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CHARACTERIZATION OF SMALL AND MEDIUM ENTERPRISES (SMES) OF POMERANIAN REGION IN SIX SIGMA METHODOLOGY APPLICATION

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ABSTRACT. **Background:** Six Sigma is related to product's characteristics and parameters of actions, needed to obtain these products. On the other hand, it is a multi-step, cyclic process aimed at the improvements leading to global standard, closed to the perfection. There is a growing interest in Six Sigma methodology among smaller organizations but there are still too little publications presented such events in the sector of small and medium enterprises, especially based on good empirical results. It was already noticed at the phase of the preliminary researches, that only small part of companies from this sector in Pomerian region use elements of this methodology.

Methods: The companies were divided into groups by the type of their activities as well as the employment size. The questionnaires were sent to 150 randomly selected organizations in two steps and were addressed to senior managers. The questionnaire contained the questions about basic information about a company, the level of the knowledge and the practical application of Six Sigma methodology, opinions about improvements of processes occurring in the company, opinions about trainings in Six Sigma methodology.

Results: The following hypotheses were proposed, statistically verified and received the answer:

- The lack of the adequate knowledge of Six Sigma methodology in SMEs limits the possibility to effectively monitor and improve processes - accepted.
- The use of statistical tools of Six Sigma methodology requires the broad action to popularize this knowledge among national SMEs - accepted.
- The level of the awareness of the importance as well as practical use of Six Sigma methodology in manufacturing SMEs is higher than in SMEs providing services - rejected, the level is equal.
- The level of the knowledge and the use of Six Sigma methodology in medium manufacturing companies is significantly higher than in small manufacturing companies - accepted.
- The level of the knowledge and the application of elements of Six Sigma methodology in SMEs is positively appreciable by these companies, which implemented the QMS -accepted.
- SMEs prefer to improve already existing processes rather than radically to redesign them in order to reduce the inconstancy - accepted.

Conclusions: The level of the knowledge of tools and techniques of Six Sigma methodology in SMEs in Pomeranian region is low and requires a broad popularization action. The level of the awareness of the significance as well as the practice of the use of Six Sigma methodology in manufacturing companies is not significantly different from that one in companies providing services, but it is higher in medium ones in comparison to smaller ones. The introduction of QMS has also a positive influence on this level. The companies of this sector prefer to improve processes rather than to redesign them.

Key words: Six Sigma, small and medium enterprises, researches.

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INTRODUCTION

The concept of Six Sigma, which continuously gains in the importance, derives from theories, which put the strong emphasis on the role of a process in the management of organization. On the one hand, Six Sigma is the synonym of the highest global standard and is related to product's characteristics as well as parameters of actions, needed to obtain these products [George 2003, Truscott 2003]. On the other hand, it is a multi-step, cyclic process aimed at the improvements leading to already mentioned standard, closed to the perfection [Truscott 2003]. Although the elements of Six Sigma are successfully implemented in big organizations, both production and service ones, there are still too little publications presented such events in the sector of small and medium enterprises, especially based on good empirical results [Antony, Kumar, Madu 2005; Wiele, Brown 1998; Wessel, Burcher 2004, Brun 2011, Bratić 2011].

There is a growing interest in Six Sigma methodology among smaller organizations, which should seem to be understood due to the fact, that they are also the suppliers of bigger organization, operating on the global market [Kumar, Antony, Douglas 2009]. At the same time, the big companies, due to growing demands of their customers, cooperate with those suppliers, who are able to meet successfully those expectations [Dominiak 2005, Wessel, Burcher 2004].

As a part of the research project of the Ministry of Science and Higher Education entitled "The group implementation of selected elements of the Six Sigma concept in small an medium enterprises of Pomeranian Region", the Authors conducted a study, aimed to identify the problems and needs related to the knowledge and the practical implementation of this concept. The results have to give the answer, whether it is justified to introduce this methodology in smaller organizations as well as to determine the scope of this implementation. Due to the specific character of researched area (SMEs), there is a need to develop the appropriate implementation concept of Six Sigma, the methods so far used and implemented successfully in big companies.

Key results and conclusions are presented in this paper, which can be the basis to develop the appropriate methodological recommendations.

THE AIM OF THE RESEARCH

The aim of these researches was to identify the level of the knowledge and the implementations of Six Sigma concept in the monitoring and improving of processes in small and medium enterprises of Pomeranian Region. As it was already noticed at the phase of the preliminary researches, only small part of companies from this sector use elements of this methodology. A lot of respondents from this sector do not see the need for a methodical approach to monitoring and improving of processes and act more intuitively [Grudowski 2006].

