TOTAL QUALITY MANAGEMENT (TQM) IMPLEMENTATION CHALLENGES AND BENEFITS AT USV BREWING MICROPRODUCTION WORKSHOP

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Abstract

Beer is traditionally made with four primary ingredients: a starch source (commonly malted barley), yeast, hops, and water, resulting in a complex beverage containing over 3000 different constituents such as carbohydrates, proteins, ions, microbes, organic acids, and polyphenols. Beer gets much more complex during storage because chemical changes can occur that impact the flavor, fragrance, and appearance. As a result, maintaining the quality of beer throughout its lifespan is a difficult undertaking. The technique used in this work is based on a review of quality management tools and best practices in the brewing sector. This study seeks to synthesize the many ingredients and components of beer, address how ingredients affect the completed product, and describe some of the analytical methods used in Brewing Station to regulate quality and understand the development of chemicals in beer during the brewing process. Recommendations include ensuring that USV Brewing Microproduction Station staff members participate fully, as well as teaching all employees about TQM best practices implementation and involving everyone in TQM implementation.

Key words: quality management systems, beer production, HACCP, standards

Introduction. The brewing sector market in Romania is one of the fastest expanding industries, owing to changes in customer tastes forever weaker alcohols. The health of the brewing industry is critical for job generation and economic prosperity. Between 2008 and 2014, the volume of beer drunk in Romania decreased. As a result, just 14.9 million hectoliters of beer were consumed in 2014. However, by 2022, consumption had risen to 15.8 million hectoliters (FAO, 2023).

The businesses that are most effective in the sector are those that can balance productivity and quality while maintaining market share by addressing the needs of consumers.

Total quality management is defined as a management concept used to improve the operations of organizations and enterprises that is based on meticulous study of those processes by each individual involved in the process, whether an employee or a partner (Teryima S.J. *et al*, 2016).

Consumers are more aware of the diversity of items on the market, and they are the focus of manufacturing, therefore every company must study what customers need and fulfill them in order to stay in business by offering products of desired quality (Nash M.A., 2014).

According to the literature, customers determine the quality of goods; customers become a significant aspect that can cause competition among organizations, causing enterprises to focus more on quality in order to maintain their competitive advantage. This is because effective quality impacts the rate of productivity, making it a key factor in organizations and contributing to economic progress (Gharakhani D. *et al*, 2013).

The goal of this paper is to describe the fundamental concepts of quality management in the brewing industry by describing the brewing technology at the USV Microproduction Station, methods and tools for implementing quality management in the brewing industry, and some good practices at the USV Microproduction Station to ensure total quality management compliance.

MATERIAL AND METHOD

The data for this study came from a transversal review of the literature on the implementation of TQM in the beer industry and also the legislation in force regarding the production of beer.

RESULTS AND DISCUSSIONS

Water is the most crucial element in the

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brewing process, accounting for around 90% of the volume of a beer. Many factors influence water quality, including pH, alkalinity, ion and microbial content, and the presence of disinfection byproducts. Certain beers rely on water from specific places to produce their distinct flavor (Bokulich N.A. *et al*, 2012).

The brewing process begins with mashing barley malt in warm water to generate wort, a clear, sweet, brown liquid. The carbohydrates in the wort are required for fermentation. The wort is heated to a boil, and hops are added to give the beer its bitter flavor and aroma. Important bittering compounds such as a- and b-acids are removed from the hops during the boiling process. The hops contain a diverse variety of terpenes, which offer citric, herbal, spicy, flowery, and fruity scents to the beer. The yeast is then introduced to eat the carbohydrates in the wort and produce carbon dioxide, ethanol, and volatile phenolic chemicals, which may cause "phenolic off-flavors" in the beer (Procopio S. *et al*, 2011). The yeast is removed after a few days to several weeks of fermentation, and the beer is aged to acquire more taste before being filtered and bottled (Kenechukwu A., 2018; Veleșcu I. *et al*, 2022).

