# Development of TQM in Steel Manufacturers' Production

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***Abstract***

*The objective of this study was to examine the development of quality management in Rautaruukki Plc's Production division. The idea is to describe critical incidents in the development of quality management in the light of the historical development, current state and theoretical framework, as well as analyse whether this description follows the development process described in the literature.*

*The theoretical framework – development through the literature – describes the historical development of quality management, the development and assessment models of quality management as well as some essential sectors, tools and techniques of quality management presented in the literature. The case study is based on ten interviews made in four production sites of the case organisation. The interviews were used to create a description of the historical development and the applications of different sectors of quality management. We have also created three alternative scenarios to outline the future of the organisation.*

**Keywords:** TQM, quality management development and assessment

## 1. Introduction

Quality has been defined in almost as many ways as there are authors writing about it. The leading names in the field of quality management define quality as follows, among others: For Deming, quality means meeting the customers' current and future needs. [28] Juran [14] defines quality as "fitness for use" and "faultless", as well as equal to the failure frequency. [24] According to Crosby [3] quality must be defined as meeting the requirements, not as being good. For him, the metrics of quality are the costs generated due to faulty products and failures. [24] Shewart [26] constructed a significant definition of quality that differed from the common quality concept in the 1930's when he defined quality as meeting the requirements, not luxury, expensive or splendid as is often emphasised in common language. [16]

Today, the concept of quality is defined more extensively. Total Quality Management (TQM) is seen as total development of all operations of a company in order to achieve customer satisfaction and profitable business. The long-term goal is to maintain and improve competitiveness. [28] The concept of quality is multifaceted and relative, and it may be difficult to perceive. It is impossible to obtain a correct, profound conception by examining quality from only one perspective. [16]

Lillrank [16] divides quality into six different aspects: *production, product, value, competition, customer and society- oriented quality*. According to Silen [28] there is also operational quality, which means the efficiency and fault-free processes of an organisation, that is, the ability to achieve the quality seen from different perspectives. During the end of last decade TQM was seen in practise seen as a "chant" to solve all problems. However, it did not fulfilled all the expectations on that [10, 33].

Partially former was due to misunderstanding the content and practise of TQM, but mostly because immature capability to apply and utilise TQM. Simple and evident quick wins in the early phases of TQM utilisation lead in several cases on beliefs, that whole process of applying TQM will be easy and it will take care of everything. In a way this is sad, because already Deming [8] and others emphasised the huge amount of effort required in operationalising TQM into a practise.

Management models have been evaluated supporting quality development in several ways and also evidence of positive correlation on performance and efficiency has been shown [9, 32]. However, all these quality development modes, in total, have effect quality development path, which cannot be forecasted.

Based on former the first aim of this study is to examine the development of quality management in recent years as well as its current status in four units of Ruukki Production, to assess the situation in each period of time on the basis of the theoretical framework and draw conclusions on the development of the entire division in such a way that the emphasis is on the recent decades. The second aim of this study is to create possible future scenarios for Ruukki Production and see if TQM can still offer ideas in development of organisation.

To reach these targets we use literature, Ruukki's documents and archives as well as from the interviews made in different units. Our approach is qualitative and the study is descriptive in nature. The objective of the study is to find profound information although the number of cases is not always great. [19] This study will also apply Cunningham's four intensive methods (narrative, tabling, explanatory and interpretative case) for case study described by Järvinen and Järvinen [15] which also strive for the intensive understanding of incidents of a person, group or organisations.

The theoretical part of the study discusses the history of quality management, development models, tools and techniques for quality management, factors related to the successful and unsuccessful implementation of TQM, and characteristics of global organisations. The empirical research

describes the history and current state of quality management by means of ten interviews carried out in total in four units, on the basis of which future scenarios were made. The people interviewed varied from senior management to line management and quality managers. The questions were qualitative in nature and they were based on the literature referred to in the theoretical section of this study. In addition to the interviews, Ruukki's quality management documentation from the company's archives was used. Finally, we outline some scenarios for the future for the Ruukki Production division. The scenarios are alternative views on the future on the basis of which suitable strategies can be developed. The scenarios are based on systematic observations of the environment and weak signals received. Weak signals may be, for example, preliminary research data or first symptoms of change perceived in the environment. [18]