CHARACTERISTICS OF TESTED SAMPLES

The study was conducted in the period from December 2009 to September 2010. In order to identify the receivers of the questionnaires, the procedure of layer samples was implemented, using the previously verified address database. The companies were divided into groups by the type of their activities (production, service, and mix) as well as the employment size (up to 10 persons, 11-50 persons, 51-250 persons). The questionnaires were sent in two steps and the mailing was renewed in case of the absence of a response in the expected period.

The questionnaires were sent to 150 randomly selected organizations by post mail (together with the return envelope), e-mail or passed in person.

The covering letter was attached to the questionnaires, which explained the purpose of this study. The anonymity of the respondents was reserved. The questionnaires were addressed to senior managers. In case the company has a normative management system, the questionnaires were addressed to managers responsible for the management system, in other cases – to production managers or chief executives.

The complete responses were obtained from 36 subjects (24%). There was additionally 8 mail returns, due to the shutdowns or the address change of the company.

RESEARCH METHODOLOGY

The questionnaire contained the questions about:

1. basic information about a company (number of employees, type of the activity, normative management systems introduced in a company),
2. the level of the knowledge and the practical application of Six Sigma methodology,
3. opinions about improvements of processes occurring in the company,
4. opinions about trainings in Six Sigma methodology (this part of research will be presented in the separate paper).

The assessment of the quality of the scale used in the questionnaire was necessary before the statistical analysis could be conducted. For this purpose, the assessment of the reliability and the validity of the scale were carried out. This scale was developed for two parts of the questionnaire, i.e. "Knowledge and application of Six Sigma methodology" and "Opinions about the improvement of processes in the company".

The reliability of the scale determines the precision of the research tool, in this case - of the multi-position measuring scale, to provide the exact data. The reliability is formally defined as the proportion of the variance of true results to the variance of results obtained. The measurement is reliable if the results obtained by the use of the scale are the same or similar in the subsequent measurements.

The internal consistency method, using α-Cronbach coefficient is commonly used to verify the reliability of designed measurement scales used to estimate the responses of questionnaires. This method allows determining the extent to which the elements forming the scale are correlated and consistent with the measurement of the concept represented by them.

The value of the α-Cronbach coefficient is between 0 and 1. The values over 0,7 show the high reliability of the scale [Saraph, Benson, Schroeder 1989].

The calculations were conducted by the use of the appropriate procedure of the STATISTICA package. The obtained value of α for the adopted scale of the research tool was 0,83, which means that the scale is reliable. The values of α-Cronbach coefficient were determined according to the rule: "whether the α coefficient for the scale will increase, if the element having the weakest correlation with the scale is eliminated?" It was found that the average correlation among all elements of the scale (aspects of process approach) was close to 0.6, each element had similar contribution to the reliability of the scale and removing one of them would reduce the value of the α coefficient and thereby reduce the reliability of the scale.

The validity of the measurement scale means its ability to give information about the factor, which is measured. It informs also whether the goal of the measurement process was reached or not. The measurement scale can be reliable and not accurate but it cannot be accurate without being reliable. Therefore, the reliability should be regarded as the necessary condition of the validity and not only the sufficient one.

The assessment of the validity of the scale designed to measure the responses, was conducted according to the approach described by Saraph, Benson and Schroeder [1989]. The following types of validities were taken into consideration:

- content validity,
- criterion validity and
- construct validity.

The content validity is the subjective and systematic evaluation, whether the measurement scale covers the scope of the measured object. The criterion validity gives information, how the result of the measurement is consistent with the other criterion, related to the impact of the measured characteristics, whether the results obtained by the used of given tool can be confirmed by the use of any other measurement tool. The multiple regression was used to confirm numerically the criterion validity.

The construct validity is the most important one. It determines the degree, to which the scale adopted for the study, estimates the construct (the methodology of Six Sigma). The factor analysis is the most commonly used approach to confirm whether the adopted scale has the proper construct validity. It is estimated, whether the measurement scale is one-dimensional and whether all items of the scale make significant contribution to define the construct. In case the scale is not one-dimensional, it cannot be used to assign aggregated numerical measure, obtained from averaging marks of its individual aspects, to a construct. So called factor loadings, calculated as a result of factor analysis, indicate the saturation ratio by this factor and the correlation coefficients of a variable with other factors.

The application of proper analytical procedures confirmed the required quality of the measurement scale and therefore allowed to use the results obtained.

