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EXPECTATIONS OF MANUFACTURING COMPANIES FOR SUPPLIERS REGARDING THE IMPROVEMENT OF THEIR PROCESSES

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Abstract:

The article presents the results of conducted empirical research in which an attempt was made to identify the expectations of manufacturing companies towards suppliers in terms of process (logistics customer service, supervision over property customer, production monitoring, supplier supervision) improvement. The research was conducted using the Computer Assisted Telephone Interview (CATI) technique. The research covered 150 production medium and large size companies (employing over 50 people) who were suppliers for enterprises from the automotive, electromechanical and chemical sectors operating in the Polish industrial market. The expectations of production companies towards their suppliers regarding improvement of processes concept were assigned a rank on a scale from one (the least important criterion) to five (the most significant). The analysis of the results of the conducted research shows that the implementation of management tools such as international organizational standards (ISO), Kaizen or Lean Management by companies that are purchasers may affect the expectations towards suppliers in terms of improving their processes. The considerations undertaken in this article confirm that in order to compete on the modern market, close cooperation and cooperation within the supply chain are needed. Representatives of the surveyed manufacturing companies notice this fact and set high expectations for their suppliers in virtually all the surveyed aspects. Conducted research shows that suppliers must pay special attention to the implementation of processes related to ensuring and improving the technical quality of products by focusing on improving control and supervision processes and logistical aspects of customer service. Proper implementation and improvement of these processes requires a methodical approach. Based on the obtained research results, managers of organizations supplying manufacturing companies can obtain important information that will be used to improve processes that are important from the point of view of their recipients. On this basis, they can make an optimal allocation of resources and modify the management style to improve cooperation with manufacturing companies.

Keywords: *manufacturing companies, supplier relationship, management systems, improvement processes*

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1. Introduction

It can be commonly noticed that many enterprises, when establishing relationships with new suppliers, focus their requirements on the guidelines contained in international quality, environmental and safety management standards. The implementation of these guidelines allows suppliers to effectively ensure the quality of products, as well as standardize and improve their processes. It can also be seen that the manufacturing companies which are the purchasers, have expectations that are aimed at the continuous development of the suppliers' potential, thanks to which it is possible to improve the efficiency and effectiveness of processes in the supply chains (Basu et al. 2018, Hawkins, et al. 2020; Ratkiewicz and Walczak, 2022). The fulfillment of these expectations is verified both through supplier self-assessment cards (which are used in particular by international concerns) and through supplier audits performed by buyers (recipients) or on their behalf. The verification of the expectations of the purchasing enterprises is increasingly based on multi-criteria evaluation (Min et al. 2018). It can also be observed that many international concerns, when assessing potential partners, also follow the guidelines related to the principles of corporate social responsibility (Asif et al. 2019). The initial comprehensive assessment is conducted by analyzing the data contained in the self-assessment cards provided by suppliers in terms of detailed requirements relating to the guidelines contained in international quality, environmental and safety management standards (Schulte and Hallstedt 2018). The credibility of the data contained in the self-assessment questionnaires is verified by auditing the suppliers (Nikoofal and Gümüs 2020). Particularly important for industrial buyers who purchase raw materials, parts, components and infrastructure elements is the technical quality, which should be conducted by taking into account the criteria relating to product safety (Yazdani et al., 2022). Technical quality assessment by customers is accomplished through a comparative laboratory analysis of samples from potential suppliers and assessment of their compliance with the required technical specification, trial purchase, free temporary use (in relation to machines and devices) and by collecting opinions from current users (during the so-called reference visits). When evaluating suppliers, complaints (qualitative, quantitative, errors in documents), the timeliness and flexibility of deliveries (in terms of quality, timeliness, quantity, order sequence) are of particular importance. A vital feature is also the assessment of the communication between partners (effectiveness and the response time to inquiries, orders, complaints, technical or organizational problems). Increasingly important as a criterion for assessing suppliers is innovation and joint cooperation on solutions for new and modified products (Wang et al. 2021).

The expectations of buyers towards the supplier implementation of a quality management system based on the guidelines contained in the International Organization for Standardization (ISO) 9001 standard focus on the supplier ensuring the required parameters for products, as well as on improving operational processes. In some sectors, the requirements placed on suppliers in the field of quality management do not only concern compliance with the guidelines contained in the ISO 9001 standard (Huq et al. 2016). The dissemination of the concept of corporate social responsibility results in an ever wider range of expectations towards partners who are the source of purchases in terms of limiting their negative impact on the natural environment (Gupta et al. 2019). For this reason, more and more enterprises expect suppliers to implement environmental management system based on the guidelines contained in the ISO 14001 standard (Kumar et al. 2019, Saghiri and Mirzabeiki 2021). It can also be observed that the increasing level of awareness of business entities that are customers concerns the risk of threats related to products and processes implemented in supply chains. Risk mitigation in relation to processes has a broad scope, as it relates to ensuring occupational health and safety, information, or the entire supply chain. Due to the prospect of shaping long-term partnerships between business entities, the legal and financial situation of suppliers is also important. Assessment of the legal and financial situation of suppliers is conducted through due-diligence, which is the investigation of ownership interest, fulfillment of legal obligations, level of profitability, financial liquidity, shares in other enterprises, type and scope of insurance policies and financial guarantees. The above-mentioned expectations are taken into account by enterprises as criteria for qualifying and evaluating suppliers. This evaluation is based on the experience of cooperation (Salwin et al., 2022; Benton Jr. et al. 2020).