## 2. Development of TQM

Total quality management is a philosophical entity of the concept of management and a compilation of quality management methods and techniques. Some studies refer to the hard and soft sides of TQM. Total quality management is an approach to the management of an organisation in which quality plays a central role and which is based on the participation of all of its members. The goal is long-term success, which can be achieved through customer satisfaction, and which benefits all members of the organisation as well as society. [5, 28]

The development of quality management is often described in the literature as a four-stage process: the first stage *inspection* (I) can be considered to have started during the industrialisation and mass production. The second stage *quality control* (QC) developed in particular in parallel with the wartime industries. The emphasis of the second stage lies in the manufacturing process, which is systematically developed. The third stage, *quality assurance* (QA), incorporates the entire development and manufacturing process of a product as a factor affecting quality. In the fourth stage, *total quality management (TQM)*, quality is seen in a holistic and strategic manner. At this point, the responsibility for quality was extended to include everyone in the organisation and the role of the corporate management becomes central. [1, 5, 11]

The level of quality management of an organisation is also described using organisation maturity models, and organisations can be divided into different group on the basis of how values and principles related to quality have been incorporated in the organisational culture. Dale [9] categorises organisations into six quality management maturity levels: uncommitted, drifters, tool pushers, improvers, award winners and world class. Silen [28] has applied the model of Dale, Lascelles and Broaden [6] and added the estimated number of quality award points to organisations in each category (table 1).

Table 1: *Maturity Levels of Quality Management*

| Crosby [3] | Dale et al. [6] | Silen [27] | |
|---|---|---|---|
| | | Maturity level | Quality award points |
| Uncertainty | Uncommitted | Uncommitted | 100-250 |
| Awakening | Drifters | Drifters | 150-300 |
| Enlightenment | Tool Pushers | Tool Pushers | 250-450 |
| Wisdom | Improvers | Improvers | 450-650 |
| Certainty | Award Winners | Matured | 650-800 |
| | World Class | World Class | 800- |

All organisations do not necessarily fall into a certain category. Instead, they may be in between any of the six levels. According to Dale [5], the classification is useful in the assessment of the quality management maturity level of organisations and in interpreting the views of people working in different levels of the organisation. In addition, the classification assists in the making of future plans. Jokinen [12] has combined the aforementioned models into a table and analogously added the classification by Crosby [3] – the sea chart of quality management .

The principles of quality management were first introduced in Finland at the end of the 1970's. In addition to the companies' own interest in developing quality, the development was affected by the demands of foreign customers. In the beginning, information was retrieved from Sweden and American literature, and independent quality departments were established in companies to assure quality by means of quality control. In the 1980's and 1990's, the main quality development methods in Finland were the ISO 9000 quality management standards and quality award criteria based on quality management. Today, quality management systems have passed their high season and their importance in business is on the decrease. The most advanced companies have constructed, alongside the quality award criteria, competitiveness assessment models adjusted to their own needs. [29]

TQM does not offer quick answers to all problems no does it contain a certain tool or technique that could be used to solve all problems. Every organisation should have a "roadmap" of tools suitable for different situations and their use should become routine. [3, 7] The meaning of the word 'tool' can also be understood in a wider way to include, among others, quality systems, quality award models, self-assessments, process management and Six Sigma. Tuominen and Lillrank [31] used the word 'tool' in its more extensive meaning. According to the research of Tuominen and Lillrank [31], the most used tools in Finnish enterprises were continuous improvement/initiatives, ISO 9000 quality management standards and team work, of which the two first were used in more than half of the case enterprises. According to Tuominen & Lillrank [31], Finnish enterprises are divided into companies where

no tools were used and companies in which several tools were simultaneously used. An interesting finding was that, according to the study, most tools were used in the fields of the metal and electronics industry.

A study made in the USA and published in 2003 in the Total Quality Journal (2003) raised five factors preventing the success of TQM. According to the study, the factors were 1) insufficient resources in human resources management and development, 2) lack of quality plan, 3) lack of quality-promoting leadership, 4) insufficient resources for the implementation of TQM and 5) lack of customer-oriented operations. According to Longbottom et al. [17] the literature indicated the following factors, among others, that restrict the successful implementation of TQM: inadequate knowledge and skills at the strategic and operative level; insufficient integration between quality improvement programmes and corporate strategies, marketing and operative business; inadequate use of methods such as e.g. self-assessment; underestimation of the time and resources needed and failure to develop the right kind of performance metrics. According to the empirical study of Longbottom et al. [17], there are many illusions linked to TQM and business excellence programmes. Too little attention is paid to the best practices in the following categories: *leadership, human resources management, procedures and strategies, and resources.* Too much attention is paid to control measures in the process management and performance assessment categories, in which control measures as such are a function that does not bring added value. Thus, Longbottom et al. [17] question whether quality award models and self-assessments in their current form are suitable methods to implement TQM, because they may result in negative attitudes towards quality management. According to them, the values and needs of both internal and external customer should be emphasised more, suitable value-adding strategies should be created and functions should be integrated. TQM should also focus on the training of its *basic values*.