The analysis of results of the questionnaires was made by the use of STATISTICA and MS Excel softwares. The following calculations of results were conducted:

- normal distribution of random variables by the use of Shapiro-Wilk test,
- verification of the homogeneity of variance by the use of Brown and Forsyth test,
- verification of parametric statistical hypotheses by the use of:
  - t-test of differences of mean values for independent samples,
  - t-test for mean values, right-side,
- the significant level α=0,05 was assumed for all above mentioned tests.

RESULTS

Tables 1 and 2 present the characteristics of respondents.

Table 1. Types of surveyed companies by the type of the activity
Tabela 1. Podział badanych przedsiębiorstw ze względu na rodzaj działalności

Type of activity	Number of companies	Share % in the sample
service	6	17
service and production	9	25
production	21	58

Source: own work

Table 2. Types of surveyed companies by the size of the employment
Tabela 2. Podział badanych przedsiębiorstw ze względu na wielkość zatrudnienia

Number of employees	Number of companies	Share % in the sample
<10 (micro companies)	3	8
11÷50 (small companies)	9	25
51÷250 (medium companies)	24	67

Source: own work

The level of the knowledge and practical application of Six Sigma methodology

The primary aim of this study was to determine the extent to which the respondents are familiar with and make the use of elements of Six Sigma methodology. Preliminary tests conducted by Authors indicated that only the standard methods of passive control of products based on the visual assessment or the use of measurement tools were used to monitor operational processes in smaller companies. Only a few of questioned companies used the quality analysis of process capacities and process control supported by statistical analysis of data. As a response to the question related to the use of commonly known methods of the identification of problems or the analysis of data connected with the quality processes, many managers answered that they did not see needs for such methods or they did not have knowledge about it. Many companies operate intuitively, using a brainstorming session as the only method used to improve the processes. It should be noted, they are companies that have certificates of the quality management system (QMS), which requires the use of methods of data analysis.

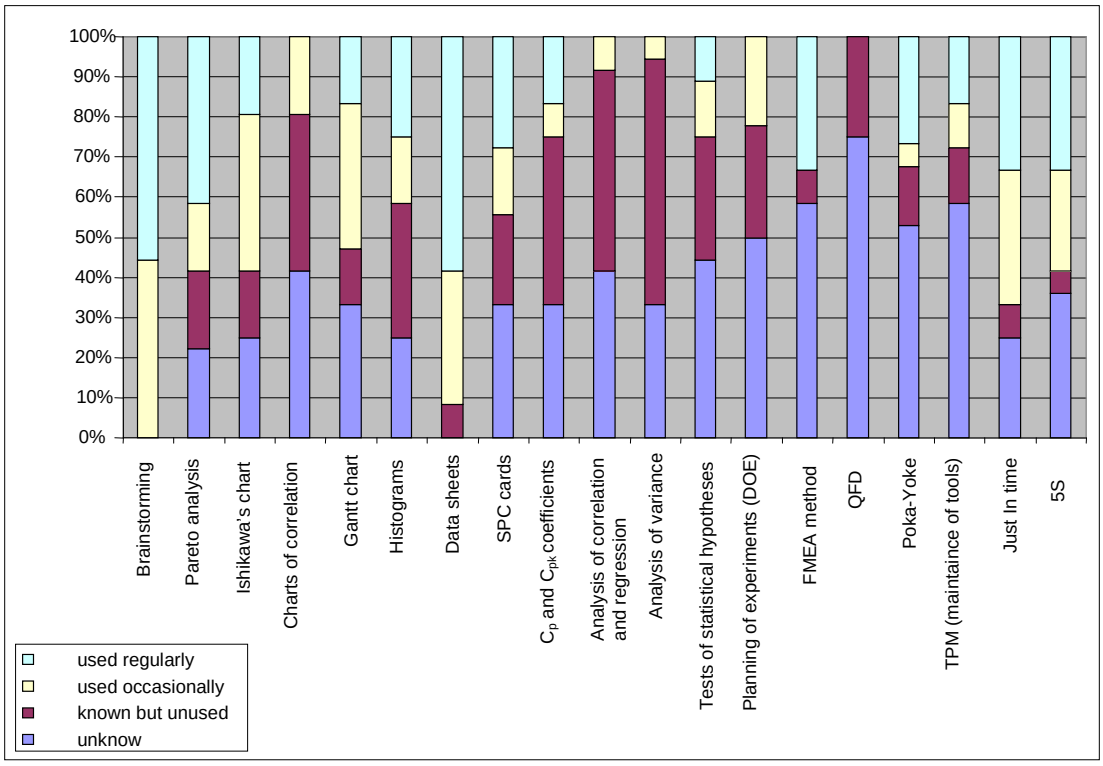
Referring to the results, the following hypotheses were assumed:

Hypothesis 1: The lack of the adequate knowledge of Six Sigma methodology in SMEs limits the possibility to effectively monitor and improve processes.

