

MANAGEMENT OF FACTORS AFFECTING QUALITY OF PROCESSES IN CONSTRUCTION ENTERPRISES

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Abstract: Construction is a sector where final effect too rarely meets expectations of investors in terms of quality. Using tools of quality management in this sector remains not much popular and does not have many enthusiasts. This approach results from specific construction activities that are characterized by the lack of repeatable results, which causes that using tools and principles of TQM is much more difficult than in production enterprises. Continual improvement is the only way to improve competitiveness of an enterprise and to satisfy customers. One of the principles of Total Quality Management (TQM) is process approach. The paper aim is indication and analysis of basic, auxiliary and service processes in construction services in order to improve quality of these processes. Area of factors that affect quality of construction was analysed in four areas: project quality, quality of subjects of labour, quality of means of labour and product quality. Based on the analysis of determinants of quality of construction services, a model of process approach was developed for the enterprises in this sector. The paper identifies the factors which most substantially reduce quality of construction processes: improper build quality (33.11%) and irregularities in the construction project (24.9%).

Key words: TQM, process approach, construction.

Introduction

In the construction sector, quality is of essential importance to final users. The problems of quality in the construction sector started to be analysed in times of the Code of Hammurabi (1750 BC), where the death of a construction object user caused by improper construction was the death of the builder (Geiger, 1996).

The effects of low quality in the construction sector include higher material costs, longer times of completion of construction works due to repairs, higher labour costs, losing contacts and orders (Hoła et al., 2013; Radziszewska-Zielina and Mirek, 2013). Low quality also causes a reduction in competitiveness of the enterprise, frustration and disrespect of the customers.

Having ISO certificates in large construction enterprises is a standard today (Witakowski, 2010). Market globalization leaves enterprises which do not want to yield to strong competition without a choice in terms of the necessity of implementation and continuous improvement of the quality management system (Najmi and Kehoe, 2000; Page and Curry, 2000; Singh and Smith, 2004; Zairi, 1991). Obviously, the fact of having a certificate of a quality management system does not guarantee a success in the enterprise. Quality should be continuously improved in each area of enterprise activity.

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The paper aim is to identify and analyse fundamental, supporting and service processes in construction services in reference to improvement of the quality of these processes.

TQM and process approach in the construction sector

Construction enterprises have to be familiarized with the concept of TQM (Total Quality Management), which proposes the use of the eight principles: 1) customer focus, 2) leadership, 3) involvement of people, 4) process approach, 5) system approach, 6) continual improvement, 7) factual approach to decision-making, 8) mutually beneficial supplier relationships.

TQM is a set of tools and methods which allow for continual improvement of processes which occur in the enterprise in order to achieve measurable benefits to the enterprise, its employees, customers and partners. Unfortunately, construction enterprises use few techniques and tools, remaining unacquainted with the entire "range" of other ones offered by the quality management system. Construction services are a specific domain of activity, where it is difficult to achieve the repeatability of the outcomes. This, however, does not mean that an enterprise cannot aim at perfection. System approach to management consists in identification, understanding and management of mutually correlated processes as a system. This approach contributes to improved efficiency and effectiveness of organization in achievement of goals (Żemigala, 2009). System approach is characterized by taking into consideration the external components of the enterprise (its surroundings), aims, components and relations between each other and considering the as an entire system.

Process approach is another principle of TQM. Process approach allows to familiarize with the relations that occur in the organization in order to easily identify critical points that have a decisive effect on the lack of consistency of the finished goods with requirements (Grabara and Kot, 2009). It is more difficult in the construction sector to ensure quality using the assessment of final product compared to production enterprises. Process approach, recommended by ISO 9001-2000 standard used in construction is much more effective. Model of process-oriented quality management system is presented in Figure 1.

According to PN-EN ISO 9001:2009 standard, the steps which should be realized by an organization in order to form a quality management system are presented in Figure 2.

The Figure 2 shows that the basis for creation of the quality management system is process. According to the definition, a process is a chain of activities aimed at creation of values that correspond to customer requirements (Müller and Rupper, 2000). Process is also considered as a set of mutually related resources and activities which transform input into output (Łańcucki, 2001; Kościelniak, 2014).

