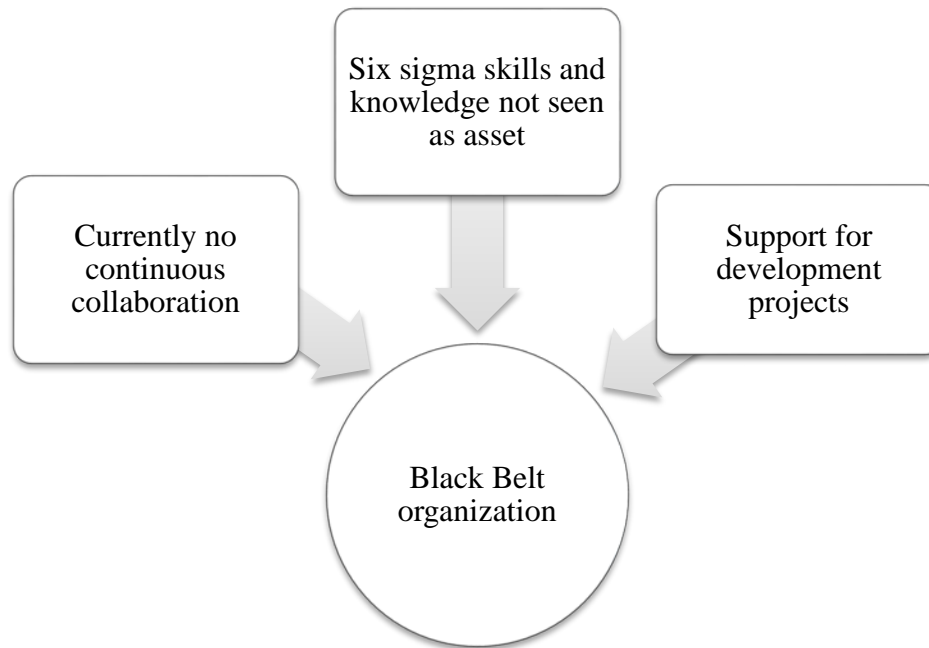
Figure 21        Black Belt organization as value adding function

The figure 21 illustrates how the Black Belts value is seen and could be seen in the organization. Currently the Black Belts are not collaborating on a regular basis and sharing knowledge among each other. Their skills and knowledge should be seen as asset and be utilized across the organization. The Black Belts could provide support and knowhow for development projects. They could form an organization or resource pool from where employees could ask assistance for challenging projects. Building a Black Belt organization or resource pool could further six sigma utilization but also share workload and responsibility among the Black Belts.

### 8.4.2    *Internal consultant*

In the Drives and Controls business unit the Black Belts are working in several functions and applying six sigma knowledge in their field of operation as they find it useful and suitable for the problem in question. There are not organizational guidelines in what extent the Black Belts are required to utilize six sigma in their work. Knowledge and skills of them are not recognized and utilized in a structured way in the organization for example there is not regular collaboration or network among the Black Belts or horizontal team for them. (Sourcing Manager.) Collaboration and communication among the Black Belts is relatively rare as they do not have meetings or info sharing at regular intervals. Due to the lack of collaboration it might be difficult for the Black Belts to find support because they might not have any colleges with six sigma knowledge and skills to help them in the

six sigma related problems. A peer group among the Black Belts would enable them to discuss, share information and ask support from each other. (Project Manager.) The management should recognize benefits of utilizing the knowhow of the Black Belts and also require that the Black Belts use their knowledge to improve organization's performance (Sourcing Manager).

The Black Belts' skills and knowledge can be used also outside their own function even though the functions differs from each other. In general the processes tend to have similar steps only the parameters vary between functions. (Sourcing Manager.) The Black Belts would provide the tools and the knowledge of problem solving in a systematic way; they do not have to be expert in the field in question. They would primarily provide their expertise in project management and problem solving process and the project team would then bring the specific technical expertise to the problem solving. (Project Manager.) In the business unit level there could be even a Black Belt organization which could help business unit to identify the most severe problems and address them by providing knowledge and acting as a project manager (Quality Manager). In order to be agile there needs to be dedicated project manager who would have enough time to organize the problem solving project and follow it up. The Black Belts could work as a task force or an internal consultant in these projects and try to solve or further the project in a given time frame. (Sourcing Manager.) On the other hand the Black Belts could act as sponsors and support project teams by challenging them and providing knowledge but not working there as active team member (Project Manager).

