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ORIGINAL PAPER

PROPOSAL OF QUALITY MANAGEMENT AND TECHNOLOGY MODEL SUPPORTS A SUBSYSTEM OF MANUFACTURING LOGISTICS

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ABSTRACT. **Background:** It is assumed that the future of quality management systems and Logistics is a technology and in particular its level of innovation and the ability to decrease the negative effects related to its improvement. Unquestionably attempt to integrate quality management and technology in the logistics subsystems requires a systemic approach to this issue. Therefore, the aim of the publication is to develop a model of quality management and logistics technology supporting production

Methods: Assumptions presented in the publication were developed during the four-month of author's scientific internship in one of the largest foundries pressures in Poland. During the internship, analyzed the functioning of the main logistics processes, and documentation of integrated quality management system. In addition, conducted a number of direct interviews with employees and management representatives.

Results: The result of the work was to develop a comprehensive model of quality management and technology addressed to large manufacturing companies. The model is general in nature, therefore it is possible to implement it in a variety of manufacturing companies.

Conclusions: Development and implementation of effective and efficient quality management system and technology to support the logistics of the production is a task extremely compiled and time-consuming. First of all, it requires the development of a generally accepted vision of the key processes in the organization focused on customers. In addition, it is worth paying attention to the costs associated with implementation and maintenance of standardized quality management systems and the development of technology, which may be too high especially for smaller organizations taking part in the supply chain. Of course, the implementation of the system is not only costs but also significant profits, manifested in minimizing the number of errors and inconsistencies, reducing the costs associated with quality control and poor quality sourced components in the growth of customer satisfaction and the level of competitiveness of the whole supply chain.

Key words: quality, technology, manufacturing logistics.

INTRODUCTION

The main goal of modern enterprises is to achieve a success in the market. This requires a broader organization, optimization, and continuous improvement of business processes. Orientation logistics in organizations has taken a different look at the processes [Zimon 2015a]. Therefore, the logistics processes should be supported with modern management concepts because quality management, technology and logistics management areas are aimed at achieving common goals. Develop a systematic approach to the management of these areas seems to be so very important in the context of business development, customer requirements are met and gain a competitive advantage [Titov et al. 2016]. A growing number of authors seem to recognize this. According to Richeya et al. [2012], Malindžáka [2012] and Li [2012]

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quality management systems should take into account and adapt modern technologies leading to increased effectiveness and development of the company. With this view also agrees Łunarski [2012] recognizing that over the last several years there have been a number of effective quality management concepts that improve both logistics activities and production. This view is also confirmed by research conducted by Hafeez et al. [2006] which shows that organizations putting considerable emphasis on the development of technology are more efficient in the management of logistics and creating the optimal level of quality [Vanichchinchai and Igel 2011].

It can therefore assume that the future of quality management systems and logistics is a technology, particular its level of innovation and the ability to decrease the negative effects related to its improvement. Unquestionably attempt to integrate quality management and technology in the logistics subsystems requires a systemic approach to this issue. System approach enforces logical analysis carried out in the company operations and obliges the practice to identify and consistently develop and use rules that must accompany this action [Fonseca and Lima 2015].

Therefore, the aim of the publication is to develop a model of quality management and logistics technology supporting production. Defining manufacturing logistics it can be assumed that it is a series of processes aimed at the full service companies in the context of supply all necessary measures in kind (materials, raw materials, semi-finished products, etc.), And improved the efficiency of material flow [Gazda et al. 2013] within production processes from warehouses input by individual production cells on the output magazines ending [Wen, Wang 2007, Chankov et al. 2016]. It is significant that the logistics of manufacturing does not deal with technological processes, focusing on the organization of effective physical movement of property and information in the manufacturing process. Having regard to the logistics of manufacturing is not engaged in the development of technology incorporation into its quality management system and technology organizations should bring significant benefits [Politis et al. 2014].

RESEARCH METHODOLOGY

The main objective of the study was to develop a model technology management in manufacturing logistics taking into account the guidelines of quality management systems. This model will be enough general and universal in nature that the guidelines will be able to implement various production companies. It should be emphasized that quality management in large enterprises making up the supply chain is extremely complex. Developed model does not simplify this process, but will order its elements and allow for more effective implementation of the objectives adopted in the entire supply chain. This model will be a combination of systems, methods and techniques of quality management in such a way that mutually complementing an impact on increasing the efficiency of logistics processes and minimizing waste. Assumptions of the model have been developed during the four-month author's research internship in one of the largest and most advanced foundry in Poland pressure, Meta-Zel. Particularly important in the context of the development of the model were suggestions and assistance so. The tutor, who was a representative of the organization's top management.

