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Measuring Costs of Poor Quality as Short Projects: The Case of a Construction Company

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Abstract
Costs of poor quality are those costs that would disappear if the company's products and processes are perfect. It is evident that avoidance of costs of poor quality is essential to long-term organisational survival. Of that reason several researchers and practitioners argue that those costs should be tracked continuously. This paper takes a different position. It presents a case study in which costs of poor quality were measured in a construction company using a quite simple and fast method including a brainstorming session and ten individual interviews. The 56 cost elements of poor quality identified amounted to 7.1% of the annual turnover. Effects achieved were increased knowledge about costs of poor quality and increased motivation for reducing those costs.

Keywords
Costs of Poor Quality, Quality Costs, Assessment, Method, Construction Company

1. Introduction

Several researchers argue that companies should measure their costs of poor quality (CPQ). Some researchers mean that companies should measure those costs continuously using specially developed tracking systems (e.g. Davis, 1987, Low and Yeo, 1998, Holland, 2000, Love and Irani, 2002). Problems with these types of systems are that they may be time consuming, may collect unnecessary data and may not motivate people to improve their businesses. There is even a tendency that the people who have developed such systems or people who run the systems in the companies consider the systems being more important than the companies' core processes. Another problem when using a system continuously is that the definition of quality, and following that also the definition of CPQ, is continuously broadened (Josephson, 2000), and that it may be hard to expand the system to cover the new elements included in the concept. Following this, it may be more

efficient to measure CPQ as short projects and to repeat the measurement when it is needed or focus further analysis on the main problems.

This paper presents experiences from a test of a simple and fast method to measure CPQ in a construction company. The method builds on Sörqvist (1998) and includes a brainstorming session followed by individual interviews. The test was made by four students from the Master programme in Civil Engineering and Architectural Management at Chalmers University of Technology. Altogether they spent 130 hours doing the test, but since all of them planned and ran the brainstorming session together and made all interviews and analyses in pairs the measurement could be done in some 40 hours. The paper presents the method, the results of the measurement and the experiences from the test.

2. Costs of Poor Quality

2.1 Definitions

CPQ is here defined as "those costs, which would disappear if the company's products and processes were perfect" (Juran, 1989), because we believe that this definition is easy to communicate particularly to practitioners. Quality costs are traditionally divided into prevention costs, appraisal costs, internal failure costs and external failure costs (see Feigenbaum, 1956). CPQ covers the last three types of costs since prevention costs usually are considered as planned investments in good quality (Sörqvist, 1998). Appraisal costs are significant with the cost of checking that the correct quality is delivered at all stages. Internal failure costs are defined as losses caused by deviations from the desired quality level discovered before delivery to customers. External failure costs are defined as losses caused by deviations from the desired quality level discovered after delivery to an external customer. Sörqvist (1998) and Campanella (1999) state that some of the elements of CPQ can be estimated but many remain unknown because they are difficult to measure. Of that reason Sörqvist (1998) uses another categorization. He divides CPQ into traditional CPQ, which are obvious losses; often identified in the production phase, hidden CPQ, which are remained losses affecting the business concealed within the economic account, lost income, which is what the company loses because of unsatisfied customers, customers' costs, which are losses hitting the external customer, and socio-economic costs, which are losses affecting the society and in a longer term also the company.

When CPQ are measured they turn out to be in the range of 1 to 10% of the company's turnover or of the total project cost. There are, however, reasons to believe that the total CPQ are something between 10-30% for a building project (Josephson, 2000). The total CPQ include all possible economic effects, in terms of poor quality time and costs that may consequence poor quality.

2.2 Assessing CPQ

It is of course of great importance to decide on the purpose of measuring CPQ in advance, since this influence the choice of which costs to measure and what method to use. Typical purpose could be to get a first view of the volume of CPQ, to indicate where to improve or to motivate people. There have been many different methods applied in order to measure CPQ depending on the goal and aim with the measurement. We have built our test on Sörqvist (1998), who uses four steps. During preparation, the necessary company management support must be obtained. Planning includes making a list of typical CPQ in the company, by means of a brainstorming session. The session consists of selected employees considered to be well informed about the business. The members of this team should have a cross-functional structure since the team of individuals then possess a good overall picture of all areas to be studied. Sörqvist explains that the brainstorm

will not give a complete list of costs, but initialises the work and, more importantly, involves the participants. During the executing phase there are two main tools for carrying out the assessment, the deviation analysis and the best practice analysis. The deviation analysis concentrates directly on the faults, deficiencies and insufficient features. The costs can be estimated by identifying and determining what resources they consume. Apart from already recognised problems it is of great importance to try to identify hidden and chronic problems, and to analyse all areas in the business. In best practice analysis, the first step is to determine the best, or at least a considerably better, way of doing the work, i.e., the best practice. The CPQ are then defined as the difference between the best practice and the actual practice studied (Sörqvist 1998). A follow-up of the results and the assessment procedure should be carried out in order to document the experience and expertise acquired to enable future improvements.