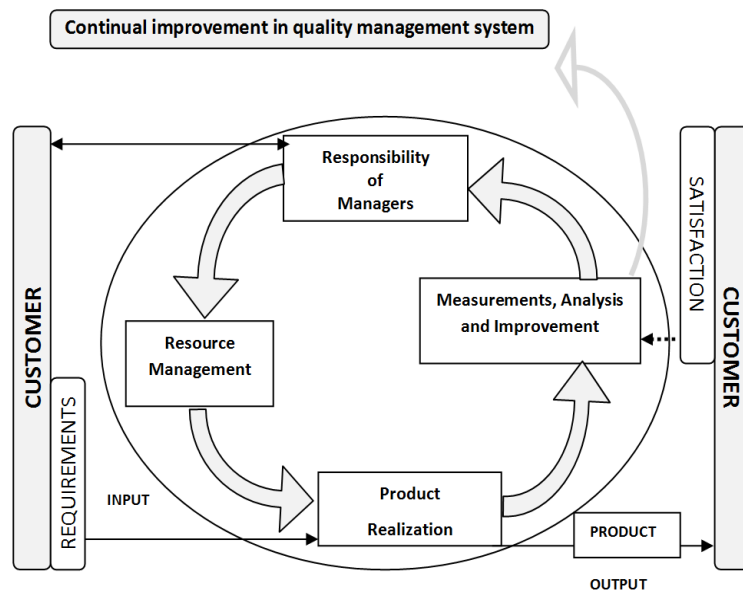


Figure 1. Model of process-oriented quality management system (International Organisation for Standardization, 2015)

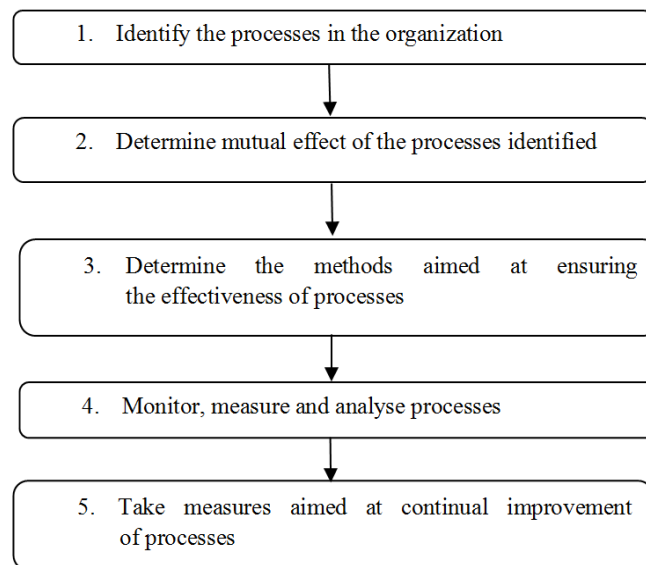


Figure 2. Implementation of quality management system based on the process (International Organisation for Standardization, 2015)

Focus on improving quality of individual processes leads eventually to high quality of final products. Analysis of the figure that illustrates a model of quality management system leads to the conclusion that enterprises operate in correlation with their customers who play an essential role in determination of the requirements concerning equipment, supplies, human resources, resources of information, resources of technology with their properties, costs and times of delivery. All processes that occur in enterprises are oriented at customer satisfaction (Bednar and Modrak, 2014). If not for customers, there would be no need for manufacturing or providing services. At the beginning of the activities connected with providing services, the priority should be customer requirements, completed with customer satisfaction. Feedback that provides information about meeting the customer requirements by the enterprises is very important. There is a group of mutually related processes inside enterprises which are aimed at meeting customer requirements. The substantial role in this model is played by monitoring of customer satisfaction, evaluation of information concerning relationships between perception and expectations. This assessment is materialized through effects: outcomes in the form of properties and characteristics of the product offered but also through less noticeable effects, such as e.g. increased confidence in the enterprise that offers these products in the market. In general, processes in construction enterprises can be divided into basic processes, auxiliary processes and management-related processes (Grajewski, 2012). Basic processes are those which directly form value added and are directly related with customers (Nowicka-Skowron, 2001). In the construction sector, these processes are related with design, preparation and completion of projects (Nowakowska-Grunt and Wiśniewska-Sałek, 2014). Auxiliary processes are directly related to customers. They include purchasing, storage, inspections and maintenance. These processes are "hidden" for the external customers. The aim of processes connected with management is coordination, control over auxiliary and basic processes and monitoring of their effectiveness.