Based on the above considerations, it can be concluded that manufacturing companies use a number of different systems to improve not only their operational processes, but but they also recommend them to their suppliers for mutual benefit - improving the quality of the product and the quality of order fulfillment in suply chains (Li and Chen, 2019; Savic et al., 2017). Moreover, on the basis of the requirements contained in the management systems, manufacturing companies formulate requirements for their suppliers (Zimon and Madzík, 2020). This situation is quite understandable because, as Purwanto and Juliana (2022) points out, the development of suppliers contributes to an increase in the efficiency of the supply chain. Considering more broadly the issue of proper relations with suppliers, it can be noticed that for many companies, relations with suppliers are not limited only to imposing strict requirements on them and continuous monitoring of meeting expectations. When taking action aimed at improving processes and products, many business entities also involve their suppliers in these activities, especially in the field of implementing system tools, offering them special support programs referred to as supplier development programs / vendor development programs (Kumar and Routroy 2017, Kumar and Routroy 2018). Through these programs, mutually beneficial relationships based on win-win principles are built (Proch et al. 2017). The programs are implemented through training and consultancy in the field of product quality assurance, implementation of system tools in terms of improving environmental impact and improving process safety. Consulting and training are provided by delegated specialist, employed in positions such as supplier development advisors, supplier development supervisor, supplier development project manager, supplier development engineers, supplier quality engineers or project managers focused on the development of partners. OEMs realizing supplier development programs are increasingly focused on ensuring the continuity of flows (products and information) and improving the efficiency and effectiveness of processes conducted in supply chains. In this regard, they use process improvement tools such as Toyota Production System elements (like Kaizen, 5S, Total Productive Maintenance, Poka Yoke, SMED), the Lean Management concept or Six Sigma methodologies (Golmohammadi et al. 2018). The implementation of these tools is more and more often treated as joint projects of partners in the supply chain (Kumar et al. 2018). For these reasons, OEMs expect suppliers to implement these tools to improve efficiency (shortening the cycle of process) and efficiency (they reduced costs) of their activities (Praxmarer-Carus et al. 2013). It is increasingly being recognized that the creation of a competitive advantage requires industrial customers to build relationships with suppliers, which manifests itself in joint projects. These projects focus on the implementation of product innovations (improving the technical parameters of existing and implementation of a completely new product) and contribute to the improvement of organizational performance as well as process efficiency through reducing costs by increasing employee productivity, infrastructure capacity, and eliminating wastes (Xu et al. 2017). More and more often it can be seen by partners combining Six Sigma methodologies with the Lean Management approach referred to as Lean Six Sigma. Many joint Lean Management projects are also aimed at improving the environmental impact (Kumar and Rodrigues 2020, Garcia-Buendia, et al. 2021). These projects are known as Green Lean Management and focus on reducing consumption (raw materials, energy, water, consumables) and reducing waste and emissions (gases, noise, radiation). These initiatives are aimed at improving common processes and developing concepts for improving products (Wang et al. 2020). For many companies, relationships with suppliers are not limited to imposing their stringent requirements and continuous improvement on sustaining development (Talay et al. 2020).There is a number of studies focusing on the impact of the management systems implementation on the functioning of production enterprises. (Zivaljevic et al., 2022). However, there are not enough studies that would address the issue of requirements imposed by manufacturing companies on their suppliers in terms of improving their internal processes stimulated by the implementation of standardized management systems. Therefore, it seems reasonable to ask what processes are particularly important for manufacturing companies in the context of their relations with suppliers? The article fills the research gap in the literature. The research results presented in the literature so far have focused on the expectations of enterprises towards suppliers in terms of meeting the criteria for their initial and periodic assessment (Almeida et al., 2018; Savic et al., 2017; Gordon,2005). The research results presented in the

article focused on presenting the expectations of manufacturers (who have implemented a quality management system) towards suppliers in terms of improving their processes. The expectations towards suppliers in terms of improving their processes were presented from the perspective of the requirements set by enterprises (producers) that have implemented a quality management system consistent with the guidelines of the international standard ISO 9001. This approach to manufacturers' expectations towards suppliers should, to a greater extent, to shape positive relationships and cooperation between partners by improving the quality of products and processes. This approach should be considered new, because the results of such research have not been presented in the literature so far. The aim of the article focuses on identifying manufacturers' expectations towards suppliers regarding the improvement of their processes

The article has the following structure. Sections 1 and 2 provide the theoretical background. Section 3 presents a description of the research methodology and an analysis of the data obtained. Finally, sections 4 and 5 present the discussion, conclusions, implications, and limitations of this study.

2. Expectations towards suppliers regarding the implementation of quality management system and the improvement of products and processes

The technical quality of products is of particular importance in building relationships in supply chains (Negash et al. 2020). The technical quality assurance of products is based on strict compliance with legal requirements relating to safety. These requirements are included in European Union directives and technical standards. Ensuring technical quality of products also requires special supervision over the operational processes related to product implementation such as customer service, product design and development, purchasing, manufacturing and delivering products to buyers. Important guidelines in this regard have been defined in the international quality management standard ISO 9001 (Su et al. 2020). The assumption of this standard is that the quality of manufactured products is controlled in the operational processes. For this reason, organizations that are buyers in supply chains often require their suppliers to implement the requirements of ISO 9001 (Castka 2018). The latest issue of this document was based on the risk management concept described in ISO 31000 (de Oliveira et al. 2017). The ISO 9001 standard provides guidelines for companies that may constitute the expectations of suppliers in terms of processes related to the product realization such as customer service, design and development, purchasing, production, delivery, as well as product and process control. Effective implementation of these guidelines requires suppliers to define:

- the risk relating to products and processes,
- the specifications for purchased materials and infrastructure,
- the goals and principles of implementing operational processes,
- the product evaluation criteria (quality control) and processes (effectiveness and efficiency),
- the rules for identifying and traceability of products, processes, infrastructure, process participants.

The scope of controls defined by the guidelines which contained ISO 9001 standard as well as required by buyers relates to the acceptance assessment of the purchased materials / infrastructure elements, the assessment undertaken at individual stages of product processing, and the final assessment of the finished product. Customer requirements for product quality control may also include activities with the assessment of technical parameters, qualifying suitable infrastructure and suitable equipment for measuring and monitoring the quality of products, as well as assessing the qualifications of persons controlling and deciding on the status of the product evaluation.

