Proceedings of the 17th International Conference on Manufacturing Systems – ICMaS
ISSN 1842-3183
University POLITEHNICA of Bucharest, Machine and Manufacturing Systems Department
Bucharest, Romania

PERCEIVED COMPETITIVE POSITION AS CLASSIFICATION CRITERION OF WORLDWIDE MANUFACTURING COMPANIES

Artur Swierczek

Abstract: *The manufacturing strategy is often an element of crucial importance for producers operating in the market. To make sure that a strategy matches the external environment, a company should identify its competitive priorities. The literature presents many examples of factors which should be considered when comparing a company's performance with major competitors.*
The aim of the paper is to classify the analyzed sample of companies with regard to factors concerning perceived competitive position towards market rivals. To obtain this goal a necessary multivariate statistical analysis were employed. In the result of sample classification two clusters were formed and interpreted. The interpretation of the results enabled to indicate major characteristics of the groups and to explain which factors differentiate significantly and which are similar in two clusters of companies. The basis of the description are factors and variables which contributed in the classification process.

Key words: *manufacturing companies, competitive goals, classification methods.*

1. INTRODUCTION

The competitive advantage is perceived as the most fundamental strategic goal of every organization operating in the market [1]. Teece and Pisano suggest that competitive advantages stem from dynamic capabilities rooted in high performance routines and embedded in the firm's processes [2].

Proper competitive strategy becomes often the means of survival and development for companies. It supports the success of manufacturing firms [3]. In this vein, the producers should perceive a manufacturing strategy as the issue of crucial importance for their market position.

The manufacturing strategy describes the use of manufacturing as a competitive weapon, as opposed to a function that is passive with respect to its competitive environment [4]. At present, manufacturing is recognized as a strategically important and operations management is becoming more integrated with other areas of research [5].

Acur makes the point that different research efforts investigated the content of manufacturing strategy, viewing it as the basis for strategic choices related to processes and infrastructure [6]. Hence, the producers consider the competitive strategy as the priorities that develop manufacturing strengths. The strategic use of strengths determining core competencies for competitive advantages has increasingly played a significant role in operations of manufacturing companies [7].

The paper is an attempt to group manufacturers by the variables reflecting their perceived competitive position within the most crucial and sensitive areas.

2. PERCEIVED COMPETITIVE POSITION VARIABLES

Producers develop their manufacturing strategies as a logical consequence of cascaded down general business strategy, translating corporate vision and mission into critical enterprise success factors [8]. According to Slack *et al.*, the content of manufacturing strategy comprises the set of operations' role, objective and activities [9].

Thus, first step in a formulation of manufacturing strategy should be an identification of companies' competitive priorities [10]. This view is also supported by Hayes and Wheelwright who claim that the composition of competitive dimensions is a starting point in the formulation of the manufacturing strategy defined as "…a sequence of decisions that, over time, enables a business unit to achieve a desired manufacturing structure, infrastructure, and set of specific capabilities" [11].

There is general consensus regarding the composition of key elements determining the nature of competition. Several authors enumerated the following factors: cost (price), product differentiation, amount produced, distribution, flexibility, delivery, innovation, quality, environmental and social responsibility [12, 13, 14, 15, 16, 17, 18, 19]. In the opinion of Boyer, the degree of fit between an organization's competitive priorities and its crucial decisions regarding structural and infrastructural investment provides the key to developing the full potential [20].