Identification of factors influencing the quality of the construction process

The paper attempts to identify these factors of the construction sector which most noticeably fail to meet the expectations of customers in construction enterprises. Table 1 present the most frequent causes of dissatisfaction among customers of construction enterprises which were collected based on a questionnaire survey. The data were used to prepare Pareto-Lorenz diagram (Figure 3). Pareto – Lorenz diagram is universal instrument to analysis of quality level and hierarchy of identified nonconformities. Analysis orders data in respect of their quality and is based on assumption that 80% of lacks result from 20% of causes (Borkowski and Czajkowska, 2012).

Table 1. The Pareto – Lorenz diagram for causes of incompatibility in the construction industry

| No. | Name of reasons of incompatibility | Percentage fraction [%] | Accumulated fraction [%] |
|-----|--|-------------------------|--------------------------|
| R1 | Improper build quality | 33.11 | 33.11 |
| R2 | Irregularities in the construction project | 24.90 | 58.01 |
| R3 | Poor quality of material | 18.87 | 76.88 |
| R4 | The timeliness | 15.12 | 92.00 |
| R5 | Others | 8.00 | 100.00 |

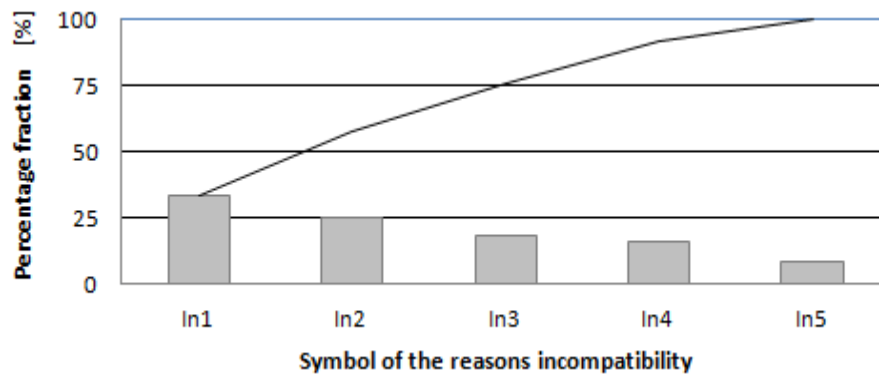


Figure 3. The structure of the causes of incompatibility in the construction industry

Pareto-Lorenz diagram shows that two causes are 58% of all irregularities. These areas are: R1- improper build quality (33.11%) and R2 - irregularities in the construction project (24.9%).

High effectiveness of construction processes is determined by high quality of measures/factors used in completion of these processes. Factors that form quality of construction processes can be classified under the four groups:

- project quality,
- quality of subjects of labour,
- quality of means of labour,
- quality of completion of processes.

Systematization of the factors that affect quality of construction services is presented in Figure 4.

Analysis of the study shows that the area which is the most frequent cause of reduction of the quality of construction services (insufficient quality of 33.11%) affects all the factors classified in the areas: project quality, quality of subjects of labour, quality of means of labour.

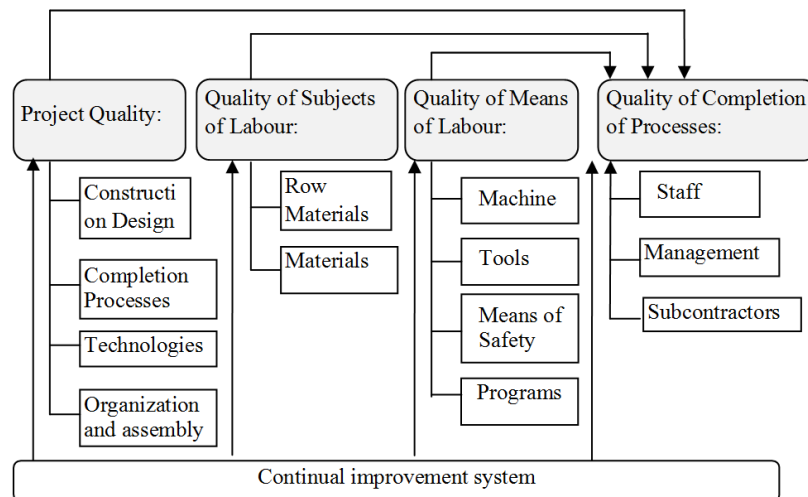


Figure 4. Correlations between the areas of quality in construction services and continual improvement. Factors that affect quality of construction services

The group of project quality includes not only construction design, but also project of completion processes, technology, logistics processes, organization and assembly. The project should also include the costs of investment projects, land lot management, deadlines, character, time, type and method of supply organization. Subjects of labour include materials and raw materials. In the case of construction services, quality of materials is of essential importance. From the standpoint of the chronological order of events and processes of construction services, material quality is the prerequisite for meeting customer requirements. It cannot be assumed that this condition is sufficient. Material with good quality can be used so that it meets its function but it can also be insufficiently used i.e. wasted. Furthermore, it is impossible that the material with poor quality can be used so that it offers maximum satisfaction.