Hypothesis 2: The use of statistical tools of Six Sigma methodology (control cards, analysis of quality capacity, DoE, ANOVA, correlation and regression) requires the broad action to popularize this knowledge among national SMEs (promotion, free of charge trainings, postgraduate studies, courses, etc). The local authorities, universities and other institutions should be involved in this process.

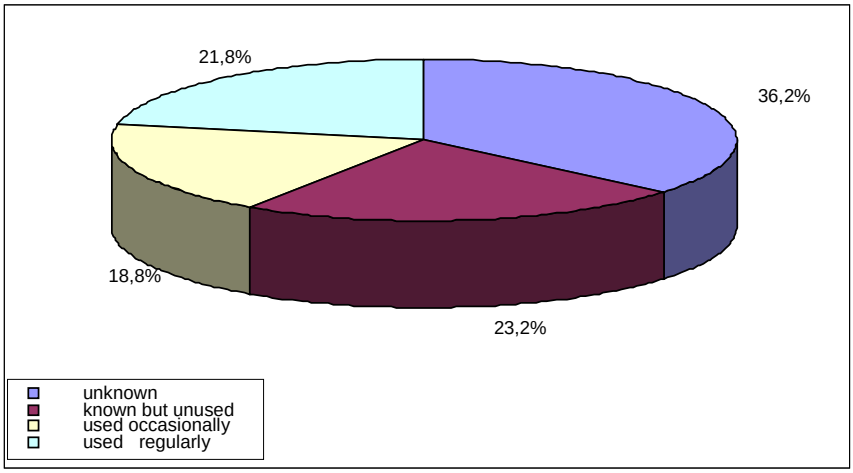
The special set of methods, tools and techniques of Six Sigma was prepared to assess the level of the knowledge and practical use of elements of Six Sigma methodology as well as to verify the proposed hypotheses H1 and H2. The following classification scale was applied: “we do not know”, “we know, but we do not use”, “we use occasionally” and “we use regularly”.

The percentage share of responses of each category is presented in the Figure 1. The conclusion, based on this, can be made, that the knowledge of elements of Six Sigma methodology is very low. There was no answer “we do not know” only in case of two methods: the brainstorming and data sheets. It can be concluded, that every meetings and attempts to solve current problems are considered as brainstorming and MS Excel spreadsheets, used simply to set together data and to prepare graphic presentations of them, are considered to be data sheets. Therefore, it seems reasonable not to take into consideration these responses in the further analysis.



Source: own work

Fig. 1. Percentage shares of responses describing the knowledge and practical application of key methods, techniques and tools of Six Sigma
Rys. 1. Procentowy udział odpowiedzi opisujący znajomość i praktyczne stosowanie kluczowych metod, technik i narzędzi Six Sigma



Source: own work

Fig. 2. Cumulative percentage shares of responses describing the knowledge and practical application of key methods, techniques and tools of Six Sigma
Rys. 2. Skumulowany procentowy udział odpowiedzi opisujący znajomość i praktyczne stosowanie kluczowych metod, technik i narzędzi Six Sigma

The level of the knowledge of other methods, tools and techniques is also very low. The cumulative percentage share of the response "unknown" is very high and is equal to 36,2% (Fig. 2). The representatives of SMEs do not know even the simplest tools like histograms (25% of responses "unknown") or Pareto analysis (22,2%). In case of methods that are even more sophisticated the percentage share of the response "unknown" was even higher and for example, for FMEA method – 58,4% or for QFD – 75%. It should be mentioned there were only three questionnaires, where there was no answer "unknown". The average number of such answers was 6-10. There were two cases, where even 17 responses were "uknown". They were small firms offering services.

The most regularly used methods were: Pareto analysis (41%), FMEA method (33,3%), 5S (33,3%), SPC cards (27,8%) and histograms (25%). It should be mentioned, that these responses were given mostly by the manufacturing companies.

Based on these results, there is no reason to reject the Hypothesis H1. There is no adequate knowledge of Six Sigma methodology among SMEs, which significantly limits the possibility of effective monitoring and improving of processes.

The answer "known but unused" (23,2%) was the next most frequently given answer, which together with answer "unkown" gives nearly 60% of all responses. Therefore, not only the level of the knowledge of Six Sigma methodology is very low in our SMEs but also the level of the use of basic methods available in Six Sigma methodology. Even, if there is not always a need to use a big number of various tools, it can be concluded, that the companies do not use them due to the lack of appropriate formalized approach (guidelines, manuals).