In order to improve systematic problem solving the Black Belts skills should be utilized in a greater extent and more structured way (Quality Manager). There should always be either Green or Black Belt in the development project for bringing six sigma knowledge and skills to the development process. Green or Black Belt is needed in enable and order to guarantee that problems are solved in a systematic manner instead of relying on feelings and insights. This person, Green or Black Belt, would bring tool using skills to a project so that decisions are based on facts. (Project Manager.) The dedicated project manager could improve the efficiency of problem solving because he or she would focus on the project or several projects at a time and has no other daily task (Sourcing Manager). Having a Black Belt as a part of project team would expand six sigma knowledge and also give new perspectives to the project team members. It would also provide a learning opportunity for the Black Belts when they are working outside their own function and applying six sigma skills in different projects. (Sourcing Manager.) Alternatively the Black Belts could work as change agents in the organization and being as a task force in difficult problem solving situations (Quality Manager; Sourcing Manager). Being as a task force could help the Black Belts to maintain their skills and also provide interesting opportunities to apply six sigma philosophy outside their own team which would not be possible in their everyday work (Project Manager).

Possibilities to work with projects outside their own function could motivate the Black Belts and inspire them to actively seek interesting projects where to utilize their skills (Sourcing Manager). It would also expand the skills and knowledge also to the functions which do not have six sigma trained employees. By having a Black Belt in a project team would ensure that also the teams without six sigma training could use the formal approach and statistical tools in their projects. (Quality Manager.) It is sufficient that there is one person with six sigma knowledge in a project team because this one skilled person can guide problem solving process and steer team work with more systematic approach (Quality Manager).

Six sigma knowhow in every development project

More structured way to utilise six sigma knowledge

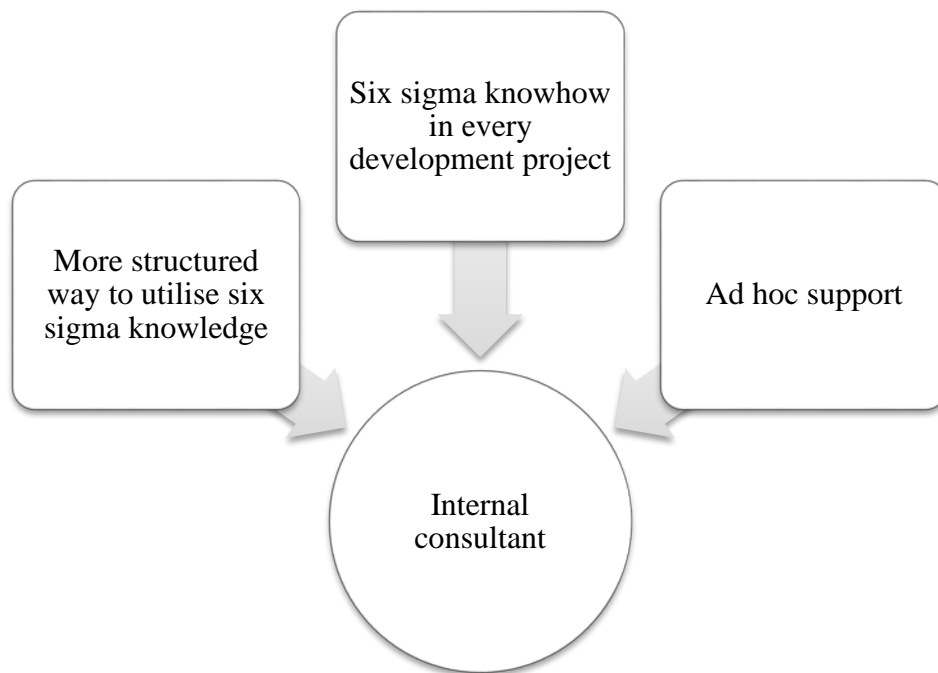Ad hoc support

Internal consultant

Figure 22       Black Belts as internal consultants

The figure 22 presents how the Black Belts skills and knowledge could be used more structured way. The Black Belts could provide their knowhow by working as an internal consultant and supporting employees in development projects. There should be either Green or Black Belt in every development project so that the utilization of six sigma is not dependent on employees' background and training. The Black Belts could provide ad hoc support and act as task force in challenging projects and share their expertise also outside their own function.