Tari [30] lists factors presented in the literature that are vital for the successful implementation of TQM. According to Tari [30], the implementation of, among others, customer-oriented approach, leadership and commitment of the management, quality planning, management based on factual information and process thinking allows TQM to be more than just a fashionable passing trend. According to Rahman [21] studies on the correlation between certain main elements of TQM and the success of the organisation indicate that only a part of the soft factors of TQM correlate with the success of the organisation. The commitment of upper management; open organisation; training, participation and empowerment of employees were the factors affecting the company's performance the most. According to Rahman [21] some studies show little or no correlation between a company's performance and statistical quality control, benchmarking and flexible production systems. In his opinion, the results conflicted with the literature in which the hard factors of TQM are considered to correlate with the performance of an enterprise. [21]

A research on Brazilian and Japanese world-class productive companies (WCC) published in 2005, raised, among others, the issues of leadership, strategic planning and process management, in which WCCs were superior to other companies. In the field of management, the senior management actively develops quality plans aimed at the achievement of business goals. The senior management monitors the realisation and implementation of the quality plan in order to improve processes. The company develops products and processes that cause the minimum possible load to the environment. In terms of strategic planning, the company has a short-term plan (1–2 years) to implement TQM and a long-term plan (3–x years) to ensure product quality and customer satisfaction. In the field of process management, the company has strategies to develop processes that need to be improved. [4]

The same study also gives some recommendations on how to go beyond TQM. The study suggests that TQM should be integrated with other management systems. The customers' needs should be examined in a more detailed manner and the information should be communicated to those who might need it most. The enterprises should pay special attention to the health, morale, wellbeing and continuous learning of all employees, that is, to develop a good human resources policy. The managers should use time and resources for the tuition and counselling of future managers. The study indicates that, in order to remain successful, the companies should develop their ability to face changes and give their employees the opportunity to innovate and take risks. Those succeeding in taking risks should be rewarded and renowned. Failures should not be punished but those failing should be encouraged to try again. [4]

According to Hannukainen et al. [11] the quality 2020 survey carried out by the American Society for Quality showed the following outlines: the application of quality thinking must become more innovative, more flexible and quicker to implement. This discovery supports the changes in the operating environment discussed earlier in this study well. The number of professionals working in the field of quality may decrease, but the need for quality-related skills will not. The trend seems to be towards the decrease of the importance of a quality department's role as a separate unit and making quality increasingly into everyone's concern. The challenge for specialists in the field of quality will be to develop to meet the needs of business and technology.

## 3. Development path and current state of TQM in the case company

Rautaruukki specialises in the supply or metal-based components, solutions and holistic deliveries to the

engineering workshop and construction industry. Its turnover in 2005 was approximately 3.7 billion euros; it had operations in 23 countries and employed approximately 13,000 people. Ruukki Production manufactures hot and cold rolled coated plate and strip products for divisions with customer-responsibility. Production has a steel works in Raahe and 10 other production plants in Finland, Sweden and Ukraine. This study focuses on the development of quality management in four units of Ruukki Production in Finland: Hämeenlinna, Oululainen, Pulkkila and Raahe. [23]

The first unit of Ruukki Production was established in 1960's, and the goal at that time was to launch production and increase the amount produced. The 1970's were a period of strong growth and development: the foundation of metallurgical know-how was created during the 1970's. Quality was then achieved by means of tests and inspections (I), and several product approvals were obtained for different steel grades. Quality was not, however, considered a competitive factor, and quality assurance was mainly the work of specialists. External customers did exist, but operations cannot be called customer-oriented. The concept of the internal customer was not recognised either.