The individual interviews conducted by Authors with the representatives of SMEs indicate that if the SMEs had better prepared staff and received systemically organized assistance in the implementation, supported by examples of benefits of their use, the situation certainly would be improved. Therefore there is no reason to reject the hypothesis H2, since there is a possibility to effectively increase the level of the knowledge and use of Six Sigma methodology thanks to such activities as the promotion of this knowledge, free of charge training, practical workshops organized with the support of local authorities and universities (such solutions can be found already in other countries).

The level of the knowledge and practical application of elements of Six Sigma methodology in SMEs sector

Another part of the questionnaire was to enable to verify following hypotheses:

Hypothesis 3: the level of the awareness of the importance as well as practical use of Six Sigma methodology in manufacturing SMEs is higher than in SMEs providing services.

The null hypothesis to verify the above-mentioned one was assumed as follows:

H3-0: The average value of the estimation of the knowledge and the use of Six Sigma methodology ($x_{śr1}$) in manufacturing SMEs is not different from the average value of the estimation of the knowledge and the use of Six Sigma methodology ($x_{śr2}$) in SMEs providing services, i.e. $x_{śr1} - x_{śr1} = 0$.

The alternative hypothesis was assumed as follows:

H3-1: The average value of the estimation of the knowledge and the use of Six Sigma methodology ($x_{śr1}$) in manufacturing SMEs is higher than the average value of the estimation of the knowledge and the use of Six Sigma methodology ($x_{śr2}$) in SMEs providing services, i.e. $x_{śr1} - x_{śr1} > 0$.

The 5-grade Likert scale was applied to estimate the attitudes of respondents, where the value "1" means "definitely not", the value "3" means "neither yes nor no" and the value "5" means "definitely yes". The positions on Likert scale represent the approximation of normal and interval distribution of the characteristics.

The *t*-test for the differences of means for independent samples (manufacturing SMEs and SMEs providing services) was applied with regards to the knowledge and the practical application of

statistical control of processes, described by 5 aspects. The results of the analysis of data obtained from the verification of the hypothesis H1 are presented in the Table 3.

Table 3. Statistical data for the verification of the hypothesis H3
Tabela 3. Dane statystyczne do weryfikacji hipotezy H3

Knowledge and application of Six Sigma methodology					
manufacturing SMEs (n_1= 21)		SMEs providing services (n_2= 6)		Critical value $t_{0,05;25}$=2,06	Difference significant? yes/no
$x_{śr1}$	s_1	$x_{śr2}$	s_2	*t* value	
4,11	0,42	3,9	0,33	**1,14**	**no**

Source: own work

The results of the analysis indicate, there is no reason to reject the null hypothesis H3-0. It proves that the level of the awareness of the significance as well as the practical application of Six Sigma methods is the same both in manufacturing SMEs and in those, which provide services.

The next hypothesis was related to the size of the organizations.

Hypothesis 4: The level of the knowledge and the use of Six Sigma methodology in medium manufacturing companies is significantly higher than in small manufacturing companies.

The null hypothesis to verify the above-mentioned one was assumed as follows:

H4-0: The average value of the estimation of the knowledge and the use of Six Sigma methodology ($x_{śr1}$) in medium manufacturing companies is not different from the average value of the estimation of the knowledge and the use of Six Sigma methodology ($x_{śr2}$) in small manufacturing companies, i.e. $x_{śr1} - x_{śr1} = 0$.

The alternative hypothesis was assumed as follows:

H4-1: The average value of the estimation of the knowledge and the use of Six Sigma methodology ($x_{śr1}$) in medium manufacturing companies is higher than the average value of the estimation of the knowledge and the use of Six Sigma methodology ($x_{śr2}$) in small manufacturing companies, i.e. $x_{śr1} - x_{śr1} > 0$.

The *t*-test for the differences of means for independent samples (medium manufacturing companies and small manufacturing companies) was applied with regards to the knowledge and practical application of Six Sigma methodology. The results of the analysis of data obtained from the verification of the hypothesis H4 are presented in the Table 4.

Table 4. Statistical data for the verification of the hypothesis H4
Tabela 4. Dane statystyczne do weryfikacji hipotezy H4

Knowledge and application of elements of Six Sigma methodology					
medium manufacturing SMEs (n_1= 15)		small manufacturing SMEs (n_2= 6)		Critical value $t_{0,05;19}$=2,093	Difference significant? yes/no
$x_{śr1}$	s_1	$x_{śr2}$	s_2	*t* value	
4,28	0,38	3,70	0,11	**3,59**	**yes**

Source: own work

The rejection of the hypothesis H4-0 for the benefit of the hypothesis H4-1 indicates, that the level of the knowledge and the application of statistical Six Sigma methodology in medium manufacturing

companies is significantly higher than in the small manufacturing ones. It may indicates, that both the knowledge and the application of Six Sigma methodology is at the higher level due to the facts, they exist already longer and they have stronger cooperation with foreign partners, which use those methods.

