

A STRUCTURED MODEL FOR THE IMPLEMENTATION OF TQM IN AGGREGATE EXTRACTION

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ABSTRACT. The Total Quality Management (TQM) approach is a management philosophy that is applied by organizations operating in various sectors of the national and global economy. The present study aims to describe the possibilities of applying key elements of TQM in the mining of aggregates. In the research process, eight elements directly related to basic processes and activities affecting the management of an organization were identified. These elements are: leadership, customer management, people management, supplier management, information management, process management, organizational learning and continuous improvement. A questionnaire survey was also conducted to assess the level of implementation of the identified TQM elements. The results of the survey show that customer management, processes and leadership are represented to a greater extent than others, and information management is the least recognized. Key practices that make up the individual elements were also successfully identified. Based on an analysis of the results, a structural framework was developed for the application of TQM in the mining of aggregates.

Key words: total quality management, people management, supplier management, business performance.

СТРУКТУРИРАН МОДЕЛ ЗА ПРИЛАГАНЕ НА ЦЯЛОСТНО УПРАВЛЕНИЕ НА КАЧЕСТВОТО ПРИ ДОБИВА НА ИНЕРТНИ МАТЕРИАЛИ

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РЕЗЮМЕ. Подходът за цялостно управление на качеството е философия за управление, която се прилага от организации, работещи в различни сектори на националната и световната икономика. Настоящото изследване има за цел да опише възможностите за прилагане на ключови елементи на цялостно управление на качеството при добива на инертни материали. В процеса на изследване бяха идентифицирани осем елемента, пряко свързани с основните процеси и дейности, засягащи управлението на една организация. Тези елементи са: ръководни умения, управление на клиенти, управление на служители, управление на доставчици, управление на информация, управление на процеси, организационно обучение и непрекъснато усъвършенстване. Проведено е и анкетно проучване за оценка на степента на прилагане на идентифицираните елементи на цялостното управление на качеството. Резултатите от проучването показват, че управлението на клиентите, на процесите и на ръководните умения са представени в по-голяма степен от останалите, а управлението на информацията е най-слабо познато. Успешно бяха идентифицирани и ключови практики, които съставляват отделните елементи. Въз основа на анализ на резултатите беше разработена структурна рамка за прилагане на цялостното управление на качеството при добива на инертни материали.

Key words: цялостно управление на качеството, управление на служители, управление на доставчици, бизнес резултати.

Introduction

Research on the applicability of the Total Quality Management (TQM) approach can be summarised in several key areas. The first of them is described by authors who observe the application of the principles and elements of TQM in the processes implemented by organisations in various sectors of the economy. (Delgado-Hernandez and Aspinwall, 2008; Koh and Low, 2008) A second area of focus involves the development of a practice model to support the implementation of TQM in an industrial organisation. (Low and Teo, 2004; Elghamrawy and Shibayama, 2008) The next area of increased interest is related to the problems and barriers in the implementation of TQM, which are mainly associated with the presence of administrative and organisational inconsistencies and characteristics. (McIntyre and Kirschenman, 2000; Abdul-Aziz 2002; Low and Teo 2004).

The application of the principles underlying TQM in the sector in question is largely determined by strong competitive relations, unscrupulous management behaviour, and unclear supply chains. The presence of these challenges in the past few years has significantly hindered the possibility of a smooth implementation of the principles and their binding to the accepted organisational culture and behaviour in the market. The TQM approach itself is primarily perceived as a leading

philosophy for managing processes and activities, the orientation of which is to create and use an appropriate model to improve the organisation's competitiveness in a dynamic market environment.

The present study is part of a wider-scope exploration that aims to investigate the relationships between competitiveness improvement, organisational culture, and the principles underlying TQM in aggregates mining. The data thus presented should contribute to the development of opportunities for practical implementation of the approach in a dynamically developing and highly competitive sector of the national economy. Possibilities for future development are related to the creation of a conceptual framework for the application of the total quality management approach, which will improve the applied behavioural and methodological aspects related to known management practices.

Key elements of the TQM approach

Based on a literature survey on the philosophies, principles, and approaches of various researchers in the field of quality management systems, the authors define six main elements related to the implementation of TQM. These elements are: leadership skills, customer satisfaction, people management,

supplier relationships, process management, and continuous improvement.