Analyzed organization is one of the largest and most advanced open pressure casting foundries in Poland. Its' products include pressure castings of aluminum and zinc for household appliance OEMs, construction industry, consumer electronics sector, power machinery engineering and automotive industry. Meta-Zel also offers services in specialist CNC machining, research and laboratory testing. With over 40 years of experience, the company has thorough casting expertise and proprietary know-how based on their own processes and patents. Years of tradition and experience allow the company to meet the requirements and exceed the expectations of its customers. Proper preparation and performance of manufacturing processes are guaranteed by design engineer

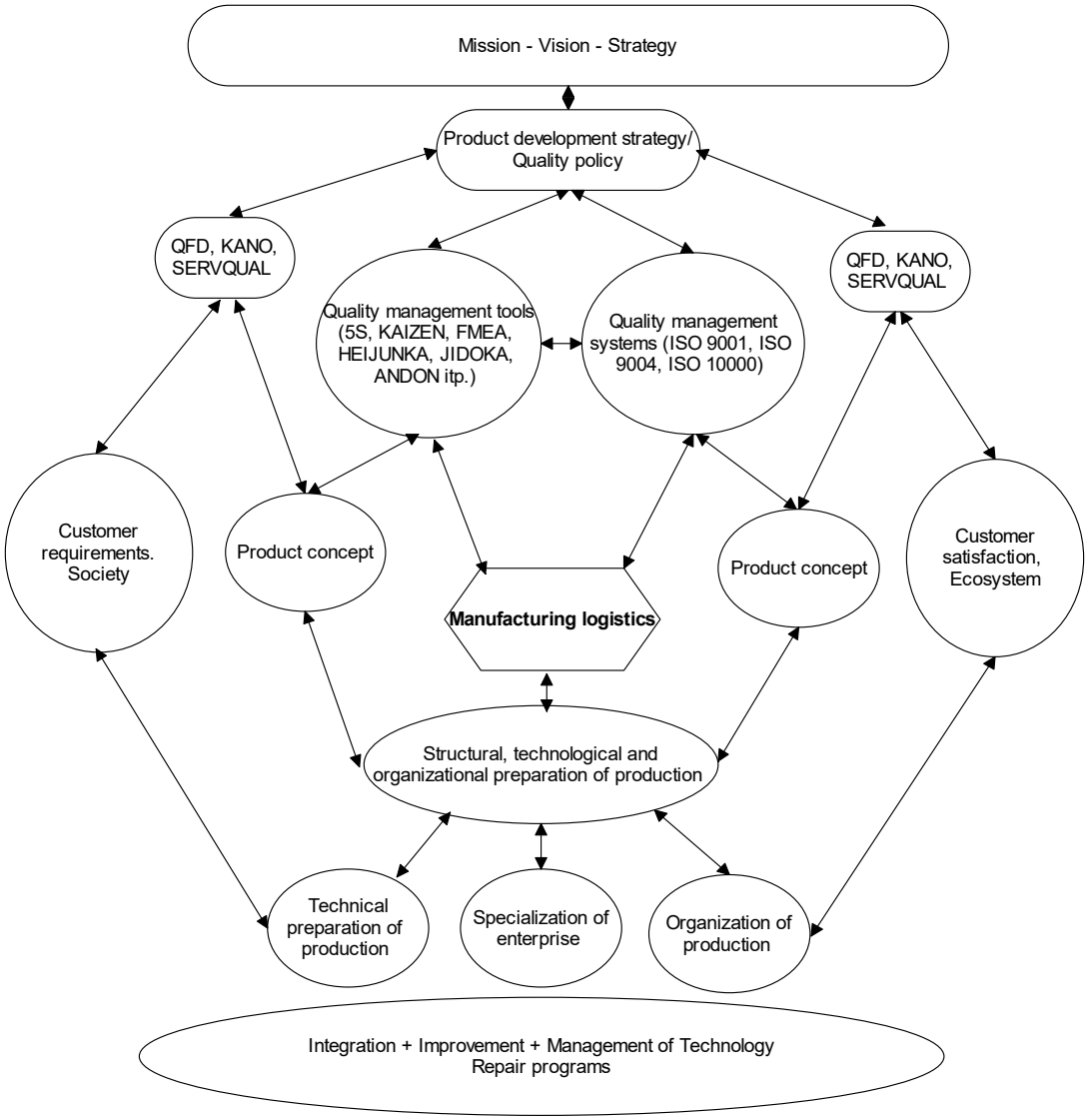
specialists, process engineers and the Quality Control Department.