Quality of means of labour is also important. Means of labour include machines and tools and equipment aimed at ensuring safety of construction employees. The use of improper protective equipment remains one of the major causes of accidents in construction sites. Reliable machines and equipment ensure timely and safe completion of construction works. Machines and equipment should be regularly inspected in order to minimize the risk of abnormal operation. Total Quality Management also proposes methods for this area that are aimed at improving efficiency of machines and equipment and, first and foremost, failure rate. These methods include Total Productive Maintenance (TPM).

The fourth item is completion quality, with employees and managers being responsible for this area. Neither managers nor employees are able to do anything without good projects, high quality of raw materials and materials, efficient machines and equipment. The role of a team consists in proper performance of the

tasks assigned. Humans perform their work properly if they have a feeling of satisfaction from performing the work, know what their duties are and are responsible for performing the work. More and more often, the main factor that motivates people for working is not salary but the atmosphere at work and development opportunities. The role of managers is to change the approach of the employees in their organization to the work performed. It is organization that, through training aimed at improving the knowledge about quality and improving qualifications, is able to change the mentality of their employees, who feel they are professionals who are not afraid of changes stimulated by the quality management system and its continual improvement (Borkowski, Ingaldi and Jagusiak-Kocik, 2013). Lack of supervision and exchange of information leads to chaos, stoppages during the process and causes that employees' motivation decreases. With respect to the example-comes-from-the-top principle, the role of leaders in improving quality is of utmost importance. It is managers who determine mission, policy and objectives to be accomplished by the enterprise. An action plan is also set by managers for achievement of these objectives and the appropriate resources are assigned. Managers' tasks are also to regularly verify effectiveness of enterprises and the degree of achievement of the objectives.

Application of the process approach in order to improve quality of construction services

Identification of factors that affect quality of construction services and identification of relationships between each other represent the basis for development of the process approach in construction enterprises (Sroka, 2014).

The aim of processes connected with management is coordination, control over auxiliary and basic processes and monitoring of their effectiveness. Main processes in a construction enterprise include:

- PG1- Processes connected with preparation of investments, obtaining permissions, preparation of documents and design of investments. This group includes construction design, land lot management plan, technological process design for completion of services, cost estimation for services.
- PG2 - investment completion processes which include the technology used, employees employed during completion of the project, method of inspection in the building site, methods and frequency of inspections of supplies, schedule for the project.

Auxiliary processes in a construction enterprise include:

- PP1 – Purchase Processes connected with purchasing basic and auxiliary materials, construction equipment, and organization of supplies and choice of suppliers.
- PP2- Storage Processes connected with storage of materials used for implementation of investments. Procedures concerning supplying materials to the warehouse and material release.

- PP3 – Inspections A method of inspecting completion of construction works and final acceptance of the construction works should be determined. This includes the inspections of quality of materials used for completion of investment.
- PP4 – inspections and maintenance of machines and equipment. A schedule of inspections and maintenance of machines and equipment within TPM should be determined (Tabor, 2014).
- PP5-human resource, financial and accounting services.

The third group is processes connected with management spheres (Nogalski and Lachiewicz, 2010):

- planning,
- coordination,
- management.

These processes are also invisible for the external customer, but they are very important. Processes connected with management have a direct effect on both basic and auxiliary processes. The managers affect work organization in the enterprise, attitude of the employees towards their duties and state of their knowledge. TQM principles are employed in each group of processes: basic processes, auxiliary processes and management processes. The use of the principles of continual improvement allows for stimulating quality at each stage of providing services. An important element is employees' confidence in self-improvement and improving qualifications.

Overall division of processes used in construction enterprises is presented in Figure 5.