Part of the commonly defined goals of the TQM philosophy is to establish quality improvement practices as a clear organisational priority leading to increased organisational effectiveness (Spencer, 1994). The process of ensuring high quality and continuous process improvement begins with the presence of commitment from the top management, as its responsibility is key in creating a competitive organisational infrastructure. The role of senior management is mainly manifested in the presence of leadership skills, commitment, and personal involvement in the implementation of TQM principles. Top management creates values, motivation, and attainable quality-related goals. At the operational level, leadership engagement often involves analysing quality performance and accountability for continuous improvement team leaders. Other responsibilities involve planning updates in goals, emphasising the importance of quality over costs and accepted production schedules, economically providing resources to achieve high quality, and effectively communicating the organisation's intentions when using TQM principles. (Chase, 1993; Delgado-Hernandez and Aspinwall, 2005).

Having a clear focus on customer needs and wishes is a clear sign of an organisation that has adopted TQM as a guiding management philosophy. This focus is often expressed through the production of goods and services that fully satisfy customer requirements. In the mining of aggregates, this is associated with meeting the requirements of the accepted projects in terms of technical specification and customer satisfaction expressed through repeat orders. In addition to this, it also includes maintaining a close relationship with the customer and seeing this approach as key in quality management activities and developing future strategic alliances. At the operational level, TQM envisages the promotion of cooperative working relationships between all participants in the formation of collaborative teams. This implies an emphasis on building future fruitful relations, rather than the formal implementation of agreed clauses between the parties. Customer focus is also associated with good communication and feedback processes regarding possible discrepancies and customer satisfaction. Subsequently, this information can be effectively used for both internal and external benchmarking. Aggregate mining initiatives include delighting our client's customers by establishing proper relationships with end users/users in subsequent phases after mining, and offering differentiated services or solutions for a given client's projects.

The people management element involves building cooperation between managers and other employees, as well as between customers and suppliers. This element is associated with the presence of a systemic approach in an organisation and is based on benefits that can potentially be derived through a clear partnership between different parties. (Dean and Bowen, 1994). People management often involves the participation of employees in quality management processes and decisions related to the improvement of the achieved results and updating of the set goals. This enables the use of cross-functional teams to implement innovations and other technology solutions, as well as to provide feedback on their overall performance. Recruiting and selecting employees based on their ability to work in a team and problem solving skills is another key skill. This is extremely important because TQM is successfully implemented in the presence of a team working

environment and commitment of people to the accepted quality management plan in the organisation. In addition, emphasis is placed on empowering people, encouraging them to improve their work and correct any problems related to the quality and use of the resources provided to them.

The key importance of supplier relationship management activities stems from the fact that organisations compete with each other primarily through the allocation of resources in a supply chain. The presence of mutually beneficial relations between suppliers in a chain is often associated with the presence of the so-called cooperative interdependence (Anderson et al., 1994). These relationships between suppliers are particularly pronounced in the mining of aggregates, where there are a number of subcontractors who participate with different types of arrangements in the execution of a given order. The quality of the final product (facility) is directly dependent on the quality of the resources and activities provided by related suppliers and related market entities. Supplier relationship management involves creating mutually beneficial partnerships that involve evaluating criteria, such as quality, quantity, price, and delivery time. The sector in question relies on a limited number of suppliers or sub-contractors due to the nature of work, which necessitates the development of long-term relationships, mutually beneficial contracts, and a cooperative attitude.

A characteristic feature of process management in the considered sector is the possibility to perceive them as a set of horizontal interconnected operations. The quality of semi-finished or intermediate products/services and that of the finished product/facility depends to a large extent on the processes by which the required resources are processed. Since the presence of an uncontrolled small deviation in the performed processes often causes a large-scale quality problem, it is essential to analyse and control the critical success factors of the activities. Process management involves the application of a process approach that requires quality control measures and continuous monitoring of critical processes. The implementation of internal inspections on accepted projects and their implementation, safety measures, conformity assessment, and the like, are essential to ensure the quality and efficiency of the processes.

The last element considered is associated with the presence of continuous improvements and often includes commitment to constantly research and analyse technological and administrative processes and apply better methods for their implementation. By improving these processes and activities, the organisation is able to successfully meet the growing expectations of customers over time. Continuous improvements aim to improve the reliability and control of the entire production system. The element itself emphasises active learning so that the organisation has the opportunity to continue to develop new knowledge, skills, and abilities. Successful implementation of given improvements requires strong leadership and an appropriate organisational infrastructure. This involves using a distinct technology system that helps identify and study key processes leading to improvements. Also, an effective process control mechanism, progress assessment, ability to analyse cost data, measure overall performance and benchmark.