The scope of controls required by buyers relates to the acceptance assessment of the supplies of purchased goods (materials / infrastructure elements), the assessment conducted at the product processing stages, and the final assessment of the finished product (Makinde et al. 2020). The above scope of control determines the safety of products delivered to customers. It is important in the event of a complaint (O'Connor et al. 2020). Control records, evaluation status, and product identification at each stage allow suppliers to identify the exact cause of the nonconformity. It can also be observed that many Original Equipment Manufacturers require from their suppliers special controls over the research and development processes (Wlazlak et al. 2018). Each stage of research and development work on new and modified products must be documented by appropriate

records (formulas, drawings, test results of prototypes, validation results. Such control records allows the certainty/surety of a high level of product safety (Taifouris et al. 2020). This applies in particular to suppliers for the automotive, aviation and railway sectors as well as medical devices. These sectors require very close cooperation between OEMs and suppliers in R&D projects (Franke et al. 2018).

3. Methodology

The subject of the conducted research was to define the processes which the suppliers expect to be improved by the surveyed industrial enterprises. The research was conducted using the Computer Assisted Telephone Interview (CATI) technique. The research covered 150 production medium and large size companies (employing over 50 people) who were suppliers for enterprises from the automotive, electromechanical and chemical sectors operating in the Polish industrial market. The respondents in the study were managers and specialists from purchasing or quality management departments. The expectations of production companies towards their suppliers regarding improvement of processes concept were assigned a rank on a scale from one (the least important criterion) to five (the most significant). The study was commissioned to a specialized research agency that conducted a targeted selection of companies registered in the Bisnode database, which is a business directory search platform.

The data structure based on the processing of the questionnaires is shown in table 1. This table contains a list of the variables used and their code designation, which was used in evaluating the results. At the same time, there is a measure of a particular variable in the table. The Capital variable was a nominal measure with two options – Polish and foreign. Number of employees was measured on two levels (50-249 employees and more than 250 employees). A nominal measure with a dichotomous character (yes/no) was used for the types of implemented systems. Other variables that had an ordinal measure were measured using a 5-point Likert scale. Statistical analyses were processed using IBM SPSS Statistics and Minitab software. In the initial stages of the analysis, descriptive statistics procedures were used to describe the primary results regarding the sample and the main expectations of manufacturing companies. In a later analysis, a 2-sample t-test was used to test whether organizations statistically differ in these expectations with regard to the monitored classification variables (e.g. capital, managerial system, etc.). The relationships between the monitored expectations (that is, between the measured variables) were examined through bivariate correlation analysis, in which the intensity of the relationships was analyzed through Pearson's linear correlation coefficient.

Exploratory factor analysis was used to examine the possibility of the existence of latent factors that would explain the correlation structure between the expectations of the manufacturer. The factor simply represents a broader group of variables between which the correlation relations are very intense. In other words, a factor can be considered an abstract construct in this case, which is not directly measured (like the measured variables), but can relatively reliably represent those variables linked to it. The suitability of the data was checked through the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity. Principal Component Analysis was used as an extraction method using Varimax factor rotation. The Kaiser-Guttman rule was used to choose the optimal number of factors, based on which it was determined that the number of factors is equal to the number of factors with eigenvalues greater than 1.0. The factors were subsequently named and briefly interpreted.

Exploratory factor analysis (EFA) is one of the standard statistical procedures aimed at multivariate analysis – that is, in cases where several variables investigate a single phenomenon. It is one of the most widespread methods for the exploration of new phenomena, and the EFA procedure has developed quite well in practice (Costello and Osborne, 2005). In the supply chain research area, the use of EFA was verified in several studies, which were aimed, for example, at examining critical success factors of additive manufacturing for higher sustainable competitive advantage in supply chains (Singh et al., 2023) at evaluating the impacts of Covid-19 on supply chain transformation (Min, 2023), or on the adoption of new technologies in supply chains like blockchain (Mukherjee et al., 2023). EFA is one of the appropriate statistical tools that allow us to examine the internal structure of a little-known area, which makes EFA one of the most suitable tools for our research.

4. Results

The sample consisted of 150 organizations. Their structure can be found in Figure 1. While analyzing the data contained in Figure 1, we note that more than half of the surveyed companies have implemented the requirements of the ISO 14001 standard, while Kaizen is used by 26% of them. Other systems, such as industry systems or Lean Management, were implemented by only a few of the surveyed enterprises. Among the surveyed organizations, 57% belonged to large and 43% to medium-sized enterprises (classified on the basis of the number of employees). Moreover, 61% of them were enterprises with Polish capital and 39% with foreign capital. The surveyed companies operated mainly in the automotive, chemical and metallurgical industries.

Table 1. Overview of variables

Variable	Code	Measure
Capital	Capital	Nominal
Number of employees	Size	Ordinal
ISO 9001	ISO_9001	Nominal
Sector system	SectorSystem	Nominal
ISO 14001	ISO_14001	Nominal
ISO 45001	ISO 45001	Nominal
Kaizen 5S/ TMP	Kaizen	Nominal
Lean Management	Lean	Nominal
Sector	Sector	Nominal
Product design process	ProdDes	Ordinal
The supplier's ordering process	SuppOrd	Ordinal
Vendor selection process	VendSel	Ordinal
Process of periodic evaluation of suppliers	SuppEva	Ordinal
Quality control of the accepted delivery	QCDel	Ordinal
Control of compliance of the accepted delivery with the order	QCOrdDel	Ordinal
Accepting orders from customers	AccOrd	Ordinal
Process of technical preparation of production	TechnPre	Ordinal
Production planning process	ProdPlan	Ordinal
Production	Production	Ordinal
Maintenance	Maint	Ordinal
Quality control of the production process	QCProdProc	Ordinal
Quality control of the finished product	QCFinProd	Ordinal
Packing	Packing	Ordinal
Product storage in a consignment warehouse	ProdStor	Ordinal
The process of delivering to the customer	CustDel	Ordinal
Installing the product at the customer's site	ProdInst	Ordinal
Training and consultancy related to the use of the product	Train	Ordinal
Technical service	TechServ	Ordinal
Complaints service	CompServ	Ordinal
Waste disposal	WastDisp	Ordinal

