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DETERMINANTS OF MAKING DECISIONS IN IMPROVING THE QUALITY OF PRODUCTS

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Purpose: The basic purpose of research was to determine the causes of making the decision that manufacturers on their way to improve the quality of their products.
Design/methodology/approach: The research method applied in article is mainly standardized survey research making based on survey conducted in contact and remote way conducted in 78 enterprises in south-eastern Poland. The research process also accompanied analysis of the source documentation.
Findings: It was concluded that decision during improving quality of the product were making mainly in simultaneously with considering customers' requirements of the customers about the quality of the products and the impact of products on the natural environment.
Research limitations/implications: Most of the verified enterprises from SMEs are tried integrating qualitative-environmental actions as part of improving the quality of products. This is a favorable condition for further research, so that it is possible to adjust the quality and environmental approach when improving the quality of products in SMEs.
Practical implications: Discussion of the results of research have a series of practical implications mainly for product management staff. Especially in organizations that designed new products or also in significant modification of these products.
Social implications: Building awareness improves not only quality of products, but also simultaneously in line with sustainable development, including in improving environmental aspects.
Originality/value: The article has cognitive value for development of knowledge, science, quality, and environmental in the area of management of products.

Keywords: decision support, management, quality management, production engineering, improving quality of products, customers' requirements, mechanical engineering.

Category of the paper: Research paper.

1. Introduction

Decisions in the area of product quality are one of the most difficult decisions made in an enterprise (Gładkowska-Chocian, 2018; Pacana, Siwiec, 2022). There are complex decisions, which usually include creating a new or changing existing products and services. Economic, social, and environmental forecasts are included (Ostasz, Siwiec, Pacana, 2022). The key to this type of decision is to achieve customer satisfaction, which is identified with the quality of the products (Siwiec, Pacana, 2021). The quality investigation is based on processes and also the high value of the enterprise (Gajdzik, Wolniak, 2021). The need to make an improving decision is not referred only to enterprises about long-range (enterprise world scale). Small and average enterprises operating in regional and world markets also compete by the quality of their products (Pavlovskaia, 2014; Siwiec, Pacana, 2021). This pursuit of a better quality of its products leads to changes, referring to improving production processes, implementing innovation, and changes in organized character (Jonek-Kowalska, Wolniak, 2022; Zarte, 2022; Szymanik, 2016). The development of management concepts and methods causes, on the one hand, the emergence of new organizational solutions, and, on the other hand, it is a source of decision-making problems in relation to the solutions already used (Stoma et al., 2018; Siwiec, Pacana, 2021). In a moment of a new concept occurring, managers are standing by resignation from previous management methods and tools, and their improvement to the direction of following changes or maintaining the existing solutions (Ejdys, Kobylińska, Lulewicz-Sas, 2012; Maik, 2017).

A single of the most commonly used management instruments is a modern approach to management processes and its simultaneous improvement, which comes down to the use of, for example, formalized management systems (Woniak, Jonek-Kowalska, 2022). New management concepts refer to broadly understood quality management: physical products and services, and more and more often the natural environment surrounding man (Pacana, Siwiec, Bednárová, 2020; Siwiec, Hajduk-Stelmachowicz, Bełch, Czerwińska, Pacana, 2021). Despite that, mainly SMEs have a problem with making the right qualitative-environmental decisions. This problem refers to decisions during the determination of products, which will be simultaneously satisfactory to customers and environmentally friendly (Ulewicz, Siwiec, Pacana, Tutak, Brodny, 2021).

Hence, the purpose of the article was to perform research as part of the identification of determinants of making decisions to improve products in SMEs.

2. Methods

The purpose of the analysis was to determine the determinants of making decisions to improve the quality of products in production companies in the SME sector. It results the most the share of these enterprises in the Polish industrial sector. It was considered that if these enterprises had the right tools for product design, it would contribute to their growth, competitiveness and less consumption of the natural environment. In this purpose, survey research was created, which was directed to persons responsible in enterprises for product design and to managers of productions and board members. The survey consisted of record and survey questions (open and closed). Questionnaire questions (Krok, 2015):

- type of enterprise (micro, small, medium, large),
- company headquarters (rural area, urban area),
- scope of activity (local, regional, national, international),
- implemented systems ISO 9011:2015 and ISO 14001:2015.