The beginning of the 1980's was the period of quality control (QC) and the first IT systems were created. Quality manuals were made and, around the mid 1980's, the quality concept started to expand towards quality assurance (QA) and total quality management (TQM). The focus was changed to the development of quality. The objective was to achieve a finished product at once, and the idea was to produce quality in the production processes with lower costs. Rautaruukki participated in the quality board of the association of Finnish Metal Industry (currently the Association of Finnish Technology Industries), which provided the company with preliminary information on development trends in the field of quality. The company was able to shorten delivery times to half using the JOT project and the number of products rejected was decreased by one third thanks to a quality campaign carried out in one unit. More information was sought from Japan where the positive impacts of TQM could be seen in practice, and quality circle operations were learned. The importance of the external customer increased and ideas of internal customers were presented. The management, however, considered quality-related issues mainly as specialist work and quality was not recognised as a competitive factor. The appreciation of the personnel may have been slightly higher than in the previous decade.

The 1990's was called the decade of quality. Quality was increasingly understood as everyone's concern, and responsibility for quality was transferred to production units. An extensive quality project was carried out, and it culminated in the quality award won by the Raahe unit. The units certified their quality systems at the beginning and environmental management systems by the end of the decade. The making of self-assessments and process thinking was learned and quality theme days of certain units and the Group were launched. There was fruitful ground for quality issues and continuous improvement, because there were no financial resources to make investments. The management was aware of the importance of quality and interested in it. Customer-oriented operations and tailoring were carried out even in the expense of the company's own profitability. Internal customership was rather advanced. The importance of the personnel was emphasised, perhaps too much so. The examination of (quality) goals from the strategy commenced. There was a slight downturn in quality management at the end of the decade due to changes in the organisation structure and large-scale investments.

At the beginning of the 2000's, many issues that were current in the 1990's were brought into discussion again. The new Ruukki was formed in 2003, and the organisation of quality management in the Production division was carried out in a somewhat conservative way. The years following the organisational change have mainly included adjusting the old structures to the new business model. Development in system thinking has been towards a more integrated direction in the field of EHSQ management. The Group's focus in the development of quality has been on Six Sigma and the promotion of process thinking. Quality is seen as an important factor of the entire supply chain, and the importance of the customer has been further highlighted as the new Managing Director took the lead. The role of the customer is reflected in, among others, the strategic goals related to the quality of operations. The concept of internal customers is not in use in the Production division. The role of the specialists in quality is to describe and develop processes, maintain and develop systems and change management. Investments have been made in HR issues at the Group level, and operations in this, as well as other aspects, have been harmonised within the Group.

Figure 1 describes the history of quality management in Ruukki Production. The Y-axis does not only indicate the number of quality award points but also the degree of development of quality thinking and culture. The Production division cannot currently be even assessed by means of quality award criteria, because it mainly carries out cost-efficient production. The characteristics of the number of points on the axis however do apply to Production. The figure is based on the assessment of the interviews made.

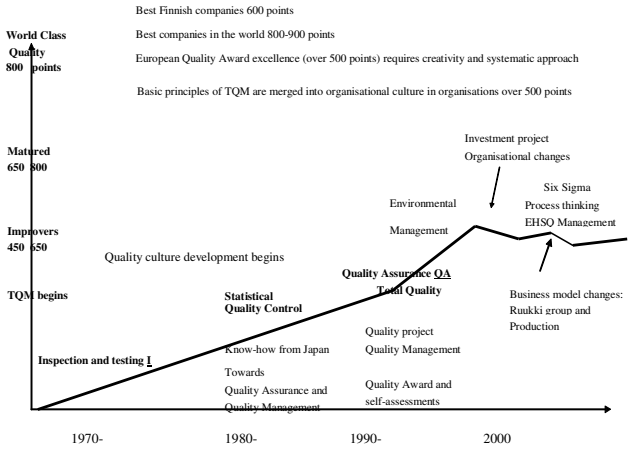


Figure 1. *History of quality management at Ruukki Production*

The fact that there is still room for development does not mean that things are bad. The organisation has many strengths and it currently produces high-quality products in an efficient way. A strength of a mature organisation must, however, also be the recognition of its weaknesses and development in those areas. At the moment, if one assesses the quality level of the organisation, transition to the last stage, TQM, in Dale's [5] four-stage model *from inspection to quality management* has certainly taken place as early as in the 1990's. When examining the level in the light of the quality culture maturity model [5, 28] Production is most likely to be at the level of an *improver* organisation. The characteristics of the level are, among others, the awareness of total quality management, improvement of co-operation partners' ability to produce quality and the goal of long-term co-operation in subcontracting. The changes in the culture needed to access the next level have been understood at least in some parts of the organisation, although the change has not yet been implemented. Customer-oriented operations are being emphasised throughout the Group from the senior management onwards. A characteristic of the maturity level is also that TQM is not fully incorporated in the organisation. This can be seen the ceasing of certain operations (e.g. quality circles) when active personnel members leave their current posts.