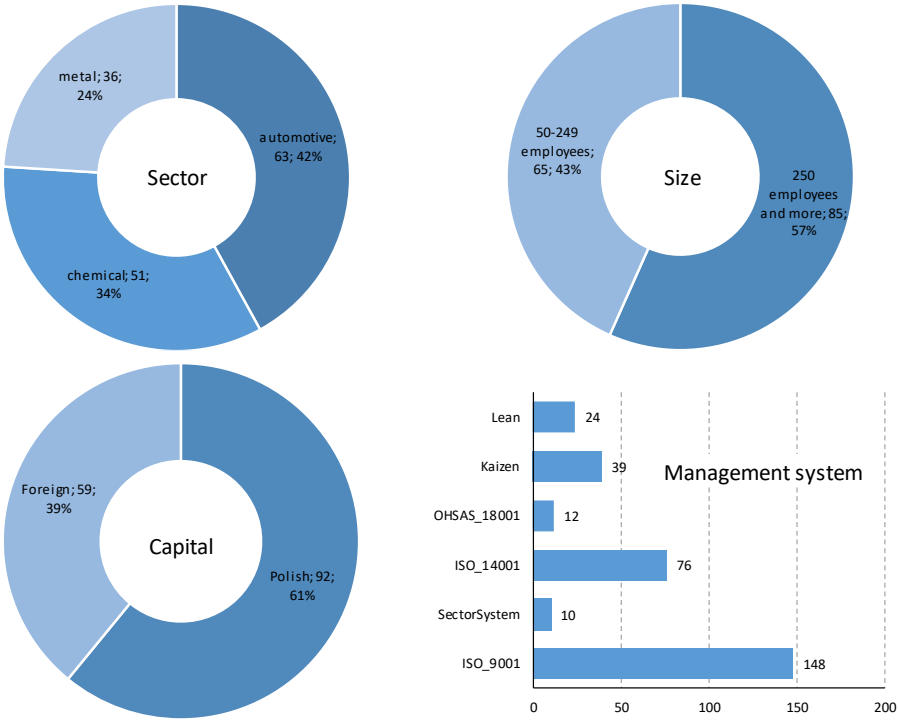


Fig. 1. Main characteristics of the sample

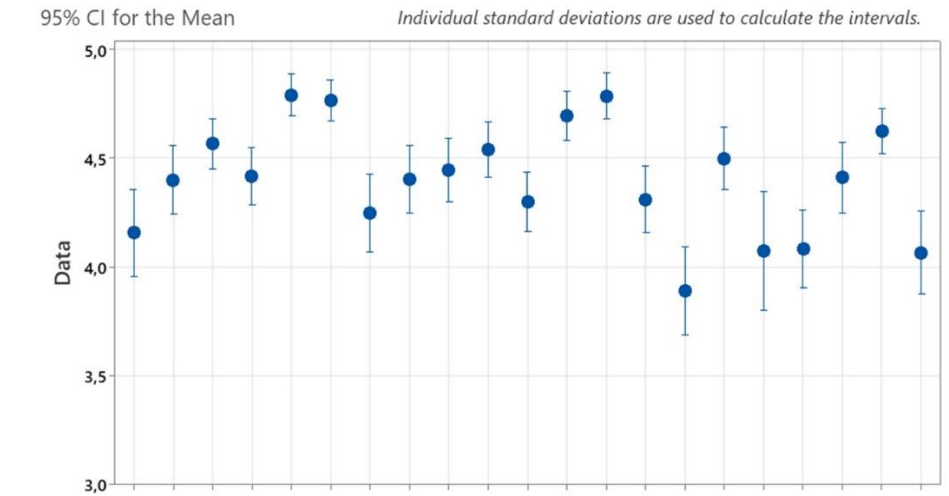
Before the actual evaluation of the results, we tested the validity of the data. Non-response bias was tested by splitting the sample into early (n=71) and late (n=79). We then randomly selected ten variables between these groups. The results of the t-test reached a p-value higher than 0.05, indicating a lack of non-response bias. Scale reliability of 21 ordinal variables was performed by individual investigation. Cronbach's alpha reached 0.925, which indicates a high level of reliability. In the suitability test of the variables, we noted only insignificant improvements that would have occurred if we excluded the given variable from the analysis - Table 2. However, by excluding it, we would have lost a much higher interpretive ability, so we kept all the variables in the analysis.

Figure 2 shows an overview of the average values of expectations of manufacturing companies for suppliers regarding the improvement of their processes. The result shows that the respondents assigned high values to almost all variables - usually higher average values than 4. The highest values were achieved by QCDel (Quality control of the accepted delivery), QCFinProd (Quality control of the finished product) and QCOrdDel (Control of compliance of the accepted delivery with the order). All these variables relate to quality control, which is an interesting finding. It is, therefore, evident that quality control plays a critical role in in building proper relationships with suppliers.

It can be observed that companies operating in the production sectors, while improving their processes, also require actions in this area towards suppliers. The results of these studies indicate that the expectations of production companies towards suppliers focus primarily on ensuring and improving the technical quality of products. For this reason, the expectations of the surveyed business entities towards suppliers relate primarily to the improvement of the effectiveness of control processes (acceptance of deliveries, production, finished products) in order to avoid the risk of product non-compliance.