Total Quality Management can be thought of as a cycle; first and first, customer needs must be identified and met. Their needs are essentially what they say they are, not necessarily what the organization would like them to be; therefore, the brewing organization should strive to supply exactly what their consumers want, delivering the correct services at the right time (Vrellas C.G., Tsiotras G.D., 2015). In order to meet these objectives, the brewing company should strive to increase the quality of its operations in terms of people, systems, and technology, as well as overall performance. People can be improved for a little cost, but they must be recognized and treated as a valuable resource. Total Quality Management should so begin with the strategic leader, who must stress a commitment to it, then permeate across the brewing company (Alfnes E. *et al*, 2008).

Lean Manufacturing - Because lean principles were established in the automotive sector for repeated automobile manufacture, they apply to repetitive jobs in production lines, including brewing industry. According to Kobayashi I. (1990), the lean vision of business excellence is "the entire factory has become a single production line with zero internal storage. The facility employs quick transition technologies and follows a fully mixed production schedule, giving it complete flexibility" (Boeing L. *et al*, 2008).

This notion of operational excellence as a single production line capable of producing a diverse range of products is certainly more appropriate for batches or production lines. Lean manufacturing necessitates standardized labor with minimal variation and is best suited to standardized products with minor modifications as well as markets with generally consistent demand. Authors such as Schonberger R.J. (1996) and Godson R.E. (2002) created the lean production assessment system, which has been considered as the best model of operational excellence for the beer sector and meets the following criteria:

• the production process takes place in production lines;
• batch production;
• mixed products (several types of beer);
• standardized – automated work;
• relatively stable demand.

Another operational excellence concept that can be utilized in the USV Microproduction station is the *Six Sigma* problem-solving approach (*figure 1*).

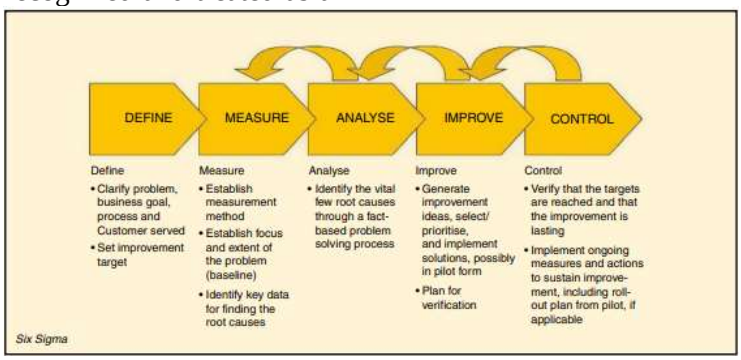

Figure 1 **DMAIC methodology** (Vrellas C.G., Tsiotras G.D., 2015)

Six sigma seeks to improve the quality of any process by detecting and eliminating the sources of defects and minimizing production variations. It employs a collection of quality management methods, including statistical methodologies, and builds a unique human infrastructure within the firm. Each six sigma strategy is carried out in a certain number of steps and includes quantifiable financial goals (cost reduction or profit growth). As shown in figure 1,

Six Sigma use the Define – Measure – Analyze – Improve - Control methodology (DMAIC) in conjunction with a variety of statistics, behavioral, and administrative methodologies to improve business procedures (Kristiansen G.A., 2010).

The *operations excellence audit sheet* is a generic and neutral business excellence assessment instrument for all forms of production. The audit sheet, on the other hand, is based on tools developed in the context of lean manufacturing. These instruments are synonymous with business excellence and straightforward execution.

Several tools for evaluating unit productivity have been developed over time. As a result, the research of Kobayashi I. (1990), who used the traditional Japanese model for production site planning, but also Schonberger R.J. (1996), whose research was extended to a broader range of activities, such as attracting customers, benchmarking, but also to have an employee perception. In 2002, Godson R.E. developed the Rapid Factory Assessment (RPA), an individualized assessment technique based on a short factory tour. This strategy focuses on visual data and readily available fundamental information, with the goal of managers analyzing manufacturing performance (Alaercio N.J., de Oliveira M.C., 2019).

Table 1 shows the audit sheet control with areas of excellence developed by specialized authors, which can be used within the USV Microsproduction Station (Vrellas C.G., Tsiotras G.D., 2015; Ayandele I.A., Akpan A.P., 2015).