In order to achieve the objectives pursued, during the internship was performed the following tasks:

- An analysis of the functioning of the different quality management systems implemented in Meta-Zel and the supply chain of the company were made,
- In detail familiarized with the ways of integration of quality management systems,
- The system procedures was analyzed and proposed improvement actions,
- The barriers and limitations of the model were determined.

PRESENTATION AND DISCUSSION OF THE MODEL

In this chapter the author will present a proposal of a model which improves the functioning of logistics processes in a subsystem of production through the integration of systems and concepts of quality management and technology (outline of the model is presented in Fig. 1). According to the authors the implementation of the proposed model will achieve synergies, which will increase the effectiveness and efficiency of the organization.



Source: own elaboration

Fig. 1. Idea and main guidelines for the model
Rys. 1. Idea i główne wytyczne modelu

The model presented is general in nature and leaves a lot of flexibility in choosing the optimal management concept considering the specificity a particular company or supply chain. While implementing the guidelines of model it's suggested to make necessary adjustments that take into account the specific nature of the organization and the industry. It is therefore recommended to supplement the model with implementation of the systems and professional use, if necessary with greater quality management instruments.

Its proper implementation should include the following principles:

- Quality management system and technology presented on the model is ancillary and should closely support the implementation of the mission and strategy of the company. The starting point is the customer requirement and external stakeholders whose requirements should form the basis for the development of the quality policy and technology development strategy.
- Acquiring information from the customer should be supported by appropriate methods (QFD, KANO), which greatly increase the likelihood of correct interpretation.
- Before the implementation of the model it should be carried out inspections of the current state of technology and technological potential of the company. This step will help to predict the optimum direction of technology development. At this stage, we should also evaluate the potential of technological competitive supply chains.
- Technology management subsystem production should be closely linked with quality management. These concepts should be complementary and mutually displace and grow. On the basis of their integration should be developed, the concept of product development.
- Production logistics should be perfected tools such as Poka-Yoke, 5S, Heijunka, KANBAN, Milk run or Jidoka. The implementation of these tools will increase the efficiency of the production system and minimize inconsistencies and errors. The choice of tools is optional and should take into account the organization's strategy.
- Implementation of the requirements of standardized quality management system will result in the development of effective and clear management system aimed at maintaining the continuity of production [Urbaniak 2015].
- Design, control and quality management should be created based on customer requirements and market and supported selected instruments, concepts and quality management systems. The idea behind the model is to develop a philosophy of total quality management throughout the supply chain [Talib et al. 2011; Sabet et al. 2016].
- Improving logistics processes and technology development should be initiated by needs of internal and external clients.
- To better meet the needs of the organization, increasing productivity, improving the quality, integration processes, reduce negative impacts on the environment there is need to constantly improve the technology used. These measures should be aimed at taking into account the development of technology in the overall strategy, analysis of its life cycle, the introduction of continuous surveillance, and to initiate processes which enhance the competence of personnel.
- The premise of the model is guided by the outside (to the customers) and the consolidation of relations between the internal processes in the company [Lisińska-Kuśnierz and Gajewska 2014]. Implementation of standardized quality management systems emphasizes the chief role of the client in business management. Research customer needs and their satisfaction should be carried out in a continuous manner.
- The model highlights the importance of efficient communication systems within the organization and across the supply chain.
- The model is based on the integration of type IV (systems integration of basic systems industry) [Łunarski, 2011]. Organizations that do not have a standardized quality management system are recommended to their simultaneous implementation.

- The condition of proper implementation of the model is effective technologies, recognized as the basis for optimal and rapid implementation of logistics processes [Bienstock et al. 2008].
- Improving technology should be subordinated environmental and social aspects [Stachowiak et al. 2013].
- The aim should be to a taking into account societal needs through the implementation of sustainable solutions, particularly through eco-design, reducing the consumption of components, extensive use of recycled seeking alternative components more environmentally-friendly design of energy-saving products, etc.
- Implementation of the model is a significant investment and requires a long time (even several years), so that it can fully integrate with the company. The first years can be extremely difficult period, in which the model does not produce the expected results. Having this in mind it should be used measures that allow up to date evaluate its effectiveness. Measures should include the following criteria: a pro-quality awareness of senior management and personnel, the degree of achievement of the objectives adopted in the quality policy, the number of flaws and mistakes, analysis of the number of complaints, the degree of modernity and efficiency of machines, linking the organization with the environment. Rating overall model can also be modeled on the methodology of the EFQM.
- In the model, some fields are presented in two locations (product concept and QFD, Kano and Servqual) is the purposeful intention of the authors, aiming to underline their importance in both design and improvement (validation) of the product.