Table 2. Testing of reliability if item deleted

Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
ProdDes	87,500	103,206	0,793	0,917
SuppOrd	87,333	109,647	0,328	0,928
VendSel	87,222	112,301	0,261	0,928
SuppEva	87,444	103,908	0,675	0,920
QCDel	87,000	105,059	0,771	0,918
QCOrdDel	87,000	105,765	0,723	0,919
AccOrd	87,556	102,732	0,675	0,920
TechnPre	87,111	112,340	0,476	0,924
ProdPlan	87,333	103,765	0,777	0,918
Production	87,333	108,941	0,463	0,924
Maint	87,611	101,663	0,805	0,917
QCProdProc	87,167	109,206	0,633	0,921
QCFinProd	87,000	109,647	0,532	0,922
Packing	87,278	107,859	0,650	0,920
ProdStor	87,833	100,971	0,636	0,921
CustDel	87,000	109,647	0,624	0,921
ProdInst	87,500	111,088	0,366	0,926
Train	87,722	107,977	0,614	0,921
TechServ	87,056	112,526	0,378	0,925
CompServ	86,889	112,575	0,420	0,924
WastDisp	87,444	100,732	0,853	0,915



Characteristic	ProdDes	SuppOrd	VendSel	SuppEva	QCDel	QCOrdDel	AccOrd	TechnPre	ProdPlan	Production	Maint	QCProdProc	QCFinProd	Packing	ProdStor	CustDel	ProdInst	Train	TechServ	CompServ	WastDisp
Mean	4,16	4,40	4,57	4,42	4,79	4,77	4,25	4,40	4,45	4,54	4,30	4,70	4,79	4,31	3,89	4,50	4,70	4,80	4,41	4,63	4,70
Median	4,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	4,00	5,00	5,00	5,00	4,00	5,00	4,00	4,00	5,00	5,00	4,50
Geometric Mean	4,20	4,30	4,51	4,32	4,74	4,72	4,11	4,29	4,34	4,46	4,21	4,63	4,72	4,18	3,73	4,40	3,90	3,95	4,30	4,58	3,89
Harmonic Mean	3,83	4,15	4,45	4,17	4,67	4,65	3,92	4,15	4,18	4,33	4,11	4,53	4,59	3,98	3,53	4,23	3,62	3,75	4,90	4,52	3,66
Std, Deviation	0,92	0,82	0,65	0,78	0,57	0,57	0,95	0,86	0,85	0,74	0,80	0,67	0,63	0,88	1,01	0,81	1,01	0,89	0,83	0,63	1,07
Skewness	-1,10	-1,30	-1,40	-1,66	-3,31	-3,05	-1,04	-1,43	-1,47	-1,85	-0,87	-2,54	-3,62	-1,46	-0,63	-1,81	-1,08	-1,05	-1,76	-1,46	-0,72
Kurtosis	1,03	1,60	1,62	3,51	11,86	10,71	0,26	1,25	1,71	4,11	-0,05	6,50	14,51	2,29	-0,39	3,32	1,20	1,50	4,14	0,98	-0,54

Fig. 2. Results of variables analysis

We also monitored the implemented management system in the sample of organizations. It must be said that almost all the companies involved had an ISO 9001 system implemented. However, several of them also had other systems implemented. Using a 2 Sample t-test, we examined whether organizations that implemented particular managerial systems reported higher values for individual variables. An example of the analysis can be found in Figure 3 (Fig.3.A. and Fig.3.B.) In the upper part of the Figure 3, there can be seen a graphical interpretation of the differences between the analyzed groups - in the sample, there can be seen the differences in the ProdDes response for organizations that had implemented ISO 14001 (value 1) and those that had not implemented ISO 14001 (value 0). At the same time, the exact values of two samples (with ISO 14001 and without ISO 14001) and the calculated difference between samples can be found on the left side. At the bottom of the Figure 3, two run charts show the time-ordered results (for anomaly analysis) of the monitored variable ProdDes for the two monitored groups of manufacturers (with ISO 14001 = "1" ; without ISO 14001 = "0"). In the very bottom part of the picture, there is a calculation of the power of the test - that is, the detection ability of the test allows the identification of statistically significant differences. Detection power is largely determined by sample size.

We included six management tools in the analysis - ISO 9001, Sector system, ISO 14001, ISO 45001, Kaizen, and Lean Management. At the same time, we added capital to the analysis. In total, seven aspects were analyzed for all 21 variables. The analysis, which can be found in Figure 3, was thus repeated 154 times (7x21). Its results can be found in Table 3.

The table 3 contains values representing the difference between the average reported by companies with a particular system and the average of companies without a particular system. Among the respondents were organizations that implemented various management systems. The table 3 shows, that to significant results between companies using different management systems. These differences will be discussed further in the discussion section.