Table 1

The audit sheet

Ctr. no	Measure	Ratings						Score
		Poor	Below average	Average	Above average	Excellent	Best in class	
		1	2	3	4	5	6	
1	Leading technology							
2	Safely, environment, cleanliness							
3	Layout, product flow, space, material movement							
4	Teamwork, skill level, and motivation							
5	Equipment and tooling state and maintenance							
6	Customer satisfaction							
7	Commonality of work and component							
8	Quality system deployment							
	Total							

Only after the installation of the *Key Performance Indicators* (KPI) system did continuous quality improvement become applicable in terms of process and product quality management and monitoring. A set of performance measurements that reflect how successfully an organization is achieving its primary objectives is known as key performance indicators. KPIs not only provide chances for strategic and operational improvement, but also a means of comparing results with similar firms. To be effective, the KPI must be well defined and quantifiable; communicated throughout the organization and department; critical to achieving the intended goal; and relevant to the line of business (Khalil A. *et al*, 2023).

Continuous product quality improvement is achievable since there are always things that might be improved, particularly due to the technical, technological, and cognitive performances attained. The traceability and analysis of potential for the creation of new products and services play an essential role (Solomon M., 2021; Veleșcu I. *et al*, 2022).

Total quality, according to Jijabai R.B. *et al* (2023), means that we ensure that everything and everyone in the organization is subject to improvement. The process of improvement must be carried out on a daily basis and must be connected with other organizational improvement projects and business plans. Statistical tools aid in the quantification of variances in systems and processes. Variations might occur owing to instrument measurement ambiguity, external and internal suppliers, machine variability, manpower (experience and attitude), and environmental factors like as temperature and humidity, among other things. There are two types of variations: special cause and common cause (Maiturare M.N., 2010). These can be reduced by timely data receiving via early warning indications. The variability of process output can be minimized by

detecting problems utilizing the Pareto Analysis and studying causeandeffect relationships.

The term *Statistical Process Control* (SPC) refers to the use of statistics to monitor processes. Statistical Process Control is the application of statistical methods to processes in order to continuously enhance the quality of products and services (Maruf A.R. *et al*, 2016).

Best Practices - Breweries should concentrate on their quality policy, as well as methods for managing the quality of their brands and all standards for raw materials, packaging materials, and the final products (*figure 2*). The Quality Department ensures that the Brewery's standards, specifications, and procedures reflect quality requirements. These criteria are in place to ensure that the brewery produces, delivers, and sells safe, high-quality goods (Kumar S.R., Nandgopal P., 2018).

Activities connected to the implementation of traceability of a full product chain, from raw material origin to finished product, are a significant determinant for gaining competitive advantages. Assuring the quality and safety of food products through the implementation of codified ISO 22000 / HACCP quality management systems, as well as environmental management, is a necessity for the brewing industry's synergy of activity (Bamforth C.W., 2017).

Breweries should be certified in QMS (Quality Management System) and FSMS (Food Safety Management System) standards such as ISO 9001 and HACCP. Validation of a quality laboratory for chemical, microbiological, and taste analysis is required. Setting auditing standards and procedures, as well as educating auditors to perform these responsibilities, help to enhance supplier evaluation (Veleșcu I. *et al*, 2022).

Procedure-defined responsibilities and duties contributed to each employee's accountability for each operation performed, which allowed identification and traceability in all production phases, resulting in a reduction in complaints and product quality (Liu F. *et al*, 2021).

Brewers must establish and monitor quality metrics that are close to the customer and consumer, such as product consistency and freshness in the marketplace. Finally, the brewery should seek assistance from external specialists on food safety and quality issues in addition to relying on its own resources (Lo C.K. *et al*, 2018*;* Wicaksono T. *et al*, 2021).