Research design and data collection

When designing the research, a sample of participants was selected in different departments and with different functions in

the implementation of production and administrative activities. The purpose of the research was to study and analyse good practices related to quality management in the extraction of aggregates. In order to achieve a greater representativeness of the sample in the study, people related to the top management participated as well, since they play a key role in the implementation of the principles related to TQM. Second, the inclusion of people from middle to lower management level provided an opportunity to successfully explore the diffusion of these principles, leading to the formation of an organisational culture leading to continuous improvement.

Based on the frameworks for conducting the study, 25 participants were identified who personally participated in collecting the necessary data. Target respondents included senior management and quality managers who were leaders in implementing quality management systems. In addition, the organisation had all the necessary certificates and standards that were necessary to carry out the activity and include certain elements of TQM.

The created questionnaire consisted of two main parts. The first contained general information about the respondent's position and functions, and the second assessed the extent of TQM implementation. The questions aimed to obtain information on the degree of application of each of the TQM principles, using information from other similar empirical studies (Claver et al., 2002; Kululanga et al., 2002; Low and Tan, 2002). Some of the management systems through total quality were relevant to the sector under consideration and were substantiated by conducting a literature survey. As the literature data presented were largely developed for a real material product production environment, changes were made to reflect the specificities of aggregates extraction. Each item in the questionnaire described an activity that required the respondent to rate the level of current implementation of TQM in terms of "degree of implementation" on a scale of 1 to 5 similar to that proposed by Likert. '1' was 'weakly implemented' and '5' is 'highly implemented'. The time of data collection was from October 2023 until December 2023, with answers from all 25 participants provided.

The summary characteristics of the respondents showed that 31% were senior managers, 40% were project managers, quality managers, etc., and the remaining 29% were employees in various areas of the organisation. For the scope of activities, all employees were involved in more than one process or activity, with more than two-thirds involved in projects related to the main activity and the over half in ancillary activities. As for the certificates, in the short term the organisation acquired the necessary documents to carry out blasting and drilling activities, which suggested that it had a relatively short experience with TQM-like quality management systems.

After statistical processing of the data, the level of TQM implementation ranged from 3.05 to 3.76. The items related to customer satisfaction (3.60) and process management (3.76) and to some extent leadership skills (3.50) apply to a moderate to high degree as fourth degree performance. The management of processes in the organisation is evaluated with the highest degree of implementation, which is in line with the traditionally applied management models adopted by the top management.

The second highest mean score of 3.60 for customer satisfaction should be interpreted as an increasing recognition of a stronger perception of customers as participants in the design and engineering processes. This was due to consistent actions to integrate different stakeholders into separate

processes as mutually beneficial partners in order to improve the overall performance. In addition, the results showed a growing awareness of the opportunities to achieve competitive advantages, for both contractors and clients, from such close cooperation. In this regard, the element related to customer satisfaction (relationships with suppliers, people management and continuous improvement, can be used as a catalyst for the organisation to be more open to different partner initiatives by being involved in a project. That is why TQM as a successful management approach should be seen as a strong motivator for inter-organisational partnership in a supply chain.

The third highest mean score of 3.50, related to the element of leadership skills, was a key indicator, as the leadership and commitment of top management is perceived as a prerequisite for the successful implementation of TQM. The result showed that the people in the organisation recognise to a certain extent the efforts of top management as leaders in implementing principles related to TQM.

Tools for the implementation of the elements related to TQM

Leadership skills

Tool 1: Build a comprehensive communication strategy and develop a quality improvement policy and detailed plan. This, in turn, includes the successful implementation of clear policies and objectives related to quality assurance. Senior management, heads of departments and projects possess leadership qualities, actively participate in business process improvement activities, and support people in making decisions about TQM principles.

Tool 2: Construct and disseminate quality as a leading element in the overall organisational culture. Promoting such a culture throughout the organisation involves taking a long-term view of improvements. Implementing this understanding among senior and middle managers changes their performance, communication, and involvement in resolving quality issues. Thus, the awareness and motivation of people to actively participate in activities aimed at improving competitiveness is promoted. The main goals here are related to implementing a culture that emphasises on the involvement of people through the personal example of prominent leaders in the organisation.