# 9 BLACK BELT INVOLVEMENT IN THE CASE COMPANY

## 9.1 Foundations of the case company framework

The framework of the Black Belt involvement is based on the current situation in the case company regarding six sigma usage among the Black Belts. It aims at describing the circumstances in ABB Drives and Controls in order to understand the underlying issues that hinder effective six sigma utilization. The description of the current situation aims also presenting the potential gaps in Black Belt involvement. The perceptions of Black Belts are grouped under nine umbrella-like categories that are defined in the data analysis phase. Findings from the empirical data represent challenges perceived by the interviewees. Challenges are defined by finding similarities between the interview responses and combining perceptions but preserving different perspectives among the Black Belts. Even though there are uniform perceptions about majority of the issues, differences can be also found. The aim of the framework is to illustrate issues perceived by the Black Belts which why there can be single or several Black Belts supporting the issue and not all interviewees are facing similar challenges. Some factors were found contradictory among the interviewees: some of them perceived these factors to irrelevant or unsuitable for improving six sigma usage whereas others found them useful.

Especially the perceptions towards six sigma targets vary between the interviewees. Some Black Belts found the targets to have encouraging effect on the six sigma usage and perceived them relatively useful. On the other hand the effectiveness of the targets were questioned. The ability of the targets to lead to the desired outcomes concerned some of the interviewees. Six sigma target might not be seen effective as a bonus target although the interviewees stated that there is need for more strict approach to six sigma usage from the management side. Due to the subjective nature of the research topic the findings are not extensively summarized, instead the detailed descriptions of the issues are presented when applicable.

Similarities can be found between the case study finding and the literature review but there are issues unique to the case company and also issues in the literature review that are not relevant in the case company. The issues in the case company and suggestions from the previous studies have been collected together for the framework for Black Belt involvement. The issues are grouped under nine factors for each issue best practices from the previous studies are presented if applicable. It is important to notice that this case study in ABB Drives and Controls and the previous studies have been conducted in different research environment thus there might not be best practice suggestion for each issue faced in the case company. In addition, the findings from the case study and the literature research also deviate from each other. In the previous studies the challenges

have been found to be related to employee motivation through goals and incentives. However, in the case company the challenges are more caused by culture and organizational environment and the role of goals in employee involvement is not seen important.

## 9.2    Black Belt involvement framework

The aim of the Black Belt involvement framework is to present the findings from empirical research together with the best practices found from the literature review. The framework aims at summarizing the empirical data into concise descriptions of the current situation in the case company.

Table 3        Current situation and best practices for Black Belt involvement

|  | Current situation in the case company | Best practices from literature review |
|---|---|---|
| Organizational support | 1. Silo structure hindering collaboration between different functions<br>2. Systematic approach not embedded into the organization | 1. Eliminating barriers of cross-functional collaboration and improving horizontal communication<br>2. Highlighting the importance of six sigma and spreading it into all levels of the organization |
| Management support | 1. Six sigma understanding missing in the management<br>2. Managers' support lacking in some functions<br>3. From top to down cultural change needed | 1. Training of six sigma principles and methods to all managers<br>2. Managers' participation in six sigma projects<br>3. Strong and visible commitment in all manager levels and six sigma prioritization |
| Six sigma related targets | 1. Six sigma is not seen to directly contribute on achieving financial targets<br>2. Should be related to daily work<br>3. Need to be unambiguous to measure<br>4. Systematic approach and continuous improvement highlighted instead of six sigma<br>5. Targets could enhance six sigma usage | 1. Also non-financial targets and soft measurement to cover six sigma issues<br>2. Targets linked to operational goals<br>3. Targets that can be understood easily<br>4. Emphasizing learning and continuous improvement |