On the other hand, the survey questions referring to the decision-making determinants included questions concerning:

- actions that are made as part of the improving the quality of the product,
- type and number of decision criteria the most often included in the enterprise during improving product quality,
- awareness of the enterprise to making decisions qualitative-environmental as part of improving the quality of products,
- attitude of the enterprise to making decisions in a shot of qualitative-environmental as part of improving the quality of products.

The survey questions were developed on the basis of the literature review on the subject, e.g. (Ejdys, Kobylińska, Lulewicz-Sas, 2012; Ostasz, Siwiec, Pacana, 2022; Pacana, Siwiec, 2021; Siwiec, Pacana, 2021; Pacana, 2015; Świrk, 2020). The analysis of the survey results is presented in the next part of the article.

3. Results

The survey research was conducted in the first quarter of 2022. The research sample was selected in a random way. The results from 78 enterprises. There were mainly industrial enterprises in south-eastern Poland belonging to SMEs. The sample was obtained as part of the initial research; therefore, it was considered enough to verify the determinants of making decisions in improving the quality of products. Therefore, it is a planned extension of the research sample in future research and confronting the obtained results with the current ones.

The results of the survey research are presented in Figure 1.

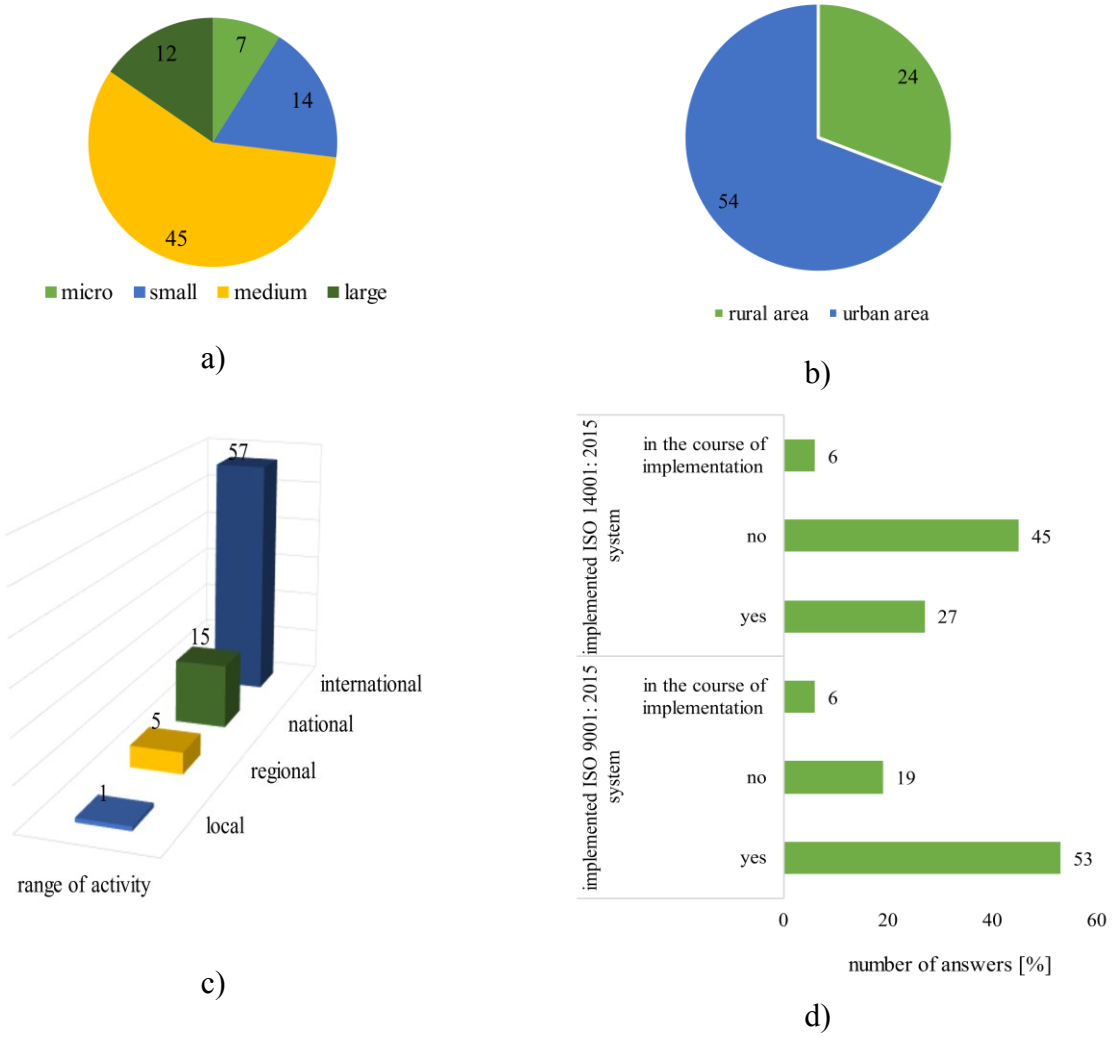


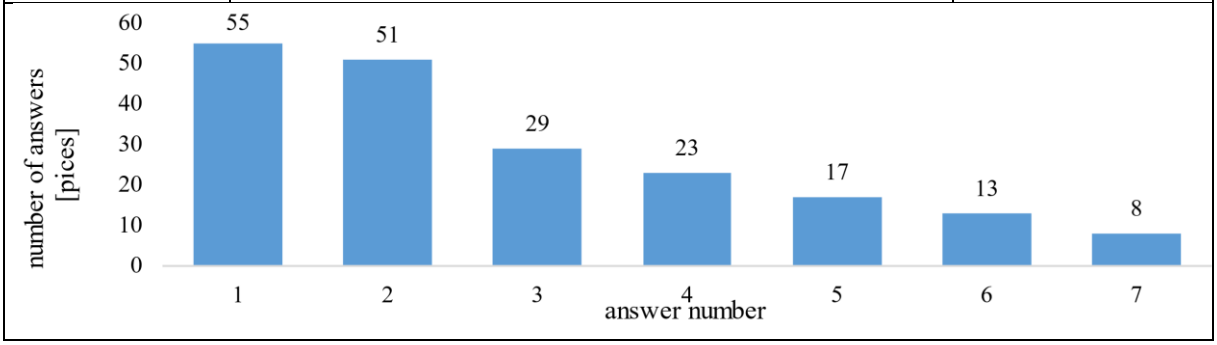
Figure 1. Survey certificate test results: a) type of company, b) location of the enterprise, c) range of activity, d) implemented ISO 14001: 2015 and ISO 9001: 2015 system. Source: own study.