Tool 3: Perceive quality as a leading objective that is prioritised over production schedules and accepted costs. The use of this tool on the way to TQM is usually associated with a change in people's mentality, which is the basis of the previous two factors (tools). Viewing quality as a key competitive advantage cascades from senior management to day-to-day operational activities. In a similar way, the processes related to the provision of adequate resources to support efforts to improve quality should be carried out.

Customer satisfaction

Tool 1: Providing opportunities to provide differentiated services to customers according to their individual requirements. Most often, this approach includes a set of services of a different nature that organisations provide to clients in the form of an alternative design or proposal for an individual work project, which leads to a reduction in the costs that the client will continue to carry out. The various services offered by the organisation also include active service of additional customer requirements to the offered quality.

Tool 2: Maintaining good and fruitful customer contacts. This factor for the implementation of the elements of TQM coincides with some of the characteristics described in the previous part. Keeping in close contact with customers means taking the time to study their current and future requirements. In addition, researching customer satisfaction and spreading the word to different people on the project team is part of the way to achieving a long-term relationship.

Tool 3: Provision of additional (indirect) services. Managing customer relationships and taking care of their requirements is often associated with holding informal meetings with people from the customer's team. Most often, these are general events, short trainings, seminars, etc. In addition, indirect service may also take the form of subcontracting services to customer partners. This is often encountered in the implementation of large infrastructure projects, where contractors frequently provide additional services to end users.

People management

Tool 1: Continuous communication and people's involvement in quality improvement processes. Communication issues include promoting awareness, providing feedback and recognition from management to those responsible for achieving quality objectives. In addition, the top management should also take the impact on the high results achieved and the people working in the departments directly involved in quality control and assurance.

Tool 2: Empowering people in the organisation. This includes ensuring that people have the opportunity to inspect their own activities and correct any possible issues in a manner that complies with accepted procedures. To achieve this, senior management must provide the resources that are necessary to adequately address problems. Another way to assess people's empowerment is to use cross-functional teams and encourage the participation of all team members. An additional element covered by this factor is linking human resource management with quality improvement plans. Oftentimes, the responsibility for good people performance is directly linked to a commitment from senior management to provide the appropriate empowerment.

Tool 3: Recruit and select people based on their ability to solve problems. In addition to adequate solutions to problem situations, the selection of employees is also based on his ability to work effectively in a team. The importance of teamwork in aggregates mining is key and is reflected not only in selection based on teamwork ability, but also in motivating people to achieve outstanding performance.

Supplier relationships

Tool 1: Mutually beneficial and long-term relationships with suppliers/subcontractors. This factor mainly covers three problem areas related to TQM. In terms of mutually beneficial relationships, close cooperation is manifested in the involvement of suppliers/subcontractors in the development of mining processes/projects, provision of technical assistance, and clear specifications of delivered products/services. The second issue concerns securing long-term working relationships with suppliers/subcontractors. This element is often applied in practice, especially when several contractors have adopted a strategic partnership with their suppliers/subcontractors to secure future contracts. The third emphasis here is associated with supplier/subcontractor evaluation, which is expressed in strict compliance with accepted quality standards based on a

pre-agreed evaluation system. In general, it is possible to apply circumstantial issues when deciding on a network partnership with a particular customer, but in strict compliance with the adopted policy for continuous improvements of operational processes and activities.

Tool 2: Trusted relationships with a relatively small number of suppliers/subcontractors. Although having a small number of trusted suppliers is a key element in this factor, managers agree that it is key. In practice, the second factor is applied more often; it is associated with an assessment of relations regarding quality, quantity, price, and delivery time. In addition, the collected data show that the assessment also includes the presence of financial stability. In the sector, selection of suppliers/subcontractors based on quality (not price or time) is not often practiced. Similar observations in the sector suggest that contractors rely on fewer suppliers/subcontractors, and their choice still depends significantly on a number of criteria other than quality.

Process management

Tool 1: Continuous quality control of the processes related to the extraction of aggregates. In the first place is the presence of the traditional inspection and verification of the mining processes, both at the intermediate and at the final stages when the mined resources are handed over. This check will lead to the prevention of accidents or incidents in the subsequent operational processes. The second emphasis here is related to the adoption of measures to assess the quality of mining processes. This includes developing a detailed schedule with an emphasis on quality and maintaining safety measures to minimise disruptions to the production processes.