| | | |
|---|---|---|
| Tools and data available | 1. Inconsistent and unreliable data<br>2. Data editing needed for statistical analysis<br>3. Tool kit and guidance needed | 1. Tools and methods provided so that employees can achieve what is expected from them |
| Six sigma usage | 1. Six sigma used preliminary as a mindset, statistical data analysis rare<br>2. Six sigma is not familiar in the organization | 1. Six sigma spread into the entire organization<br>2. Basic skills and knowledge provided to all employees |
| Black Belts capabilities | 1. Not enough possibilities to utilize and practice in daily work<br>2. Support and guidance needed<br>3. "Laziness" to use | 1. Black Belts focus on quality improvements<br>2. Resources for six sigma projects provided and the projects facilitated by managers |
| Six sigma vision | 1. Clear definition for six sigma missing<br>2. Black Belts' role not known<br>3. Possible six sigma projects not recognized | 1. Clear vision, need and a plan needed and they need to be converted into operational context<br>2. Black Belts work as quality improvement specialists |
| Six sigma role structure | 1. Black Belts not formally organized<br>2. Black Belts skills and knowledge not utilized in a systematic way<br>3. No general requirements for six sigma usage | 1. Forum established for sharing information and knowledge<br>2. Six sigma usage monitored by top management |
| Black Belt organization | 1. Continuous collaboration lacking<br>2. Six sigma skills and knowledge not considered to be asset | 1. Black Belts working as six sigma specialists |

The table 3 presents the current situation the case company regarding six sigma usage and the best practices found from the literature research. The issues are categorized under nine factors: organizational support, management support, six sigma targets, tools and data, six sigma usage, Black Belts capabilities, six sigma vision, six sigma structure and Black Belt organization. Regarding organizational support the biggest challenges in ABB Drives and Controls are the lack of cross-functional collaboration and the weak implementation of systematic problem solving method (two Quality Managers; two Sourcing Managers). Silo structure organization makes it difficult for the Black Belts to support their colleagues in other functions in formal projects (Sourcing Manager). Eliminating barriers in the organizational structure and culture is crucial for implementing six sigma

culture successfully (Yeh 2003, 263; Buch & Tolentino 2006, 364; Huq et al. 2010, 117-118). The Black Belts should have possibilities to co-operate across the functions easily. The interviewees stated that there is not natural encouragement for six sigma usage because it has not been embedded into the culture and it is not common practice in the organization (two Project Managers; Quality Manager). Six sigma approach should be spread to all employees regardless of the organizational level (Sohal & Terziovski 2000, 166; Ho et al. 2008, 268). The Black Belts found management support to be weak in general although there are managers who are strongly committed to applying six sigma principles (three Project Managers; five Quality Managers; Sourcing Manager). The interviewees feel that the lack of support is due to poor understanding of six sigma principles and benefits (Quality Manager). Six sigma training should be provided also to managers; they should understand the basic principles and usefulness of six sigma, they do not necessarily have to participate in Green or Black belt training (Sohal & Terziovski 2000, 166; Hanson et al. 2003, 1002). They should also participate more actively into six sigma projects and other activities in order to show their commitment towards it (Henderson & Evans 2000, 270; Ho et al. 2008, 268). The cultural change is needed to come down from the top management in order to involve the entire organization (Quality Manager). Managers need to highlight the importance of six sigma by prioritizing it (Soltani & Wilkinson 2003, 386).

Six sigma targets have been found unnecessary among the interviewees. Because current targets are mainly financial, six sigma targets are not seen contributing the financial objectives (Quality Manager). It has been also stated that six sigma targets are not directly related to daily operations since none of the Black Belts' daily job to execute six sigma projects (Sourcing Manager). For tackling these challenges the organization should develop also non-financial targets for six sigma usage (Kumar et al. 2008, 221). There could be also soft measurements for managers to follow and encourage six sigma usage (Quality Manager). In addition the six sigma targets should be linked to operational goals and daily work (Oliver 2009, 558). On the other hand the measurement of six sigma targets might be challenging because there is not clear definition for six sigma and each person interprets it differently (Quality Manager). In order to succeed in target setting the term six sigma should be clearly defined and the targets written so that each person can understand them easily and similarly (Goffin & Szwejczewski 1996, 29). One alternative is to focus on systematic approach and continuous improvement in the target setting instead of six sigma (Quality Manager).