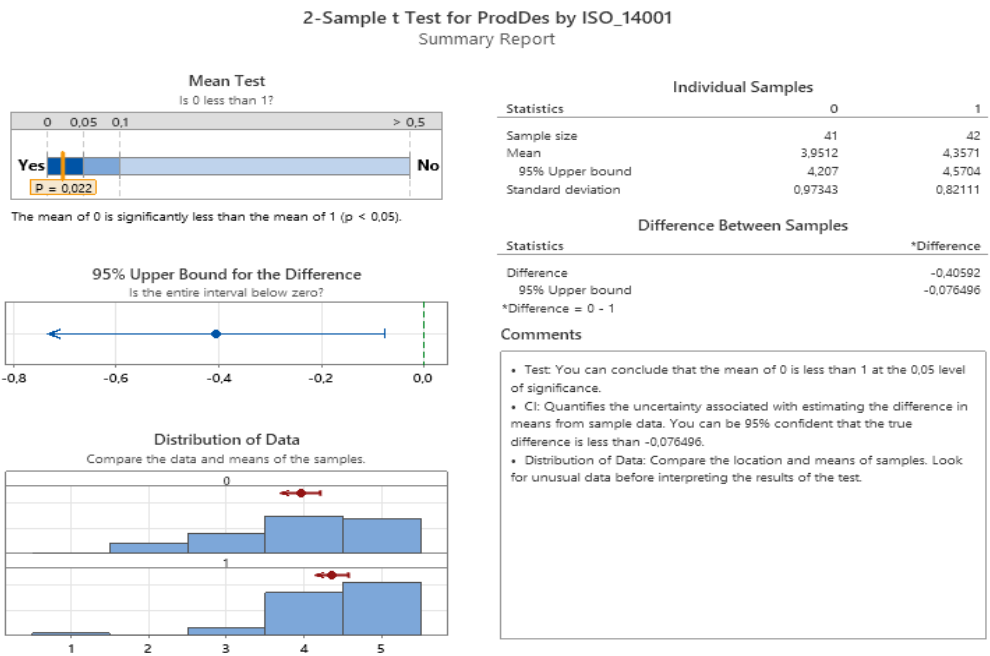


Fig. 3.A. Example of testing differences by 2 Sample t-test

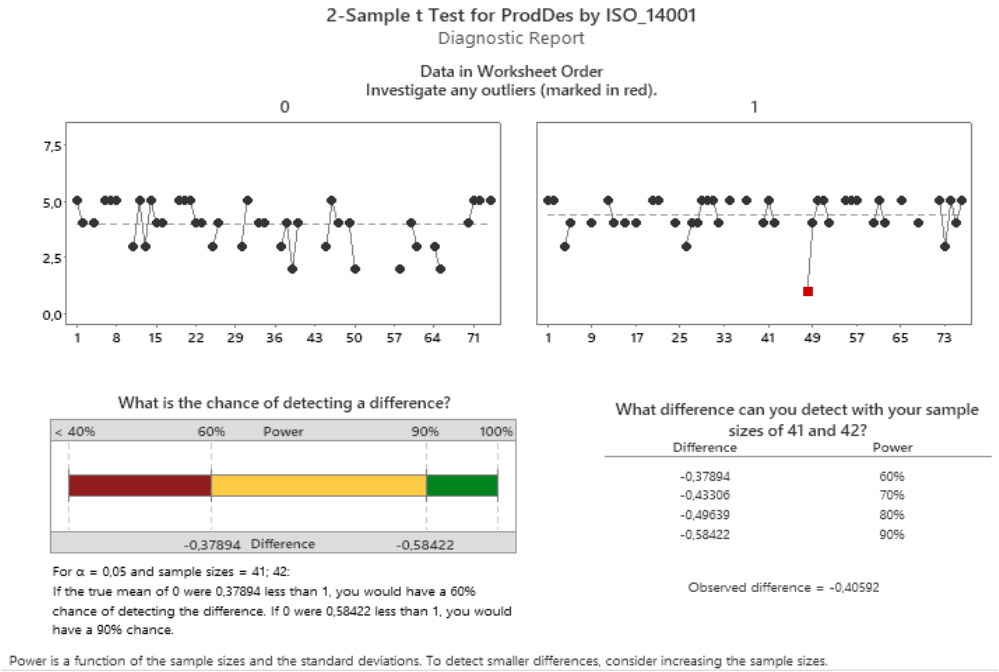


Fig. 3.B. Example of testing differences by 2 Sample t-test

Table 3. Differences of average values related to system (non)implementation

Variable	Capital	ISO_9001	SectorSystem	ISO_14001	ISO 45001	Kaizen	Lean
ProdDes	0,441*	NA	-	0,405*	0,447*	-	0,622**
SuppOrd	-	NA	-	-	-	0,399*	0,456*
VendSel	-	NA	-	-	-	-	-
SuppEva	-	-	-	0,388*	-	0,422*	0,370*
QCDel	-	NA	-	0,184*	-	-	0,202*
QCOrdDel	-	-	-	-	-	-	-
AccOrd	0,301*	-	-	-	-	-	-
TechnPre	-	NA	0,524**	-	0,476**	0,293*	0,412**
ProdPlan	-	-	0,491**	-	-	-	-
Production	0,230*	-	0,387*	-	0,413**	0,375**	-
Maint	-	NA	-	-	-	-	-
QCProdProc	-	NA	0,220*	-	-	-	-
QCFinProd	-	NA	NA	-	-	-	NA
Packing	-	-	-	-	-	-	-
ProdStor	0,564**	-	-	0,386*	-	-	-
CustDel	-	-	-	0,307*	-	-	-
ProdInst	-	-	-	-	-	-	-
Train	-	NA	-	0,402*	0,577**	-	-
TechServ	-	NA	-	0,340*	0,319*	-	-
CompServ	-	NA	-	0,222*	0,316**	-	-
WastDisp	-	-	0,691**	0,490**	0,627**	-	-

*NA – not available (not enough data); * p<0,05 ; ** p<0,01.*

The correlation structure was examined to determine whether there are latent patterns among the 21 variables. Bivariate linear correlation analysis was used, while the Pearson correlation coefficient was chosen as the primary metric. The results of the intensity of interrelationships between variables can be found in Figure 4.

The correlation analysis results indicate a rather complex correlation structure between the variables, which could indicate the existence of latent factors. We, therefore, explored such a possibility through factor analysis - the results are found in Table 4.

Table 4 shows the level of explained variability in the case of the application of exploratory factor analysis. This is a standard way of checking the interpretive potential of factor analysis. Each row of the table shows the results of the measure of explained variability if a specific number of factors were extracted. So, for example, if we were to extract only one factor (the first row of the table), it would be able to explain 26% of the variability, which is insufficient. If we were to extract two factors, the rate of explained variability would be 48.58%. This was done until such a number of factors were identified that the eigenvalue was higher than 1. In our case, it was in a situation where we extracted four factors from the data. Together, they explain up to 79.67% of the variability, which is a sufficiently high level for later interpretation of the data. Table 5 shows the rotated factor matrix.