3. RESEARCH FRAMEWORK AND METHODOLOGY

3.1. Data collection and sample

The main research instrument used for this study was a questionnaire developed by the Global Manufacturing Research Group and consists of several sections examining, besides general demographics of surveyed companies, such aspects as: competitive goal measurement, internal manufacturing practices, manufacturing planning and control information systems, outsourcing and supplier relations, sales forecasting, purchasing practices. The whole questionnaire contained several hundreds of variables and led to the creation of a database extremely

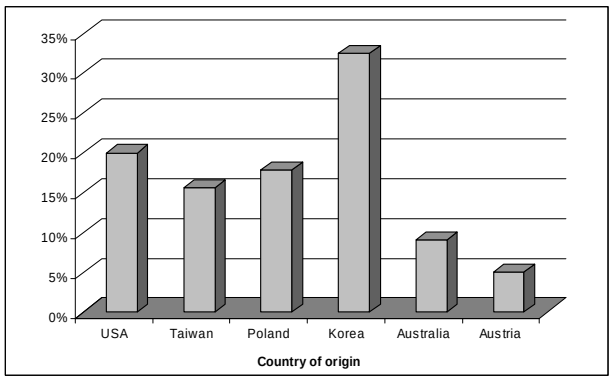

Fig. 1. Breakdown of the dataset by country of origin.

rich with informative value. Data has been collected by researchers from several countries in Europe, North America, Asia, and Africa.

For the purpose of the research presented in this paper only a portion of that data has been used. Six countries have been considered, namely Poland, Australia, Austria, Korea, Taiwan and USA. The total sample used for this research consisted originally of 392 manufacturers. As a result of initial data analysis, screening and elimination of observations with missing values 72 companies were excluded from the further research. The detailed breakdown of companies by country of origin is illustrated in Fig. 1.

The size of the analyzed companies was quite diversified with the majority representing small and medium enterprises. The companies represented a variety of industries, with engineering standing out as the prevailing industry.

The examined companies were not subject to random selection and the items included in the questionnaire are not stochastic variables. Instead a non-probabilistic extraction of the data set was used. It means that a descriptive (not a stochastic) approach was employed in the presented research. Although the research sample of 320 companies is relatively large, the obtained conclusions can by no means be generalized to the entire population of companies in the analyzed countries. The results of the research indicate only certain tendencies and may be used to the further in-depth analysis.

3.2. Research methodology

In order to classify the manufacturing companies by their perceived market position comparing with major competitors two-step statistical analysis was employed. The first step was the reduction of the many variables available through factor analysis in order to highlight the main underlying multi-item constructs. Factor analysis was performed in the area of the variables reflecting a perceived competitive position, namely direct manufacturing costs, total product costs, raw material costs, product features, product performance, perceived overall product quality, order fulfillment speed, delivery speed, delivery as promised, delivery flexibility, flexibility to change output volume, flexibility to change product mix, manufacturing throughput time, new product design time. In order to perform the factor analysis a principal component analysis (PCA) with Varimax Rotation was employed. PCA was performed to structure the collected information and it was conducted on standardized variables. The Varimax Rotation was employed to reduce multicollinearity among variables.

In the result of factor analysis two variables (manufacturing throughput time and new product design time) were excluded as they indicated factor loadings below a nominal cut-off point of 0.65 [21]. Finally 12 variables were a subject to the factors' qualification.

The number of factors was determined according to the analysis of the percentage of variance explained and the Kaiser criterion [22]. In the result of the analysis four factors were identified, namely:

- Factor 1: Variables connected to delivery service performance: order fulfillment speed, delivery speed, delivery as promised, delivery flexibility,
- Factor 2: Cost-oriented elements embracing the following observed variables: direct manufacturing cost, total product cost and raw material cost,
- Factor 3: Product-related elements consisting of following variables: product features, product performance and perceived overall product quality,
- Factor 4: Variables concerning a general flexibility, namely: flexibility to change output volume and flexibility to change product mix.

The obtained factors explain above 0.78 percent of total variance. The Cronbach's alpha coefficients were calculated to check the internal consistency of extracted factors. Alpha score of variables (represented by adjusted seven point Likert scale items: *far worse – far better*) in all instances is higher than 0.7 (for factor 1 and 2 – 0.85, factor 3 – 0.90 and factor 4 – 0.77). Considering the rule provided by D. George and P. Mallery, the obtained results of the alpha coefficients (above the nominal cut-off point of 0.7) suggest a good internal consistency of all extracted constructs [23].