3. Case Study

3.1 The company

The study considers one of Scandinavia's leading companies in the field of construction and civil engineering with business in Sweden, Norway, Finland and Poland. The group's sales are 19 billion SEK and it has 11,000 employees. Their motto is to be the local contractor close to the customer, with everything a large group can offer. The construction division works nationwide and the building activities operate through five regional divisions. According to the quality manager, the company has for some time, experienced a need for identifying costs caused by poor quality in their activities. He believes that identifying CPQ is a good way of increasing the awareness and commitment for improving quality in the company, but also a good way of identifying areas where improvements should be made in order to reduce costs. Their quality management system follows the structure and requirements stipulated in the ISO 9001 quality standard.

The test was based on one specific business unit consisting of one project manager, three project engineers, four site managers, eight supervisors and 40 workers. The annual turnover was approximated to 125 million SEK, equalling around five major projects per year, excluding value-added tax and costs of support staff.

3.2 The method

For executing the assessment, the deviation analysis was chosen, since the alternative best-practice analysis involves a rather superior task of determining what 'best practice' actually is. The first step of the analysis was to identify typical CPQ. The identification was introduced to the company by arranging a brainstorming session with the Quality manager and five representatives from the department for building construction. The representatives were chosen to cover as many tasks as possible. The brainstorm, which took approximately two hours, aimed at making the participants coming up with as many examples of typical CPQ as possible. In total approximately 100 cost elements were listed, from which 56 were chosen for the next step. The purpose with the brainstorming session was also to create necessary commitment for forthcoming interviews. The CPQ elements from the brainstorming were supplemented with typical CPQ gathered from the literature (e.g. Harrington, 1987; Sörqvist, 1998; Campanella, 1999; Josephson and Hammarlund, 1999). The cost elements gathered mainly represent the traditional CPQ. These were classified as appraisal costs, internal failure costs and external failure costs and then broken down into different categories. The cost elements were then listed as CPQ parameters in an interview guide. With support of an experienced manager within the company it was decided who should be interviewed about each parameter.

As a second step, individual interviews were held with ten employees representing five different areas of responsibility, i.e. two project managers, two project engineers, two site managers, two supervisors, and two construction workers. Two persons from each category were chosen in order to make the results more valid, supplemental and reliable. The interviews lasted for 1.5 – 2 hours each. The questions regarded time and money spent on all the CPQ parameters in the guide, i.e. each person interviewed were asked to estimate how much each of the relevant parameters cost. On average three different categories of employees, i.e. six persons, were asked about the same parameter. In order to facilitate the somewhat difficult task of putting a price on different CPQ-elements, the interviewees were sometimes asked to estimate how much time they spend in average, on a monthly or sometimes even weekly basis, dealing with different issues. Some answers were given as a percentage share of time or money totally spent during a year.

For each cost parameter the answers were transferred to annual costs. The average was then calculated for each parameter and summarised for each cost category. When time was mentioned instead of costs, it was multiplied by the hourly wage of the interviewee in question and extrapolated in the final cost calculations to represent 11 months, i.e. excluding one month holiday.

3.3 Results

The annual CPQ were calculated to 8.90 million SEK, which is equivalent to 7.1% of the net sales for the business unit. The internal failure costs amounted to 6.88 million SEK and include costs related to both design and production. The external failure costs amounted to 0.64 million SEK and the appraisal costs amounted to 1.38 million SEK.