Implementation of the model should be based on the following stages:

1. A first step it should be a determinate of a quality policy containing objectives set based on analysis of customer requirements. Simultaneously with the development of a quality policy must develop and implement a strategy for the development of technology.
2. The next stage should include the implementation of the requirements of ISO 9001, which is considered as the foundation to create more perfect forms of quality management. Proper implementation of this system is the foundation for further quality enhancement.
3. Next step is to implement further standardized quality management systems and seek to integrate them. According to the authors, the most reasonable solution is to implement systems gradually (after the implementation and development of the first, implementation of the next). Of course, if the organization has an adequate infrastructure and properly trained staff can opt for the integration of several systems at the same time. The integration process should take into account the systemic management of technology and its place in the integrated management system.
4. Simultaneously with the implementation and integration of systems the company should support a process by selected instruments of quality management. These instruments will allow for easier solving the existing problems and will be the basis for further development of systems (towards TQM). Implementation of instruments and concepts of quality management should be preceded by training for executives and regular employees [Dahlgaard and Dahlgaard-Park 2006]
5. The last stage involves audits, inspection and initiating of improvement actions.

Developed model has some limitations [Zimon 2015b]:

- Development and implementation of the model is relatively expensive. Companies have to make substantial investments into the so-called external quality assurance costs [Kafel and Sikora 2014], which include costs of designing and implementing different quality management systems, staff training costs, external audits, etc. Therefore, this model is primarily targeted at medium and large enterprises with a strong economic position and presenting innovative solutions.
- Smaller companies can also implement certain assumptions of the model, but in

their case it is not recommended its implementation globally.
- The proper functioning of the model is not possible without the full involvement of representatives of top management. Unfortunately, the author's observation shows that not all representatives of the top management are able to set aside sufficient time to actively engage in the process of implementing and improving the model.
- The basis of the model is a comprehensive approach to the issues related to the development of new technologies, according to an observation of businesses does not have an appropriately developed strategy in this area.
- The model was developed based on the analysis of processes occurring in a particular company due to it before the implementation it should be modified and taken into account the needs, aspirations, goals, external conditions, competitive position, etc. of a specific organization.

CONCLUSIONS

Development and implementation of effective and efficient quality management system and technology to support the logistics of the manufacturing is a task extremely compiled and time-consuming. First of all, it requires the development of a generally accepted vision of the key processes in the organization focused on customers. In addition, it is worth paying attention to the costs associated with implementation and maintenance of standardized quality management systems and the development of technology, which may be too high especially for smaller organizations taking part in the supply chain [Zimon 2016].

Of course, the implementation of the system is not only costs but also significant profits, manifested in minimizing the number of errors and inconsistencies, reducing the costs associated with quality control and poor quality sourced components in the growth of customer satisfaction and the level of competitiveness of the whole supply chain. In addition, continuous improvement model leads to the maturity of the organization in many aspects of its activities.

The model proposed in this publication stands out from the rest of the concepts presented in the literature in the following manner:
- It is based on instruments and systems which are often proposed as separate solutions to problems without showing their relation,
- Emphasizes the importance of systemic technology management and its role in quality systems, this area is not sufficiently moved in the standardized quality management systems (which the authors regard as a huge mistake)
- This model is characterized by simplicity and high universality, what allows for its implementation (at least fragmentary) in almost any organization that want to improve the implementation of key processes,
- The model indicates the relationship occurring between quality, logistics and technology, which in Polish literature is relatively rarely the subject of research and reflection.

To sum up, it should be emphasized that currently support logistics operations the latest standards of quality management and technology becomes a necessity for companies that want to strengthen their competitive position and improve broader customer service.

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PROPOZYCJA MODELU ZARZĄDZANIA JAKOŚCIĄ I TECHNOLOGIĄ WSPIERAJĄCA PODSYSTEM LOGISTYKI PRODUKCJI