In order to determine, whether the implementation of the quality management system (QMS) is connected with the positive assessment of the level of the knowledge and the application of elements of Six Sigma methodology, the following hypothesis was assumed:

Hypothesis 5: the level of the knowledge and the application of elements of Six Sigma methodology in SMEs is positively appreciable by these companies, which implemented the QMS.

The null hypothesis to verify the above-mentioned one was assumed as follows:

H5-0: The average grade on the knowledge and the application of elements of Six Sigma methodology in SMEs, which implemented the QMS, is smaller or equal to 4.

The alternative hypothesis was assumed as follows:

H5-1: The average grade on the knowledge and the application of elements of Six Sigma methodology in SMEs is bigger than 4 ("rather yes" and "definitely yes"), which indicates the positive estimation of the level of the knowledge and the application of elements of Six Sigma methodology in SMEs, which implemented the QMS.

The right-side *t*-test was applied to verify the null hypothesis. The results of the calculations are presented in the Table 5.

Based on values of mean partial estimations, the average value and the standard deviation for them was calculated for the whole construct, the knowledge as well as the application of Six Sigma methodology. The statistical values of tested *t*, calculated in regard to each aspect as well as to the construct, created by them, allow rejecting the hypothesis H5-0 in favor of the alternative hypothesis H5-1, which confirms the positive influence of the QMS implementation on the level of the knowledge and the application of Six Sigma methodology in SMEs.

Table 5. Results of statistical analysis for the verification of the hypothesis H5
Tabela 5. Wyniki analizy statystycznej danych weryfikujących hipotezę H5

The knowledge and the application of Six Sigma methodology					
	$x_{śr}$	s	importance	*t* value	H.5-0 („null")
The knowledge of elements of Six Sigma methodology is at the satisfactory level and brings the benefits	4,43	0,51	1	3,87	reject
The knowledge of elements of Six Sigma methodology is at the satisfactory level and brings the benefits	4,24	0,44	4	2,50	reject

Source: own work

Improvement of business processes in a company

The next part of the questionnaire concerned the improvement of processes. The opinions on that subject had to determine, whether SMEs seek only the improvement of existing processes or they are ready to redesign them in a radical way. In order to verify this opinion, the following hypothesis was assumed:

Hypothesis 6: SMEs prefer to improve already existing processes (DMAIC – "Define, Measure, Analyze, Improve, Control") rather than radically to redesign them (DfSS – "Design for Six Sigma") in order to reduce the variability.

H6-0: The average grade on aspects of process improvement in a company is smaller or equal to 4.

The alternative hypothesis was assumed as follows:

H6-1: The average grade on aspects of process improvement in a company is bigger than 4, when the given aspect is realized in a company.

Based on the assessments of respondents in the questionnaires, the average values and standard deviation were calculated in order to determine their sequence with regard to the assessment of the impact of each of them on the total assessment.

The right-side *t*-test was applied to verify the null hypothesis. The results of the calculations are presented in the Table 6.

Table 6. Results of the statistical analysis of data used for the verification of the hypothesis H6
Tabela 6. Wyniki analizy statystycznej danych weryfikujących hipotezę H6

Opinion about the improvement of processes in the company					
	$x_{śr}$	s	rank	*t* value	H.6-0
1. The formal procedures of the identification of the incompatibility were applied in the company	3,75	0,60	1	7,35	reject
2. The incompatibility of any process are carried out at once	3,67	0,48	2	8,25	reject
3. The identification of incompatibility is connected with the identification and elimination of their reasons	4,33	0,48	4	4,12	reject
4. The improvement of the process consists of the improvement of already existing process	4,44	0,65	3	4,03	reject
5. Extreme redesign of the process takes place after finding the incompatibility	3,69	0,98	5	1,84	accept

Source: own work

As shown in the tables above, the average value below 4 was obtained only in case of the aspect 5. The calculated values of *t*-test statistics for the aspects from 1 to 4, allow rejecting the null hypothesis in favor of the alternative hypothesis. It indicates that the formal procedures to monitor incompatibilities are eliminated at once in the analyzed SMEs (this aspect was evaluated at the highest position). However, in case of the aspect 5, there are no reasons to reject the hypothesis H6-0. It suggests, that the respondents do not decide to radically redesign of the process, in which the incompatibilities were found.