The most number of enterprises surveyed were the medium-size enterprises (45 from 78). A relatively similar number has large and micro- enterprises (appropriately 14 and 12). The verification companies were localized in the vast majority of cases in an urban area (54). The range of activity of these enterprises was mainly international (57). Most of the surveyed enterprises (45) were not implemented ISO 14001:2015 system, but more than half of the verified enterprises (53) declared that implemented ISO 9001:2015 system. Among these enterprises, the determinants of decision making for improving the quality of products were analyzed.

First, actions realized as part of improving the quality of the products were analyzed. The results are shown in Table 1.

Table 1.
Actions carried out as part of the improvement of the quality of products in small businesses

Answer number	Answer	Number of answers
1	catalogues (specifications) of products are developing	55
2	researches on customers satisfaction on quality of products are making	51
3	catalogue of actions as part of improving products are making	29
4	computer software supporting making qualitative and/or environmental decisions as part of improving products are using	23
5	catalogues describing the impact of products on the natural environment are developed	17
6	customer satisfaction surveys and interested parties are conducted on the impact of products on the natural environment	13
7	others	8



Source: own study.

It was shown that the most number of verified enterprises developed catalogues (specifications) products and made research on customers' satisfaction with the quality of products (above 50 from 78). Slightly fewer enterprises (29) showed that they realized catalogues of improvement actions and used computer software (23) that supports making qualitative and/or environmental decisions as part of improving products. Definitely, a small number of companies have developed catalogues that describe the impact of products on the environment (13). Only eight enterprises showed other actions as part of improving the quality of products.

Then, the awareness of the companies to make quality and environmental decisions within the scope of product quality improvement was analyzed. The results are shown in Figure 2.