The 40 cost elements considering the internal failure costs were of practical reasons divided into design phase, purchase before production, production phase, purchase during production, administration and support and production management (Table 1). The project managers and the project engineers are often involved in the design phase. They estimated that unclear responsibilities between clients and contractors cost 0.80% of the net sales. The major problem in purchase before production considered prefabricated concrete elements, 0.50% of the net sales, which often are purchased too late. Most cost elements had to do with the production phase. Material wastage and theft on construction sites has increased considerably the last years and cost 0.80% of the net sales. Purchase during production influenced barely the internal failure costs. The reason for this might be, as stated by the interviewees, that they benefit from the company's long-term contracts with suppliers. The most expensive cost element in administration was reminders of invoices, 0.16% of the net

Table 1: Cost of poor quality in the case company

Cost category	*Cost of poor quality (% of net sales)*
Internal failure costs	5.50
During production (14 cost elements)	2.47
During design (9)	1.35
Purchasing before production (5)	0.83
Production management (3)	0.47
Administration and support (3)	0.21
Purchasing during production (6)	0.17
External failure costs (8)	0.51
Appraisal costs (8)	1.11
Total	7.12

sales. All interviewees, especially the supervisors, said that they spend a considerable amount of time dealing with communication- and coordination problems, which cost 0.31% of the net sales.

A minor part, 0.51% of the net sales, was constituted by external failure costs. Bankruptcies of subcontractors were estimated to be 0.23% of the net sales. The appraisal costs corresponded to 1.11% of the net sales. Expenses for internal inspection on site cost 0.39% of the net sales. Expenses for external inspection on site cost 0.20% of the net sales.

4. Discussion

The method used in this study is a direct and fairly simple way to measure CPQ in organisations. Of that reason it can also be criticized in several aspects. Sörqvist (1998) argues for example that it involves a serious risk that only a small proportion of the total CPQ are found. However, our experience from this test is that the method fulfills the aim as long as it is to get a first view on the volume of CPQ or to motivate people in the organization for improvements. More important, the study ended up in CPQ corresponding to 7.1 % of the business unit's annual turnover. This volume exceeds all of the most cited studies of CPQ and related concepts in construction, for example Burati et al (1992), when costs for changes are excluded, Josephson and Hammarlund (1999), Love et al (1999) and Barber et al (2000), when costs for delays are excluded. As long as no system for tracking most of the CPQ is developed this simple method seems to be an effective alternative.

The CPQ elements in the interview guide developed and used in this study mainly covers parts of the traditional CPQ and represents the more obvious losses predominantly found in the production phase. Sörqvist (1998) states though, that the traditional CPQ actually identified are often caused by sporadic incidents on a day-to-day basis while other chronic losses are remained unknown. The consequences may be that an organisation overlooks major chronic problems and base improvement priorities on the wrong picture. This is true for not only our test, but also for all of the most cited studies and systems for tracking CPQ.

To improve the business effectively it is of course necessary to know where and how to act. Many of the most cited studies on CPQ and many of the CPQ tracking systems more or less identifies the causes. This study identified where the CPQ occurred without considering the causes. On the other hand it indicates where to make further analysis.

If the company wants to repeat the assessment in the same business unit or to conduct further assessments in other business units, the interview guide can be further developed by modifications and additions of new CPQ parameters. Literature studies and interviews with experienced employees can then be valuable, as well as interviews with customers and suppliers. It is also valuable to consider quality documents that might contain data on poor quality when compiling the guide. We argue, however, that repeated measurements always should include a brainstorming session to motivate the employees. One site manager suggested that copies of the interview guide should be delivered to all sites within the company. He meant that the guide could be a tool for all site managers and foremen in their daily work.

5. Conclusions and Recommendations

This paper presents a study that includes a test of a method for measuring costs of poor quality (CPQ) in construction companies. The main reason of the test was to find a simple and fast way to estimate the CPQ

without implementing expensive and bureaucratic systems. The method proved to be simple and efficient considering the fact that the four students who made the test in practice had no previous experience from such assessments. Still they managed to accomplish the survey rather successfully. The students spent altogether 140 hours on the survey, including the fact that they worked in pairs or in the whole group all the time. We believe that it should take some 40 hours for one of the students to repeat the same survey in another business unit or in another company. The company invested less than 30 hours on the survey, including taking part in the brainstorming session and the interviews.

The method has some advantages. It is simple, cheap and fast. It can easily be modified to suite new situations. It may be a good alternative for small and medium-sized companies, which have fewer resources for this kind of assessments. On the other hand, it's more difficult to control the business with this type of method since it's not a continuous follow-up. The results are based on subjective interviews, i.e. there are no exact answers. Another disadvantage is that measurements with this type of method don't necessarily implement a quality consciousness in the organization.

We believe that this test gave information enough to motivate further developments of the method. Of that reason we suggest new tests and further analysis of how this method can be used in order to assess the quality in the business in construction companies.

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