Moreover the table 3 illustrates that the rare use of six sigma statistical tools is mainly due to the quality of data; it is not consistent or always reliable and in addition it cannot be analyzed statistically without sorting and editing it (two Quality Managers). More guidance and a ready-made toolkit are needed so that the Black Belts use the tools effectively in their work (Project Manager). If six sigma usage is required from the Black Belts

their managers should provide the tools and methods so that the Black Belts can meet the expectations (Linderman et al. 2006, 787). Six sigma usage varies among the Black Belts; for some use it as a mindset and others utilize the statistical tools frequently. Regardless of the utilization most of the Black Belts stated that the lack of six sigma knowledge in general in the organization hinders the utilization because their colleagues do not understand the terminology and underlying philosophy (Project Manager; two Sourcing Managers). In order to facilitate the Black Belts' work the management should make sure that basic six sigma training will be provided to all employees so that six sigma will be spread throughout the organization (Hanson et al. 2003, 1002). On the other hand some of the Black Belts do not have possibilities to use six sigma in their daily work which why they cannot sustain their skills and apply their knowledge into practice (two Project Managers; Sourcing Manager). Managers should provide the Black Belts possibilities to use their skills and allocate their time to improvement projects (Blackburn & Rosen 1993, 56; Andersson & Adams 1997, 5; Buch & Tolentino 2006, 364; Ho et al. 2008, 268; Elloy 2012, 630).

Another challenge faced by the case company is unclear vision of six sigma in the organization. Some of the interviewees stated that they do not know why the company has trained them to be Black Belts and how they are supposed to utilize their knowledge. They are not sure about their role as Black Belts and how they should benefit the organization. (Project Manager; Quality Manager; Sourcing Manager.) Also they feel that the organization cannot recognize possible six sigma projects thus six sigma is not used in the full extent (Quality Manager). In order to implement six sigma successfully in the organization there should be clear vision and plan how to convert the vision into operational strategy (Breyfogle III 1999, 4; Oakland & Tanner 2007, 582). The Black Belts should work as quality improvement specialists utilizing their skills and knowhow to facilitate development projects (Blackburn & Rosen 1993, 56; Elloy 2012, 630). Organizational structure is closely related to vision; currently the Black Belts are not formally organized and their skills is not utilized in a systematic manner (Project Manager; two Quality Managers). Since there are not requirements how the Black Belts should use six sigma in their work each of them is utilizing it differently. In order to tackle these challenges the management should monitor that the Black Belts are using six sigma in their work (Oakland & Tanner 2007, 582-583; Ho et al. 2008, 268). In addition a forum for knowledge sharing should be established for enabling collaboration among the Black Belts (Joiner 2007, 624; Wu & Lin 2009, 9276-927). Since the Black Belts skills and knowhow are not seen as asset in the organization the Black Belts are not challenged to benefit the organization with their knowledge (Project Manager; Quality Manager). They should have possibility to work as six sigma specialist focusing on development projects (Elloy 2012, 630; Zu & Fredendall 2009, 51).

# 10    CONCLUSIONS

## 10.1    Managerial implications

Black Belt involvement in six sigma is influenced by several factors. The perceptions of the interviewed Black Belts are relative uniform: they face similar problems in their work. Even though there are variation between the responses the Black Belts share main challenges and pointed out common development needs regardless of their position in the organization. Based on the empirical data key challenges could be identified. Furthermore, there were also suggestions given by the interviewees. In addition to the suggestions the findings from the literature review are used in identifying future actions to be taken to improve Black Belt involvement.

Based on the empirical data the key factors could be found even though there are different perceptions among the interviewees. In general the factors influencing Black Belt involvement can be categorized under two drivers: they are either management driver or Black Belt driven. Even though the interviewees pointed that majority of gaps are caused by the management actions, there are also issues that the Black Belts have possibility to influence. Management should create the organizational culture to support six sigma and facilitate the usage by providing the tools and possibilities to use them. In addition to the management actions the Black Belts have the responsibility to utilize their skills and knowledge effectively.

Furthermore, the factors have been split into detailed descriptions of the challenges faced by ABB Drives and Controls. The detailed descriptions, also known as the gaps in Black Belt involvement, represents the issues hindering the six sigma usage in the case company. In other words gaps illustrate discrepancy between current situation and desired situation. Each gap is stated to be hindrance to six sigma utilization for the Black Belts. Together with the gaps the suggested actions are presented. Recommendations have been found by applying theoretical based employee involvement framework together with the improvement suggestions given by the interviewees.

The gaps are presented by the drivers: first management driven factors will be illustrated and explained. Furthermore, the Black Belt driven gaps and the recommended actions for them are discussed.