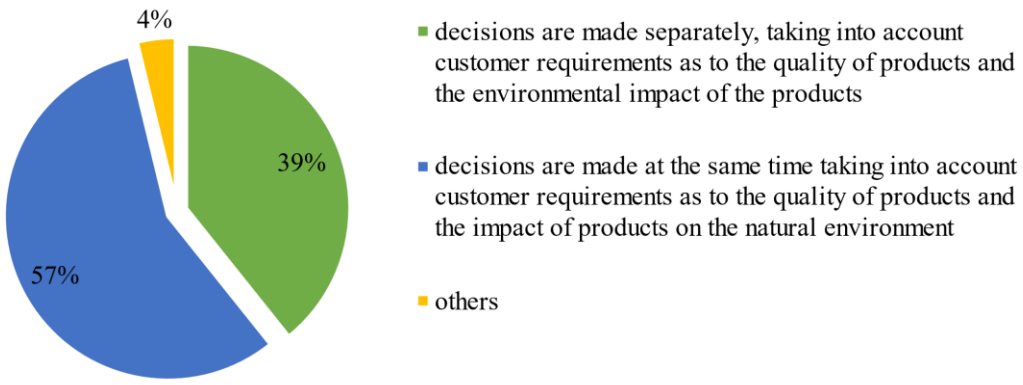
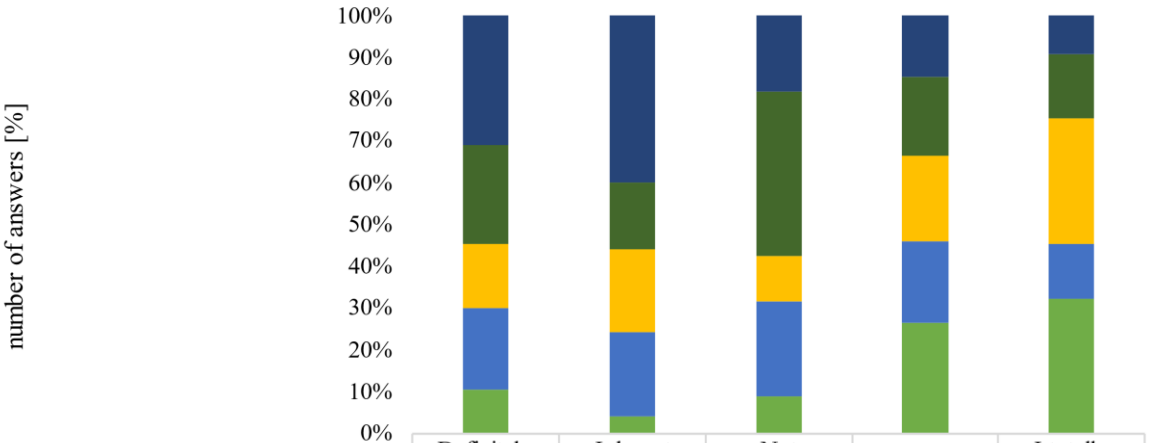


Figure 2. Awareness of enterprises to make quality and environmental decisions within the scope of improving product quality. Source: own study.

It was shown that the overwhelming number of enterprises (57%) make decisions simultaneously including customers' requirements and impact products on the natural environment. Fewer enterprises (39%) considered making decisions separately considering customers' requirements and impact the product on natural environment. Only a few enterprises considered (4%) mentioned decision making in another way.

Then, the attitude of the enterprise to making decisions in the qualitative-environmental shot as part of improving the quality of products with including customers' requirements was analysed. The results are shown in Figure 3.



	Definitely not	I do not agree	Not applicable	I agree	I totally agree
computer software supporting decision making is used	30.8	12.8	7.7	34.6	6.4
decision methods are used to support decision making	23.1	5.1	16.7	44.9	10.3
instructions or procedures for making decisions are developed	15.4	6.4	4.5	48.7	20.5
is the employee (s) responsible for making decisions	19.2	6.4	9.6	46.2	9
is the employee (s) responsible for making decisions	10.3	1.3	3.8	62.8	21.8