CONCLUSIONS

The following conclusions can be made based on the presented results of the research conducted in SMEs in Pomeranian region:

1. The medium companies of the manufacturing sector, having certified quality management systems, have shown the greatest interest in this study. This fact is positively correlated with the level of the awareness of the need for the application of appropriate methods of monitoring and improving of the process.
2. The level of the knowledge of tools and techniques of Six Sigma methodology in SMEs in Pomeranian region is low and requires a broad popularization action.
3. The level of the awareness of the significance as well as the practice of the use of Six Sigma methodology in manufacturing companies is not significantly different from that one in companies providing services.

4. The level of the awareness of the significance as well as the practice of the use of Six Sigma methodology in medium manufacturing companies is higher than in small manufacturing companies.
5. The representants of SMEs of Pomeranian regions understand the need to improve methodically their process. They focus on improving of their processes rather than on radical redesign of them.

The courses and group training on this topic in SMEs of Pomeranian region are the most favourable form of the learning. Based on the experience of Authors, the companies prefer to choose a form of group trainings, because they allow the exchange of experiences among participants as well as motivate highly to achieve agreed goals.

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CHARAKTERYSTYKA MAŁYCH I ŚREDNICH PRZEDSIĘBIORSTW (MŚP) W ZAKRESIE WYKORZYSTANIA ELEMENTÓW METODYKI SIX SIGMA NA PRZYKŁADZIE REGIONU POMORSKIEGO

STRESZCZENIE. **Wstęp**: Six Sigma jest powiązana z cechami charakterystycznymi dla produktu oraz parametrami działań, potrzebnych do uzyskania tych produktów. Z drugiej strony jest to wielostopniowy powtarzający się proces skierowany na ciągłe udoskonalenia, dążące do globalnych standardów, wręcz do stanu perfekcyjnego. Jakkolwiek wzrasta zainteresowanie metodyką Six Sigma wśród małych i średnich przedsiębiorstw, to jednak nadal w literaturze mało jest

publikacji poruszających temat tej metodyki w sektorze małych i średnich przedsiębiorstw, szczególnie popartych dobrymi empirycznymi wynikami. Wyniki badań wstępnych wskazywały, że tylko niewielka część przedsiębiorstw tego sektora w regionie pomorskim stosują w praktyce elementy tej metodyki.
Metody: Przedsiębiorstwa zostały podzielona na grupy w zależności od typu ich działalności oraz wielkości zatrudnienia. Ankiety, adresowane do kierownictwa przedsiębiorstw, zostały wysłane do 150 losowo wybranych organizacji w dwóch etapach. Ankieta zawierała pytania o podstawowe dane przedsiębiorstwa, poziom wiedzy na temat zastosowań Six Sigma, opinii dotyczących uprawnień w firmie oraz szkoleń w zakresie metodyki Six Sigma.
Wyniki: Poniższe hipotezy zostały zaproponowane i statystycznie zweryfikowane. Uzyskano następujące wyniki:
- brak odpowiedniego poziomu wiedzy o metodyce Six Sigma w małych i średnich przedsiębiorstwach (MŚP) ogranicza możliwość efektywnego monitorowania i usprawniania procesów - hipoteza potwierdzona,
- stosowanie metod statystycznych należących do metodyki Six Sigma wymaga szeroko zakrojonej akcji popularyzującej wiedzę z tego zakresu wśród krajowych MŚP - hipoteza potwierdzona,
- poziom świadomości ważności oraz praktycznego stosowania metodyki Six Sigma w MŚP sektora produkcyjnego jest wyższy aniżeli sektora usługowego - hipoteza odrzucona, poziom jest taki sam,
- poziom wiedzy oraz praktycznego stosowania metodyki Six Sigma w średnich przedsiębiorstwach produkcyjnych jest znacząco wyższy aniżeli w małych przedsiębiorstwach produkcyjnych - hipoteza potwierdzona,
- poziom wiedzy oraz praktycznego stosowania metodyki Six Sigma w MŚP jest pozytywnie akceptowany przez przedsiębiorstwa, które wdrożyły system zarządzania jakością - hipoteza potwierdzona,
- MŚP wolą raczej modyfikować istniejące procesy aniżeli radykalnie je zmieniać w celu ograniczenie w nich nieciągłości - hipoteza potwierdzona.