Table 4        Management driven gaps

| Driver | Factor | Gap | Suggested actions |
|--------|--------|-----|-------------------|
| Management | Management commitment | Weak knowledge and understanding of six sigma benefits | 1. Provide the basics of six sigma training to all managers |
| | | Six sigma usage is not actively demanded from Black Belts | 1. Use soft targets for encouraging Black Belts to use six sigma |
| | | Top management is not showing visible commitment | 1. Involve also top management in six sigma projects |
| | Organizational structure | There is not clearly defined role for Black Belts | 1. Establish a Black Belt organization for supporting development projects |
| | | Systematic utilization of Black Belts' skills and knowledge is lacking | 2. Allocate certain proportion of Black Belts' time for six sigma support such as internal consulting |
| | | Lack of cross-functional support | 1. Enable Black Belts to support also outside their own function 2. Establish a Black Belt organization |
| | Organizational culture | Six sigma philosophy not embedded to be a common practice | 1. Create development template to guide and standardize development projects to follow six sigma principles |
| | | There is not strong vision for six sigma utilization and need for Black Belts | 1. Communicate the need for Black Belts and expectations for them |
| | | Six sigma familiarization is weak among employees | 1. Provide basic training to all employees 2. Communicate six sigma issues more actively |
| | | Six sigma knowledge is not shared and seen as value | 1. Communicate the benefits of six sigma more actively 2. Recognize the skills and knowledge of Black Belts and utilize them also outside Black Belts' own function |
| | Information systems | Difficulties to analyze data statistically | 1. Develop data quality in a company level instead of function level |
| | | Lack of toolkit and template | 1. Launch a toolkit and instructions for six sigma projects |

The table 4 presents the gaps that are result from the management actions. In order to improve management commitment training of six sigma basic principles and benefits should be provided to all managers. Also top management need to show visible commitment by participating in six sigma projects. The managers who have Black Belt subordinates should require that six sigma principles are used within the team, not only by the Black Belts but also by the other team members so that the entire team is involved. Moreover, the organizational structure should be developed to support the Black Belts possibilities to share their knowledge by establishing Black Belt organization. The dedicated Black Belt organization could support employees in development projects across the organization regardless of the function. In order to successfully implement the Black Belt organization, the Black Belts' managers should allow the Black Belts to allocate their time for acting as internal consultants in development projects.

The table 4 also illustrates also the gaps caused by organizational culture. For spreading six sigma knowledge and practices to the entire organization training of six sigma basic principles should be provided to all employees. Six sigma related issues should also be communicated more actively and the need for Black Belts should be clearly stated for the Black Belts at least. It is also important to recognize skills and knowledge of the Black Belts and inform what is expected from the Black Belts regarding to six sigma usage. Furthermore, for expanding six sigma approach there should be development project template to guide employees into systematic problem solving and to standardize development processes. Moreover, the table 4 illustrates that the gaps related to information systems should be tackled by developing data quality in a company level and by launching a toolkit for employees to use in their development project. Black Belt driven gaps and the recommended actions for them are represented in the table 5.

Table 5       Black Belts driven gaps

| Driver | Factor | Gap | Suggested actions |
|---|---|---|---|
| Black Belts | Practice | Six sigma usage is not routine | 1. Use statistical tools when applicable and seek possibilities to use the tools |
| | | Not possible to use six sigma in daily work | 1. Seek possibilities also outside own role<br>2. Work as internal consultant in the Black Belt organization |
| | Effort | "Laziness" to use six sigma | 1. Start using the tools in order to improve skills |

The table 5 illustrates the two Black Belt driven factors in six sigma involvement: practice and effort. The usage of six sigma tools has been stated not to be routine-like task for all Black Belts, some of them have used tools rarely after the training. In order to

improve skills the Black Belts should use six sigma tools whenever they have chance to use them. It does not have to be complex problem as long as they can practice the usage of the tool. Moreover, they should also seek possibilities to use six sigma outside their role if they cannot use six sigma methods or tools in their daily operations. Establishing the Black Belt organization would provide possibilities for the Black Belts to apply their skills and knowledge into real-life problems. In order to overcome the "laziness" to use six sigma the Black Belts need to have self-discipline and demand themselves more active six sigma usage.

## 10.2    Theoretical implications

Employee involvement in six sigma has not been extensively studied before even though there are several studies on employee involvement in other quality management philosophies such as total quality management. Furthermore, little studies about gaps in employee involvement have been carried out. The thesis aims at widening knowledge about gaps in employee involvement in six sigma by providing case study analysis on the phenomenon. It examines the role of managers in six sigma involvement but also investigates the importance of Black Belts' commitment to six sigma utilization.