STRESZCZENIE. **Wstęp:** Zakłada się, że przyszłością systemów zarządzania jakością i logistyką jest technologia a w szczególności poziom jej innowacyjności oraz umiejętność niwelowania negatywnych skutków związanych z jej doskonaleniem. Bezsprzecznie próba integracji zarządzania jakością i technologią w podsystemach logistycznych wymaga systemowego podejścia do tego zagadnienia. W związku z powyższym celem publikacji będzie opracowanie modelu zarządzania jakością i technologią wspierającego logistykę produkcji.
Metody: Założenia modelu prezentowanego w publikacji zostały opracowane podczas czteromiesięcznego stażu naukowego autora w jednej z największych odlewni ciśnieniowych w Polsce. Podczas stażu dokonano analizy funkcjonowania głównych procesów logistycznych, oraz dokumentacji zintegrowanego systemu zarządzania jakością. Ponadto przeprowadzono szereg wywiadów bezpośrednich z pracownikami i przedstawicielami kierownictwa.
Wyniki: Wynikiem prac było opracowanie kompleksowego modelu zarządzania jakością i technologią adresowanego do dużych przedsiębiorstw produkcyjnych. Model ma ogólny charakter w związku z tym istnieje możliwość jego implementacji w różnych przedsiębiorstwach produkcyjnych.
Wnioski: Opracowanie i wdrożenie skutecznego i efektywnego systemu zarządzania jakością i technologią wspierającego logistykę produkcji jest zadaniem niezwykle skompilowanym i czasochłonnym. Przede wszystkim wymaga wypracowania jednej ogólnie akceptowanej wizji rozwoju kluczowych procesów w organizacji ukierunkowanej na klientów. Ponadto warto zwrócić uwagę na koszty związane z wdrożeniem i utrzymaniem znormalizowanych systemów zarządzania jakością oraz rozwojem technologii, które mogą okazać się zbyt wysokie zwłaszcza dla mniejszych organizacji współtworzących łańcuch dostaw. Oczywiście wdrożenie omawianego systemu to nie tylko koszty ale również znaczne profity, przejawiające się w: minimalizacji liczby braków i niezgodności, redukcji kosztów związanych z kontrolą jakości i niską jakością pozyskiwanych komponentów, we wzroście satysfakcji klienta oraz poziomu konkurencyjności całego łańcucha dostaw.

Słowa kluczowe: jakość, technologia, logistyka produkcji.

DER VORSCHLAG EINES QUALITÄTS- UND TECHNOLOGIEVER-WALTUNGSMODELLS FÜR DIE UNTERSTÜTZUNG DER PRODUKTIONSLOGISTIK

ZUSAMMENFASSUNG. Einleitung: Es wird heutzutage angenommen, dass die brauchbare Technologie die Qualitätsverwaltungssysteme und die Logistik in Zukunft zunehmend bestimmen wird und dass das technologische Niveau ihrer Innovation und die Fähigkeit, die negativen Folgen, die mit ihrer Vervollkommnung verbunden sind, besonders unterstützen kann. Der Versuch einer Integration der Qualitätsverwaltung und der Technologie in den logistischen Untersystemen verlangt eine systemvolle Betrachtungsweise für die Lösung dieser Frage. Im Zusammenhang mit dem Ziel dieser Publikation wird die Bearbeitung eines Qualitätsverwaltungsmodells und der Technologie, die die Logistik in der Produktion unterstützen, gezeigt.
Methoden: Die Richtlinien des dargestellten Modells, die in der Publikation betrachtet und dargestellt werden, wurden auf Grund eines 4-monatlichen Praktikums des Verfassers in einer der größten Dampfgießereien Polens bearbeitet.
Ergebnisse: Das Ergebnis der Arbeit war die komplexe Bearbeitung des Qualitäts- Technologieverwaltungsmodells, das Großunternehmen zur Verfügung gestellt werden kann. Das Modell hat einen allgemeinen Charakter und deswegen besteht die Möglichkeit dessen Implementierung in verschiedene Industrieunternehmen.

Fazit: Die Bearbeitung und die Einführung eines wirksamen und erfolgreichen Qualitäts- und Technologieverwaltungsmodells, das die Logistik in der Industrie unterstützen könnte, ist eine sehr komplizierte und zeitraubende Aufgabe. Vor allem verlangt sie Ausarbeitung einer allgemein akzeptierten Vision der Entwicklung von Hauptprozessen in der Organisation, die auf die Kunden orientiert sind. Man sollte auch die Aufmerksamkeit auf die Kosten lenken, die bei der Einführung und bei der Aufrechterhaltung der standardsicheren Qualitätsverwaltungsmodelle sowie bei der Entwicklung der Technologien, insbesondere für kleine Organisationen, die eine Lieferkette bilden, zu hoch werden können. Selbstverständlich verursacht die Einführung des betreffenden Systems nicht nur Kosten, sie generiert auch Profite, die sich in der Minimalisierung von Mangelzahlen und Unstimmigkeiten sowie in der Kostenreduzierung, die mit der Qualitätskontrolle und der geringen Qualität der bezogenen Komponenten verbunden ist, ferner in der Kundenzufriedenheit und der Wettbewerbsfähigkeit der ganzen Lieferkette manifestieren..

Codewörter: Qualität, Technologie, Produktionslogistik

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