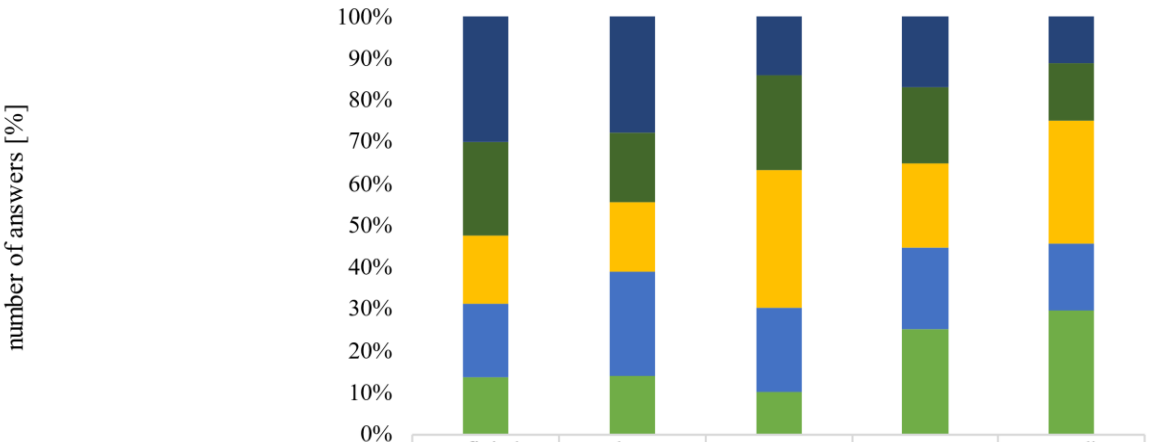
Figure 3. Attitude of the enterprise to making decisions as part of improving the quality of products with including customers' requirements. Source: own study.

It was shown that nearly half of the verified enterprises were not using computer software supporting making decisions in the context of quality of the product (average 22%). Other forms of enterprises shown that using this software (average 20%). Additionally, enterprises declared using decision methods (average 28%) and developed instructions or procedures to make decisions as part of improving the quality of products considering customers' requirements (average 35%). About half as many enterprises declared that they do not use decision-making methods for this purpose (average 14%) and do not develop instructions or procedures for making these decisions (average 11%).

Then, analysis was the attitude of companies towards organizing training in decision making. It was shown that an average of 30% of analyzed enterprises make these training. Additionally, the vast majority of companies (average 42%) confirmed that hire an employee

who is responsible for making qualitative decisions in the company. Only a few enterprises (average 6%) showed a lack of employees responsible for it. The verification of survey questions includes only the remaining percentage of companies that replied "not applicable" to the above questions.

Then, analysis was the attitude of the enterprise towards making decisions as part of improving the quality of products considering the impact of the products on the environment. The results of the survey research are shown in Figure 4.



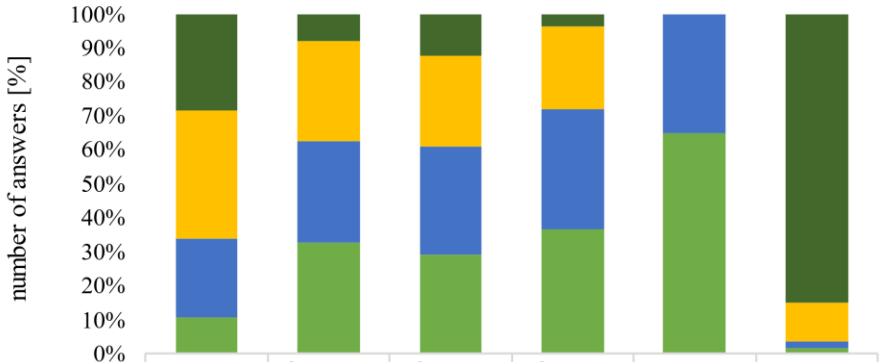
	Definitely not	I do not agree	Not applicable	I agree	I totally agree
computer software supporting decision making is used	30.8	12.8	7.7	34.6	6.4
decision methods are used to support decision making	23.1	7.7	12.2	37.2	7.7
instructions or procedures for making decisions are developed	16.7	7.7	17.9	41	16.7
is the employee (s) responsible for making decisions	17.9	11.5	10.9	39.7	9
is the employee (s) responsible for making decisions	14.1	6.4	5.57	51.3	16.7

Figure 4. Attitude enterprise to making decisions as part of improving quality of products considering impact products on environmental. Source: own study.