Wnioski: Poziom wiedzy na temat metod i technik metodyki Six Sigma w małych i średnich przedsiębiorstwach regionu pomorskiego jest niski i wymaga szeroko zakrojonej akcji popularyzującej wiedzę z tego zakresu. Poziom świadomości ważności oraz praktycznego stosowania metodyki Six Sigma w MŚP sektora produkcyjnego nie jest wyższy aniżeli sektora usługowego, ale jest wyższy w średnich przedsiębiorstwach w stosunku do małych. Wdrożenie systemu zarządzania jakością ma pozytywny wpływ na ten poziom. Przedsiębiorstwa z tego sektora preferują usprawnianie procesów aniżeli ich radykalne zmiany.

Słowa kluczowe: Six Sigma, małe i średnie przedsiębiorstwa, badania.

DIE CHARAKTERISTIK DER KLEINEN UND MITTLEREN UNTERNEHMEN (KMU) IM BEREICH VON BENUTZUNG DER SIX SIGMA METHODE AM BEISPIEL DER POMMERN REGION

ZUSAMMENFASSUNG. Hintergrund: Six Sigma ist mit den Eigenschaften der Produkten wie auch Parameter der Aktionen, die um diese Produkte zu erhalten notwendig sind, verbunden. Auf der anderen Seite, ist es ein mehrstufiger, zyklischer Prozess, gerichtet auf die Verbesserungen. Es gibt ein wachsendes Interesse an Six Sigma Methodik bei den kleinen und mittleren Unternehmen (KMU), aber es gibt noch viel zu wenig Publikationen auf diesem Thema, besonders die auf gute empirische Ergebnisse basieren. Die Vorstudien haben schon gezeigt, dass nur ein kleiner Teil der Unternehmen aus diesem Sektor in Pommern Region verschiedene Elemente dieser Methode bemerkt und benutzt.
Methoden: Die Unternehmen wurden in Gruppen nach der Art ihrer Aktivitäten sowie die Beschäftigungsgröße geordnet. Die Fragebögen wurden zu 150 zufällig ausgewählten Organisationen in zwei Schritten geschickt. Die Fragen des Fragebogen waren über allgemeinen Informationen über ein Unternehmen, das Niveau des Wissens und der praktischen Anwendung der Six Sigma Methodik, Meinungen über Verbesserungen der Prozesse in den Unternehmen wie auch Meinungen über Schulungen in Six Sigma-Methodik.
Ergebnisse: Folgende Hypothesen wurden vorgeschlagen und statistisch verifiziert. Die Antworten:
- Der Mangel an ausreichender Kenntnisse von Six Sigma Methodik in KMU begrenzt die Möglichkeit von der effektiven Überwachung und Verbesserung ihrer Prozessen - akzeptiert.
- Die Verwendung von statistischen Werkzeugen von Six Sigma Methodik erfordert die breite Aktion, um dieses Wissen bei den nationalen KMU zu popularisieren - akzeptiert.
- das Niveau des Bewusstseins für die Bedeutung wie auch praktische Anwendung von Six Sigma-Methodik in produzierenden KMU ist höher als in KMU, die Dienstleistungen anbieten - abgelehnt, das Niveau ist dasselbe.
- Das Niveau des Wissens und der Nutzung von Six Sigma-Methodik in mittleren produzierenden Unternehmen ist deutlich höher als in kleinen produzierenden Unternehmen - akzeptiert.
- Das Niveau der Kenntnisse und der Anwendung von Elementen der Six Sigma Methodik in KMU ist positiv spürbar von diesen Unternehmen, die das Qualitätsmanagementsystem nutzen - akzeptiert.
- KMU verbessern lieber die existierenden Prozesse anstatt radikal umzubauen, um die Unbeständigkeit zu reduzieren - akzeptiert.

Fazit: Das Niveau der Kenntnisse von Werkzeuge und Techniken von Six Sigma Methodik in KMU in Pommern Region ist niedrig und verlangt eine breite Aktion um dieses Wissen zu popularisieren. Das Niveau des Bewusstseins für die Bedeutung wie auch die praktische Anwendung von Six Sigma Methodik in den produzierenden Unternehmen unterscheidet sich nicht wesentlich von desjenigen in Unternehmen die Dienstleistungen anbieten, aber ist höher in mittleren Unternehmen als in kleinen Unternehmen. Die Einführung des Qualitätsmanagementsystems hat auch einen positiven Einfluss auf diesem

Niveau. Die Unternehmen von diesem Sektor verbessern lieber die existierenden Prozesse anstatt radikal umzubauen, um die Unbeständigkeit zu reduzieren.

Codewörter: Six Sigma, Kleine und mittlere Unternehmen (KMU), Untersuchungen.

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