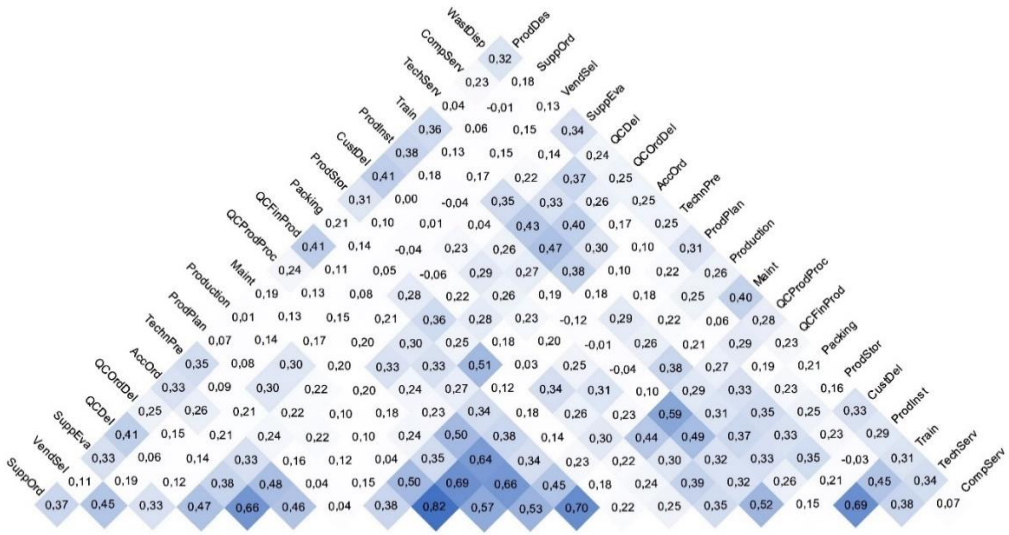


Fig. 4. Correlation map of analyzed variables

Table 4. Results of factor analysis

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %
1	9,11	43,37	43,37	9,11	43,37	43,37	5,49	26,14	26,14
2	3,55	16,91	60,28	3,55	16,91	60,28	4,71	22,44	48,58
3	2,37	11,27	71,55	2,37	11,27	71,55	3,34	15,91	64,49
4	1,71	8,13	79,67	1,71	8,13	79,67	3,19	15,18	79,67
5	0,93	4,43	84,10						
...	...	...	...	...	...	...	...	...	...
21	<0,00	<0,00	100,00						

Table 5. Rotated factor matrix

Variable/factor	Factor 1	Factor 2	Factor 3	Factor 4
QCFinProd	**0,841**	0,061	0,239	-0,071
QCOrdDel	**0,838**	0,281	-0,047	0,319
TechServ	**0,800**	0,115	-0,047	-0,224
CustDel	**0,772**	0,374	0,074	-0,070
CompServ	**0,734**	-0,216	0,583	-0,129
QCDel	**0,693**	0,500	-0,156	0,417
ProdDes	**0,644**	0,410	0,048	0,463
Train	**0,581**	0,513	0,011	0,055
Packing	0,097	**0,836**	0,233	0,105
AccOrd	0,225	**0,830**	0,162	0,092
ProdStor	0,360	**0,810**	0,148	-0,148
ProdInst	0,072	**0,748**	-0,146	-0,045
ProdPlan	0,137	**0,719**	0,445	0,318
WastDisp	0,479	**0,499**	0,357	0,424
Production	-0,036	0,197	**0,919**	0,161
TechnPre	-0,115	0,167	**0,787**	0,437
QCProdProc	0,457	0,077	**0,726**	0,195
Maint	0,164	0,525	**0,568**	0,532
VendSel	-0,133	-0,064	0,257	**0,832**
SuppOrd	-0,059	0,010	0,279	**0,773**
SuppEva	0,598	0,156	0,016	**0,683**

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization; a Rotation converged in 17 iterations.

Four factors could be named based on the intensity of their relationships to specific risk factors. In naming, the internal meaning of risk factors was considered, and a search was done for common features of those variables that formed a group belonging to a specific factor. The resulting factors are as follows:

- Factor 1 (Logistics customer service) – consists mainly of following variables: QCFinProd, QCOrdDel, TechServ, CustDel, CompServ, QCDel, ProdDes, Train. This factor includes elements related to the broadly understood logistics customer service (in all its phases) and processes related to the delivery of the service to the customer.
- Factor 2 (Supervision over property customer) – consists mainly of following variables: Packing, AccOrd, ProdStor, ProdInst, ProdPlan, WastDisp. This factor includes processes related to communication with the client and proper supervision over his property,
- Factor 3 (Production monitoring) – consists mainly of following variables: Production, TechnPre, QCProdProc, Maint. This factor covers processes primarily related to improving the effectiveness of control processes in order to avoid the risk of non-conformity of products.
- Factor 4 (Supplier supervision) – consists mainly of following variables: VendSel, SuppOrd, SuppEva. This factor concentrates processes related to maintaining proper relations with suppliers.

5. Discussion and implications

The research results indicate that representatives of manufacturing companies set high expectations regarding all aspects examine (usually higher average values than 4 in five-point scale). The results of empirical research, it should be stated that the expectations of production companies towards suppliers focus primarily on ensuring and improving the technical quality of products. For this reason, the expectations of the surveyed business entities towards suppliers relate primarily to the improvement of the effectiveness of control processes (quality control of the accepted delivery, quality control of the finished product and control of compliance of the accepted delivery with the order) in order to avoid the risk of product non-compliance. In the case of non-compliance by customers, complaint proceedings are initiated. On the other hand, if product non-conformities are not detected, emergency situations (such as accidents during product processing / use, or threats to

the environment) may occur. It can also be seen that the expectations of enterprises towards suppliers focus on the improvement of their processes related to production (planning, technical preparation, processing, product packaging, maintenance). These expectations also apply to the improvement of cooperation between partners and building partnerships with them (Lettice, Wyatt, Evans 2010). For this reason, the expectations of manufacturers are strongly focused on the initial and periodic assessment of sub-suppliers, as well as effective communication with customers (complaint handling, order acceptance, training and advice related to the use of the product).