Figure 2 **The Quality Priority Pyramid** (Brewers Association)

Quality management in the brewing business includes improving operations both inside and outside the brewery. It is most appropriate to conduct technical audits at regular intervals for the assessment of a brewery in order to discover the right instrument that can cover most of the areas in a brewery. The audit report must categorize operations in order to discover current issues that can be resolved. The main aspect that will offer the basic conditions for improvement in a brewery is the operations plan (Dihardjo D., Ellitan L., 2021).

The most successful breweries are those that manage to balance production and consistency of quality while still maintaining market share by addressing consumer needs (Ciama F.C., 2021). The use of overall quality management in brewing industry provides numerous benefits and advantages to the organization, including:

Improved productivity: By implementing Total Quality Management employees' time spent discovering and fixing faults is decreased dramatically, while performance and productivity improve (Ngwenya B. *et al*, 2016).

Reducing errors: Total Quality Management, in essence, seeks to improve quality in operations rather than checking quality, which not only reduces error repair time but also the requirement to recruit a specialized quality assurance team.

Customer satisfaction: Adopting total quality management in management work will result in better services and products, and interaction between unit and customers will be

error-free at a significant rate (Mambanda J. *et al*, 2017).

Brewing industry seek to increase the quality of their operations in order to attain greater profitability and deliver better services. However, accordind literature (Lewis G. *et al*, 2014; Sandner K. *et al*, 2020), various difficulties are encountered when applying quality management, such as:

Authoritarian leadership style: When management employs an authoritarian leadership style, it can instill fear in employees, causing them to underperform at work, reducing productivity and ultimately decreasing quality.

Incompatibility of organizational structure: Because differences in the distribution of individuals and departments can cause implementation issues, the company's restructuring should be considered in order to better fit the needs of customers, with the possibility of expelling any individual who still needs to adopt the company modern philosophy.

Unsustainable improvement: Many organizations may be tempted to relax and stop after reaching their objectives. To keep up with future advances, they must constantly enhance their products, processes, and services.

Limitations of quality culture: Because companies lack a genuine quality culture, the possibility of the change-proof team rejecting the new policy could interfere with the application mechanism due to their unwillingness to accept new techniques that differ from their current working style.

Workers' lack of commitment: Because production processes are inextricably related to personnel, their lack of dedication renders the entire quality management process ineffective.

Inappropriate communication channels: In order to achieve satisfactory results for the plans, all data and information must be communicated to the company in a timely and accurate manner; therefore, the presence of inappropriate or inaccurate communication channels will act as a barrier to achieving the required quality results.

Lack of understanding of customers' needs: Many factors influence the failure to understand customer needs, such as miscanning, inaccurate data, misinterpretation, and many others, as a result of which customers produce unwanted products and thus fail to achieve the primary goal of companies, which is to satisfy the customer.

Management's lack of commitment: To achieve proper implementation, everyone must be clearly and openly informed of the purpose of change, and all general ideas of quality must be simplified while continuing to apply the principles of comprehensive quality management.

Improper planning: Everyone on the company's team should be involved in generating quality management implementation plans and recommending any changes that would improve the programs. Two-way communication of ideas is crucial and should be considered.

Lack of continuous training and education: To make learning and training more effective, senior management of companies must train their employees in quality management techniques and implement overall quality, beginning with identifying the needs that the company needs and then making plans to achieve them. Furthermore, a lack of training might be centered on abilities for quality improvement, communication tactics, conversations, and problem identification.

CONCLUSIONS

The presence of several classes of chemicals, some of which are derived from raw ingredients and others from interactions and reactions during the brewing process, contributes to beer's complex composition. These ingredients can affect the flavor, foaming ability, and safety of the beverage in a variety of ways. Understanding common analytical processes for beer and component analysis can thus assist USV Microproduction Station in making higher-quality brews.

Total quality management (TQM) is a management style that focuses on quality, is based on the participation of all members, and aims for long-term success. This is accomplished through customer satisfaction and advantages to all organization members and society as a whole.

Determining the safety and quality of food in company management processes in the food sector is a precondition for executing firm manufacturing operations. The article's selected determinants of safety and quality management on the example of USV Brewing Micro production Workshop show that normative EU and international requirements for quality and safety in food production are met, and management creates the possibility of distribution channels with access to national networks.

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