Some characteristics of higher maturity levels can also be found in the organisation, similar to those of lower levels. Characteristics of lower levels may include, for example, the enthusiasm related to the acquisition of new tools and decline after their attempted implementation. Investments made in the development of the customer interface describe the characteristics of the higher level, or at least the intention to move towards the higher level. In some cases, power to make decisions has been granted to the grassroots level and successful changes in the organisation have been made. Also, the objective of doing the right things in the right way refers to the higher maturity level and this aspect should be continuously emphasised in all operations. In addition, the fact that the company successfully competes in global markets is a characteristic of a world-class organisation.

When the organisation is assessed on the basis of the sea chart of quality management presented by Jokinen [12] Production is perhaps somewhere in the top right corner located in such a way that the organisational culture is, on average, creative and enterprising as well as systematic. Certain things could be processed in a more systematic manner and operations could be developed to be more creative and enterprising by means of open interaction. The right top corner of the sea chart was reached as early as in the 1990's in terms of different sectors of quality management. Then, the organisation is, in a way, at the end of the screw thread of Silen [28] and at the beginning of the smooth part of the screw. At this point, the organisation must find ways to climb up the smooth part itself, that is, to develop its quality culture and thus improve its performance. According to Silen's [28] model for the directioning of operations of a company group, the actual creation of the quality culture of a company at the *improver* level should start if the organisation wishes to reach the next level. The step to change the culture has not perhaps been taken yet at Rautaruukki. However, an opportunity to do this might present itself in the coming years when the organisation will face great changes as the large population generations retire.

When the status of Production – and partially Ruukki – is compared with the characteristics of world-class organisations presented by Da Silva et al. [4] an object for development could be the training programme to improve quality awareness, team work and solving structural problems identified under HR management. According to Da Silva et al. [4] world-class companies use self-assessments in continuous improvement, process control and monitoring better than other companies. The study indicates that, in order to remain successful, companies must develop their ability to face changes and give their employees an opportunity to present ideas and take risks. The interviews carried out in this study indicate that this could also be an area for development from the viewpoint that, at the moment, development suggestions made are often greeted with negative attitudes.

According to Sebastianelli & Tamini [25] five of the factors preventing the success of TQM can be classified under the following sub-categories: 1) insufficient resources in human resources management and development, 2) lack of quality plan, 3) lack of quality-promoting leadership, 4) insufficient resources for the implementation of TQM and 5) lack of customer-oriented operations. There are good procedures in Production for most of the issues listed. The area of development in Production will be the first category, *"insufficient*

*resources in human resources management"*, training in quality development tools and problem recognition techniques. At the moment, quality professionals are highly skilled in the techniques, but suitable tools could also be given to others depending on their job description. A couple of people interviewed mentioned, that a sort of "quality pack" was being planned in the company. This could be reconsidered; however, in such a way that everyone does not need to know everything. There are also areas to be developed in the third category "*lack of quality-promoting leadership",* such as dissemination of quality awareness in all operations in order to make it everyone's concern, not as a separate matter. As stated earlier, everyone should have a clear image of what quality means in their own work and what high-quality operations in one's own job means. Longbottom et al. [17] also state that the training of basic values is important.

**4. Discussion**

The most important contribution of this study is to present the development path of quality management in the Production division, as a whole. From the viewpoint of the future quality personnel of Production, the study offers a concise survey of the near history, measures taken, development attempts and evaluation of the current state. Repeating the same mistakes can be avoided by knowing the history. It also allows considering if something could have been done in a different way and if it is possible to succeed better in the future. The development, of which this study is a part, will be continued with a benchmarking process in which good practices and possible operating models for the chosen development areas presented in the different studies of the project will be sought from outside the company.