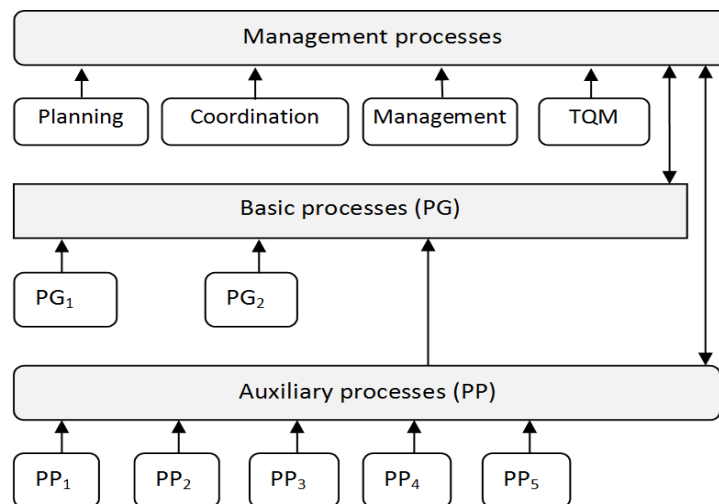


Figure 5. Overall division of processes used in construction enterprises

Conclusions

In the construction sector, any investment project is unique, and, with respect to the final effect, it can be viewed as a kind of a prototype. Due to the specific nature of this sector, repeatability of the results is hard to be achieved, especially due to high contribution of manual work. However, process repeatability can be observed, with quality of each process affecting the quality of the final outcome. Implementation of TQM requires process approach, which is the basis for complex quality management. The use of continual improvement at each stage of product or providing services represents the basis for achievement of high quality. The processes identified represent the beginning of the way to achievement of high level of quality. These processes have to be analysed in terms of the degree of completion of the manufacturing plans. The processes in the enterprise and customer satisfaction require regular monitoring, analysis and taking improvement measures in order to see how customers perceive the products or services. There are several methods to measure the degree of customer satisfaction, such as interview, survey, complaints. They help implement adequate improvement measures (correction or prevention activities). Process improvement results in cost reduction, increased quality of services and quality of labour.

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ZARZĄDZANIE CZYNNIKAMI KSZTAŁTUJĄCYMI JAKOŚĆ PROCESÓW W FIRMIE BUDOWLANEJ

Streszczenie: Budownictwo jest branżą, w której efekt końcowy zbyt rzadko odpowiada oczekiwaniom inwestora pod względem jakościowym. Stosowanie narzędzi zarządzania jakością w budownictwie jest mało popularne i nie spotyka się z entuzjazmem. Podejście takie wynika ze specyfiki działalności budowlanej charakteryzującej się brakiem powtarzalności wyników w związku, z czym stosowanie narzędzi i zasad TQM jest dużo trudniejsze niż w przedsiębiorstwach produkcyjnych. Ciągłe doskonalenie jest jedyną drogą prowadzącą do wzrostu konkurencyjności przedsiębiorstwa i zadowolenia klienta. Jedną z zasad TQM jest podejście procesowe. Głównym celem artykułu jest wskazanie i analiza procesów podstawowych, pomocniczych i obsługi w usługach budowlanych w celu

poprawy ich jakości. Przeprowadzono analizę czynników kształtujących jakość usług budowlanych w czterech obszarach: jakość projektu, jakość przedmiotów pracy, jakość środków pracy, jakość wykonania. Celem opracowania takiego modelu jest ograniczenie niezgodności w inwestycjach budowlanych. W artykule wykorzystując narzędzia zarządzania jakością zidentyfikowano czynniki, które w najwyższym stopniu obniżają jakość procesów budowlanych: niewłaściwa jakość wykonania (33,11%) oraz niezgodności związane z projektem budowlanym (24,9%).

Słowa kluczowe: TQM, podejście procesowe, budownictwo.

管理因素影響質量在建築施工企業過程的

摘要：建築是一個扇區，其中最後的效果也很少會在質量方面的投資者的期望。使用質量管理這一部門的工具仍然沒有太大的流行，並沒有很多發燒友。這種方法的結果從具體為特徵的缺乏可重複的結果，這會導致在使用的工具和全面質量管理的原則是比在生產企業困難得多建築活動。持續改進是提高企業競爭力和滿足顧客的唯一途徑。一個全面質量管理（TQM）的原則是過程方法。紙張目的是指示和在建築服務基本，輔助和服務流程的分析，以便改善這些過程的質量。工程質量，勞動主體的質量，勞動力和產品質量的手段質量；對影響施工質量的因素區等四個方面進行了分析。基於建築服務質量的決定因素的分析，過程方法的典範企業在這一領域的開發。該文件確定其中最顯著減少施工過程中質量的因素：違規在建項目（24.9%），不當的建設質量（33.11%）和。

關鍵詞：全面質量管理，過程方法，建設