Tool 2: Accepting and providing clear instructions for the processes being carried out. Accurate and comprehensible instructions should be the embodiment of a well-structured and comprehensible directive for methods used, work designs, and inspection and control plan. A working sample is often used here to enforce the requirements of the standards and to demonstrate good manufacturing practices. Directly related to this factor is having a design for safe mining processes so that human error is minimised.

Continuous improvements

Tool 1: Implement models for evaluation and process improvements. Adopting adequate models for process evaluation and improvement leads to future analysis of mining activities in terms of both costs and overall efficiency. Improvement efforts are then formulated based on the expert judgments received. However, while the analysis of performance and cost data is relatively common, other measures are underrepresented in the sector. An additional practice that falls under this factor of moderate importance is the use of a specific organisational structure (e.g., cross-functional teams) to support quality improvement activities.

Tool 2: Conduct external benchmarking. This type of benchmarking involves promoting quality improvement efforts against teams external to the organisation that are direct and/or indirect competitors. Supporting quality improvement with the help of an external team often involves collaboration with resource suppliers/subcontractors. This includes models for improvements compared to direct competitors and their successful practices, often adopted by other contractors. Despite their key importance, these practices are still poorly or moderately applied in the sector under consideration, one of the

reasons being the lack of understanding those and their impact on an organisation's competitiveness.

TQM implementation model

Based on a literature review and a practical study, the components of an exemplary model for implementing TQM principles in the mining of aggregates were determined. The key prerequisites for effective quality management in a production system are associated with the presence of commitment and leadership skills. Senior management should demonstrate a responsible attitude in defining and communicating the vision, mission, and goals aimed at cooperation with all stakeholders. Appropriately directed, these leadership efforts create a good organisational system for effective process management and continuous improvement.

The created organisational-management system consists of elements, such as managing relationships with customers, people, suppliers and the quality of the products or services offered. The system itself binds internal and external cooperation and cooperation in a common network of communication channels. Internal collaboration is manifested in elements related to people management with an emphasis on involvement and empowerment. External collaboration involves engagement with both customers and suppliers, where good partnerships and alliances are implemented in practice, regardless of formal legal independence and cultural or behavioral barriers that exist among project participants. These elements not only embody TQM as a management system, but are also a powerful catalyst for improving overall performance.

The main production processes in the extraction of aggregates include quality management activities (including assurance and control) and those related to the management of specific individual projects. Therefore, process management focuses on key productions so that they are carried out according to plan or within accepted deviations, despite changes in people, materials and the environment. This is how the management of technological processes inevitably includes motivational aspects oriented towards people, which should lead to an efficient and effective production system.

The implementation of an effective continuous improvement system covers both human resources and the technological solutions used. Active learning is a critical element of TQM and represents the essence of all improvement initiatives and implementation of innovation solutions. The strong relevance of learning lies in the fact that this is how people at all levels continuously increase their knowledge in order to improve their performance, thereby increasing the competitiveness of the organization as a team. The practical application of learning outcomes, i.e. knowledge, leads to continuous improvement. The acquired knowledge is implemented in processes where incremental changes are planned, checked, monitored, and applied appropriately to improve a specific quality indicator.

Targeted and consistent application of TQM principles leads to high efficiency and quality, which in turn generates satisfaction among customers. Achieving high quality should be considered at two levels: organisational and project. Organisational quality encompasses the results of implementing corporate strategies that are manifested in the formulation of production operations, while project quality includes the effective delivery of products and services related to an individual work project. Generating good feedback provides information about the performance of the system and the

relationship between the individual elements in it, which continues in the next cycle of production and improvement.

Conclusion

The fundamental meaning of TQM should be seen as a philosophy consisting of principles and approaches that can be united in an integrated quality management system. In the course of the research, eight elements have been identified that are paramount to implementing TQM in the mining of aggregates. The research data show that the implementation of the items fluctuates around the average level of the accepted rating scale. However, a careful analysis of the data shows that the elements are implemented with varying degrees of penetration at the mid-level vis-à-vis customers, processes, and senior management. The elements related to suppliers are in a stronger degree of implementation, while those focused on people and continuous improvement are represented to a lower degree.

From a research perspective, a set of practical observations and data analysis have enabled us to identify a small number of key elements of TQM that lead to improved competitiveness in the researched sector. The elements mentioned represent basic principles that organisations can use to begin implementing TQM in aggregates mining. These elements are: leadership, organisational structure, process management, and quality and improvement management. Adopting the mentioned key techniques and embedding them in a conceptual framework for practical application should provide an organisation with the opportunity to gain new competitive advantages.

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