This thesis addresses in Black Belt involvement in six sigma. Since minor empirical research has been carried out about six sigma involvement the literature review is based studies about other quality management approaches. This thesis contributes six sigma implementation literature by advancing research in Black Belt involvement. It studies the influence of organizational and personal factors in involvement in six sigma context. This thesis builds on studies about involvement in quality management approaches and factors promoting employees' willingness to participate in quality improvement activities. Furthermore, the thesis extends certain findings from previous research to six sigma context. Empirical support was found to the presumptions from previous researches in terms on organizational culture, management actions and empowerment. However, the role of targets, performance measurement and rewards is not entirely supported by the case study findings. In addition, this study also provides new knowledge about the involvement; it studies particularly Black Belts involvement and investigates negative factors in involvement. Moreover, it highlights the role of Black Belts in the organization as own function for development project support.

Certain limitations need to be mentioned. First, the empirical data is gathered from a single case company which is why the findings cannot be largely generalized. In other words external validity is lacking. Second, duration of the case study was not long-term which is why the empirical findings do not describe evolvement of Black Belt involvement. The study was not able to examine and understand the effect of time in Black Belts'

involvement in six sigma. A longitudinal study would provide knowledge how Black Belts' involvement has changed over years from the point of six sigma training until current status.

Future research should address the limitation of time frame: Longitudinal involvement should be further researched. Because involvement is highly dependent on organizational issues such as managers' encouragement and internal pressure to use six sigma, level of involvement might vary when organizational environment changes. In order to understand the effectiveness of such changes phenomenon should be studied in a long-term. Furthermore, the scope of the research could be widened from Black Belts to all employees in order to investigate gaps in involvement of entirely personnel. It would be interesting to study how six sigma perceptions vary between different organizational levels and how six sigma approach is successfully embedded into organizational culture.

# 11    SUMMARY

Six sigma is comprehensive quality management philosophy with formal and systematic improvement approach. It aims at improving quality by reducing variation in processes. Since six sigma is more organizational culture than set of tools, it is important that entire organization is involved in it. Furthermore, it aims at developing organizational culture towards more quality-oriented culture. Successful six sigma implementation requires that six sigma basic disciplines are adopted by entire organization. Employee involvement is crucial in the six sigma implementation. This thesis addresses challenges in long-term Black Belt involvement in the case company. In this thesis the research questions is: *What are the gaps of involving Black Belts in six sigma? How to bridge the gaps?*

In six sigma quality level process is capable of producing 99.99966% quality which means that there is maximum 3.4 defects per million opportunities (parts or process steps). Six sigma improvement methodology consists of five steps: define, measure, analyze, improve and control. Six sigma philosophy has own role structure which is based on six sigma trainings: Green Belt training provides skills and knowledge for participating improvement projects. Green Belts work only part-time in the projects and continue to execute their normal work task also. Black Belts are improvement specialists who focus solely on six sigma projects by leading improvement projects and mentoring Green Belts. In addition to Green and Black Belts there are two sponsor roles, Master Black Belts and Champions, which implement and promote six sigma in the organization.

Employee involvement is influenced by multiple factors: Organizational culture facilitates involvement if it nurtures learning and development and supports the change towards six sigma approach. Moreover, culture should be developed so that there is not barriers hindering involvement and employee collaboration is supported. Managers need to have clear vison and plan for six sigma implementation and they have to convince employees that the change is needed. It is crucial that managers show visible commitment to six sigma and trust their subordinates. In order to successfully implement six sigma in the organization employees should have possibilities to use their skills in quality improvement projects and have autonomy to execute projects independently. Employees' perceptions towards six sigma are influenced by the feeling of six sigma usefulness and their commitment towards the organization. Furthermore, the difference between outcome of six sigma implementation and presumptions of the outcome impacts on employees' attitudes towards the philosophy. In order to facilitate involvement communication should be open, both vertical and horizontal and provide possibility to employees to express their ideas and give feedback. Involvement is also dependent on training and encouragement: Employees need training in order to be able to improve their skills and knowledge. Performance measurement, goals and incentives should be in line with six sigma in order to encourage employees to use six sigma.