It was concluded that similar to the case during the improvement of the quality of products, a little larger number of enterprises are not use computer software supporting making decisions as part of improving the quality of products considering impact of these products onto environmental (average 22%), where the average 20% enterprises confirmed that do so. Despite that, a similar number of enterprises have shown that they use/or do not use decision methods (average 22%). In turn, the vast majority of enterprises declared that they develop instructions or procedures (29% on average) for making product quality decisions taking into account the environmental impact of products, where on average 12% of enterprises admitted that they did not. It was concluded that average 24% of enterprises are making training for making qualitative-environmental decisions as part of improving the quality of products, and on average 15% of enterprises are not organizing these trainings. Most of the analyzed enterprises (average 34%) confirmed that in their company an employee is responsible for

making decisions as part of improving quality of products considering the impact products on environment. Despite this, the average 10% of enterprises shows a lack of employee responsible for the decisions mentioned. The verification of the indicated survey questions also covers the remaining percentage of enterprises that answered the indicated questions 'not applicable'.

Then, the analyses were types and number of decision criteria most often included in enterprise during the improvement of quality of products. The results are shown in Figure 5.



	below 5	from 5 to 9	from 10 to 14	from 15 to 25	above 25	not included
Other	26.9	6.4	6.4	2.6	0	57.7
Proecological (positively influencing the natural environment)	35.9	24.4	14.1	17.9	0	7.7
Qualitative (subjective, unmeasurable)	21.8	24.4	16.7	25.6	10.3	1.3
Quantitative (technical, measurable)	10.3	26.9	15.4	26.9	19.2	1.3

Figure 5. Type and number of decision criteria the most often included in the enterprise during the improvement of quality of products. Source: own study.

More than half of the enterprises declared that include mainly qualitative, quantitative, and proecological criteria (about 58%). In the group of proecological criteria usually includes more than 5 criteria (36%) or from 5 to 9 criteria (24%). Therefore, in the group of qualitative criteria included, the most from 15 to 25 criteria (26%) or 5 to 9 criteria (25%), where relatively fewer answers showed that the number of these criteria is above 5 (22%). Similarly, qualitative criteria, the most often show that it is a group that counts from 15 to 25 criteria or from 5 to 9 criteria (27%). Slightly fewer responses indicated that the quantitative criteria constitute a group of more than 25 criteria (19%). Furthermore, it was observed that approximately 27% of the enterprises declared that they take into account criteria other than those indicated, where their number is not greater than 5 criteria.

4. Discussion and conclusion

The new concept of management includes an approach to managing quality of products and includes impact of products on sustainability (Pacana, Siwiec, Bednárová, 2020; Siwiec, Pacana, 2021). However, mainly SMEs still have problems with making the right quality and

environmental decisions. As part of identifying determinants of making decisions in improving products in SMEs the survey research was realized. The research was carried out among 78 enterprises. It was concluded that during improving the quality of products in SMEs, the decision was made mainly in simultaneously considering customers' requirements about the quality of products and considering the impact products on sustainability. Additionally, based on analysis, it was considered that the determinants of improving the quality of products in the context of qualitative-environmental considerations were mainly:

- making controls and actions of improving the quality of product considering mainly the customer's requirements, where the impact product of environment is mostly negligible,
- creating catalogues of improving actions and catalogues of products mainly in case of including customers' requirements,
- using the computer program as part of improving the quality of products, where including customers' requirements and impact on the environment,
- use of decision-making methods and the development of instructions or procedures to support decision-making,
- training and appointing the employee responsible for making decisions,
- taking into account the criteria from groups qualitative, quantitative, and proecological criteria,

It was shown that relevant similar number of criteria included during improving products are qualitative and quantitative criteria. In turn, the less number of criteria included during improving products are proecological criteria. This proves that enterprises have relatively high awareness about a need including customers' requirements during the improvement of product quality. Simultaneously, it was shown that enterprises include less impact of the impact product on environment. However, most of the verified enterprises from the SME sector are trying to integrate quality and environmental activities within the scope of improving product quality.

This is a favourable condition for further research, so it is possible to adjust the quality and environmental approach when improving the quality of products in SMEs.

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