Another objective of this study is to continue the quality management development path by making three different scenarios for the direction of the organisation's development. The first the "Investment" scenario assumes that the role will remain to be important and profound metallurgic expertise is seen as an essential aspect of the development of solutions business. The first scenario will invest in the building of quality culture, further strengthening of the company's strengths and overcoming of weaknesses. As a whole "Investment" scenario needs a lot of effort to take place, because a leap from constant development level to another means huge increase in development inputs. At this point according to Silen's [28] model, the organisation must find ways to develop its quality culture and thus improve its performance.

In the second scenario "Status Quo", Production's current role will remain essentially unchanged and it allows the focus to remain on production. Operations will thus continue in the same way, and the development of quality will mainly culminate in the promotion of process thinking and continuing Six Sigma. Process thinking will e.g. cause benefit in the future as the organisation learns to apply it more and more. Also the Six Sigma projects will be continued and this will, in places, lead in good results. The harmonization of "way of working" will generate benefit when overlapping operations can be torn down. The important part, however, is to remember to emphasise the role of the customer in order to avoid distancing oneself too much from the customers' perspective. In "Status Quo" scenario total quality performance level will probably improve, however, competitiveness in relation to the competitors may decline if their rate of development is better.

The third scenario "Let in be" discusses the possibility in which Production is no longer considered strategically important in the expanding solutions business and its role would change into that of a supplier. In this case, factors leading to a possible downturn in quality may include, for example, great changes in the organisation, forgetting the importance of Production to Ruukki and letting oneself be lulled by the financial success of the last couple of years. In this case, the development of the division might not be considered important and possibilities to externalise the production of steel or to find a strategic partner would be considered. "Let it be" scenario might be relevant if the emphasis in developing quality inside organisation is not kept in one of the strategic issues. Of course, quality in itself, is not the issue, but more like results provided trough it. It has been shown [12] that during the organisational development path process seem to work on their own and no supervision, controlling or instructions are needed in great extent. So the emphasis in that sense decreases. However, there is a trap that might occur, when being lulled into the result improvement on their own the dynamics related to operations of organisations might cause changes and constant need for improvement activities. So in order to keep same level of relative performance organisation must constantly develop itself. Therefore the "Let it be" scenario decreases the relative level performance.

Although it has showed some earlier duties a TQM-performance correlation, they did not strictly prove that TQM caused performance to increase, but only that the positive correlation existed. An empirical study on TQM as competitive advantage published in [20] 1995 support conclusion that TQM can produce economic value to the company, but it is not necessary to success. TQM success appears to depend critically on executive commitment, open organization and employee empowerment. On the other hand it was discovered that less success appears upon TQM adopters such benchmarking, training, flexible manufacturing, process improvement and improved measurement. Also Longbottom et al. [17], Powell [20] and Rahman [21] have got same kind of conclusions in their studies. This profile differs substantially from those found in existing TQM studies, which focused almost entirely on the TQM tools and techniques. This result is consistent with the resource-based notion of

complementary resources, which was also made in this Ruukki Production study. This means that rather than merely imitating TQM procedures, companies should focus their efforts on creating a culture within which these procedures can thrive. The first TQM weighted scenario in Ruukki Production study will especially capture this idea and suggest *"to invest"* in the building of quality culture not forgetting TQM tools and techniques.

Also a survey made in the Australia in 2007 found strong positive relationship between the extent of implementation of TQM practices and organization performance. [13] This study signals the importance of developing an environment and culture of support to further enhance the performance outcomes of TQM implementation. The implementation of TQM programs may be sub-optimal, if employees do not feel there is acknowledgement and support from the organisation and from work collegues. In Ruukki Production the changes in the culture needed to access the next level have been understood at least in some parts of the organisation.

Ravichandran & Rai [22] emphasize that a coherent, integrated strategy encompassing adoption of all identified factors is required, as opposed to the implementation of one tool or management practise. This finding is consistent with Deming's [8] assertion that system factors account for far greater variance in work performance than individual or technology factors. According Ravichandran & Rai [22] there are also critical links between leadership, management infrastructure practises and process level activities. It is important to realize the synergy by focusing on the relationship between these elements. In Ruukki Production it has been seen for example enthusiasm related to the acquisition of new tool and decline after their attempt implementation.

Based on our study, the message for other organizations is that TQM's highest purpose and its real contribution to business is in providing a framework that helps company understand and acquire these resources as part of an integrated business management. It is quite possible for companies to prosper outside the confines of the TQM ideology, so long as they nurture the intangible resources critical to survival and success.

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