It was found in empirical research that managers in general have weak knowledge about six sigma and its benefits. This challenge could be tackled by providing training about six sigma basics to all managers in the organization. In addition, managers do not actively demand six sigma usage from the Black Belts. Since six sigma bonus targets were not found effective by the interviewees, managers could use soft targets for encouraging their subordinates to utilize six sigma. Third gap related to managers is lack of visible commitment from top management. In order to show their true commitment to six sigma top management need to participate in six sigma activities.

Organizational structure and culture are also causing gaps: Silo structure is hindering cross-functional support. Furthermore, the role of Black Belts in the organization is unclear and their skills and knowledge are not utilized systematically. In order to bridge these gaps a Black Belt organization should be established. It would enable cross-functional support and knowledge sharing across the organization. Moreover, six sigma has not been embedded into culture and the vision for six sigma in the case company is lacking. For standardizing development projects to follow six sigma approach, template and guidance is needed. In addition, the six sigma vision and expectations of six sigma usage should be clearly communicated to personnel. In general six sigma is relatively unknown among employees which could be improved by providing training to the entire organization and communicate six sigma issues more actively. Also Black Belts' skills and knowledge should be recognized and utilized across the organization not only in the Black Belts' own functions. There are also two gaps related to information systems: First, data is difficult to analyze statistically and needs improvements in quality. Second, there should be template and toolkit provided to employees for facilitate launching of six sigma projects.

The gaps related to the Black Belts are mainly due to the lack of possibilities to utilize six sigma tool in daily work. Moreover, six sigma utilization has not become routine for the interviewees. In order to provide more possibilities to utilize six sigma the Black Belt organization should be established. The Black Belts could work as internal consultants in the Black Belt organization and provide support in improvement projects across the organization. The other gap is related to laziness to use six sigma; it requires self-discipline to start using the tools actively whenever possible in order to improve skills.

This thesis provides empirical support for majority of the presumptions found from previous studies. Moreover, the thesis provides new knowledge about employee involvement in Black Belt context. Not all presumptions were supported by the empirical research since these factors were not found important by the interviewees. In addition, the thesis gives suggestions of the practices with which the case company could bridge the gaps.

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**APPENDICES**

**APPENDIX 1    INTERVIEW FORM A**

**Questions**

1. Think of the last time you participated in six sigma related activity such as improvement project
    a. In which role you participated? Why did you participate? What kind of factors encourage you to participate?
    b. What were the general circumstances leading to your involvement? (such as your position in the organization)
    c. How six sigma was found among the project team?

2. How do you feel about six sigma in the above discussed activity? For example in terms of
    a. usefulness
    b. your own capabilities and skills

3. Do you feel that there were some factors/circumstances that prevent you from participating?
    a. For example lack of time and resources

4. How do you use six sigma in day to day work?
    a. Have you use it after the training?
    b. Why/why not?

5. How these following factors have influenced your involvement?
    a. Communication between you and your manager and/or colleagues
    b. Resources available and training
    c. Management actions and leadership style
    d. Incentives (such as rewarding)
    e. Organizational goals
    f. Organizational culture – Do you find that six sigma and the organizational culture match?

6. How six sigma could be more effectively utilized in ABB Drives business?
    a. What kind of factors hinders six sigma utilization in business?

## APPPENDIX 2   INTERVIEW FORM B

**Questions**

1. Think of the last time you participated in six sigma related activity such as improvement project
   a. In which role you participated? Why did you participate? What kind of factors encourage you to participate?
   b. What were the general circumstances leading to your involvement? (such as your position in the organization)
   c. How six sigma was found among the project team?

2. How do you feel about six sigma in the above discussed activity? For example in terms of
   a. usefulness
   b. your own capabilities and skills

3. Do you feel that there were some factors/circumstances that prevent you from participating?
   a. For example lack of time and resources

4. How do you use six sigma in day to day work?
   a. Have you use it after the training?
   b. Why/why not?

5. How these following factors have influenced your involvement?
   a. Communication between you and your manager and/or colleagues
   b. Resources available and training
   c. Management actions and leadership style
   d. Incentives (such as rewarding)
   e. Organizational goals
   f. Organizational culture – Do you find that six sigma and the organizational culture match?

6. How six sigma could be more effectively utilized in ABB Drives business?
   a. What kind of factors hinders six sigma utilization in business?

7. How could you more effectively utilize six sigma or its principles in your work?
   a. How could you take more responsibility of six sigma usage?