The research process also allowed for the identification of differences between respondents resulting from the implementation of different management standards. Based on this, we observed that organizations which had implemented SectorSystem attach higher importance to five areas: TechnPre; ProdPlan; Production; QCProdProc; WasteDisp. These attributes well characterize the main steps of the production process flow, which means, that the scope of sector systems includes a holistic approach to the most important logistics subsystems in supply chains (Kanan, 2023). Interesting findings are also provided by looking at the expectations of organizations implementing ISO 14001. Such organizations had higher expectations in nine areas: ProdDes; SuppEva; QCDel; ProdStor; CustDel; train; TechServ; CompServ; WastDisp. Such results could be explained by the fact that ISO 14001 is a system that goes beyond the organization and covers many areas from its external environment (Zimon et al., 2020). The more interested parties the system takes into account, the more requirements these stakeholders must meet. Thus, according to our results, the fulfillment of requirements can be transferred to expectations towards suppliers. In the case of buyers who envisaged an occupational health and safety system compliant with the requirements of ISO 45001, the expectations towards suppliers are particularly focused on improving the processes of ProdDes, TechnPre, Production, Train, TechServ, CompServ, WastDisp. It can therefore be indicated that the expectations of these enterprises are related to the improvement of process safety by suppliers (Medina Serrano et al., 2019). Respondents who have implemented the Kaizen concept clearly expect the improvement of such processes as SuppOrd, SuppEva, TechnPre and Production. This is due to the expectation of avoiding nonconformities and implementing improvement actions by suppliers. Companies that implement Lean projects strongly associate their expectations towards suppliers with such processes as: ProdDes, SuppOrd, SuppEva, QCDel, TechnPre. This is due to the expectations of improving efficiency and effectiveness by suppliers.

The deepening of the research process made it possible to identify four factors that are particularly important for manufacturing companies. The first two of them covered aspects related to the proper implementation of customer logistics and supervision over customer property. The indication of these factors may be due to the fact that most of the surveyed enterprises have implemented the requirements of the ISO 9001 standard, which strongly emphasizes the need to fully focus on customer service. (Fonseca et al., 2022; Tomic and Brkic, 2018). The third and fourth factors covered aspects related to ensuring the proper course of production processes and maintaining relations with suppliers. These aspects are undoubtedly important for ensuring the continuity of product supply. In addition, their mutual relationships are important as it recognizes Su et al. (2020) ISO 9001 is more effective when firms are well embedded in the supply chain network and least effective when they are isolated. Therefore, manufacturing companies seem to take special care of the correct implementation of key processes from the customer's point of view and the reliability of the main processes.

The conducted research provides insight into the attitude of manufacturing companies towards their suppliers. This study suggests that manufacturing companies that implement management systems place high demands on their suppliers, but not all aspects are equally important. Moreover, the integration of the quality management system according to the ISO 9001 standard with other systems affects the assessment of individual expectations of production companies towards suppliers. Entrepreneurs who have implemented the requirements of the ISO 14001 standard prioritize expectations towards suppliers differently than entrepreneurs who have not implemented this standard or have decided to implement other systems. Based on the obtained research results, 4 basic factors were also identified, containing particularly important requirements for suppli-

ers. In addition, it can be stated that the implementation of management systems creates a framework for managers to formulate requirements towards their suppliers. Manufacturer standards become required supplier expectations. Only in this way is the supplier ready to meet the manufacturer's expectations regarding the technical quality of the ordered product. This is important because coordination and cooperation in the supply chain as well as setting clear requirements for suppliers contribute to the increase in the efficiency of customer service. Based on the obtained research results, managers of organizations supplying manufacturing companies can obtain important information that will be used to improve processes that are important from the point of view of their recipients. On this basis, they can make optimal allocation of resources and modify the management style to improve cooperation with manufacturing companies. The conducted research process can also be an inspiration for researchers who would like to deepen the research process with management systems not discussed in this publication or treat the article as a starting point for further research in this important area.

6. Conclusions

The considerations undertaken in this article confirm that in order to compete on the modern market, close cooperation and cooperation within the supply chain are needed. Representatives of the surveyed manufacturing companies notice this fact and set high expectations for their suppliers in virtually all the surveyed aspects. The research shows that suppliers must pay special attention to the implementation of processes related to ensuring and improving the technical quality of products by focusing on improving control and supervision processes and logistical aspects of customer service. Proper implementation and improvement of these processes requires a methodical approach. For this reason, many enterprises require their suppliers to implement a quality management system in which the sequential stages of quality control should be conducted with due care. It is also worth mentioning that proper relations with suppliers mean not only setting requirements for them, but also establishing lasting mutual cooperation.

The article has several limitations. Firstly, the sample consists of companies from Poland, therefore economy, politics and culture could have influenced results. The results we achieved can, therefore, only be generalized to culturally similar countries such as Poland. Another limitation is the sample size – 150 organizations participated in the survey. From a statistical point of view, this is the average sample size, where the average detection capability for statistical deviation analysis or statistical hypothesis testing must be taken into account. Thus, the sample meant that we were only able to identify medium and large differences in responses, while smaller ones may have gone undetected. Despite these limitations, it must be said that this study is exploratory and aims to explore a new area. In such cases, such a sample is usually sufficient, especially when it comes to narrow focused studies (Rumanti et al., 2021; Antony et al., 2021).

Presented in the article research can be considered an initial step in the wider context of the research program. The authors intend to conduct research on a larger scale in the future, taking into account companies operating in Eastern and Central Europe. The authors also hope that the presented results will be an impulse for researchers to take up and develop the problems indicated in the article.

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