The second step in the analysis was the classification of the sample into homogenous groups through cluster analysis. The criteria for classifying the sample into clusters were the four factors extracted in the previous step of the analysis. It enabled to investigate which dimensions of competitive position of manufacturers play an important role in the extracted groups of companies.

At first in order to determine the number of clusters a hierarchical cluster analysis with Ward's partitioning method and squared Euclidean distance was performed [24]. In the result of the analysis two clusters were formed. The number of groups was obtained through the greatest increase in the agglomeration coefficient while minimizing a number of clusters [25]. The greatest increase corresponds to the grouping of all cases from two to one cluster.

The number of two clusters was used to perform K-Means Cluster Analysis to assign each case to the appropriate cluster. The criterion of the cluster membership was the minimal Euclidean distance between each case and classification center represented by centroid (cluster center).

The results of K-Means Cluster Analysis was compared with the class assignment obtained from the Hierarchical Cluster Analysis. On the basis of the results of two partition methods the contingency table was

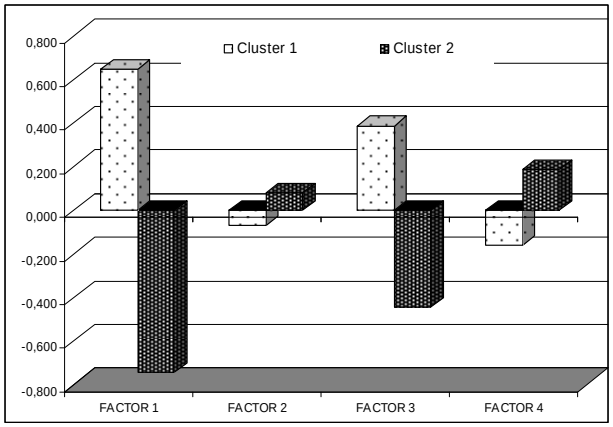

Fig. 2. Final centroids of clusters obtained on the base of adjusted factor scores.

constructed and Rand Index calculated. The measure of agreement showed that 77.8 percent of pairs of objects are placed in the same class. It means a sufficient level of agreement and confirms a correct choice of K-Means Cluster Analysis as the leading clustering method [26].

4. DATA ANALYSIS AND CONCLUSION

The analysis of two groups obtained through the K-Means Cluster Analysis suggests that classified cases differ across four factors – Fig. 2.

The most noticeable difference between two clusters is found regarding elements of delivery performance service - factor 1. Product related elements is second in line which differs manufacturing companies. Factors 2 and 4 have considerably weaker impact on companies' classification.

The obtained results are reflected more precisely in the graphical illustrations of average raw data scores of independent variables comprising particular factors.

Figure 3 illustrates the differences in the average raw data scores of factor 1. The highest level of difference between two clusters is found considering delivery as promised variable (1.5 points of Likert scale item). A similar distinguishing result is indicated by order fulfillment speed variable (a difference is 1.4 points of a scale). The third variable which strongly differentiates research sample is delivery speed variable whose level is 1.3 points.

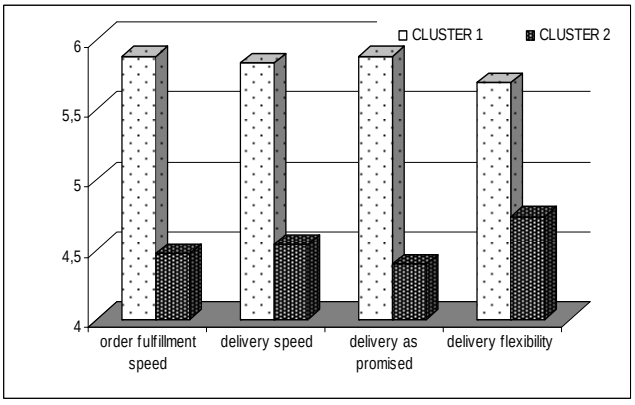

Fig. 3. Average raw data scores of independent variables comprising factor 1.

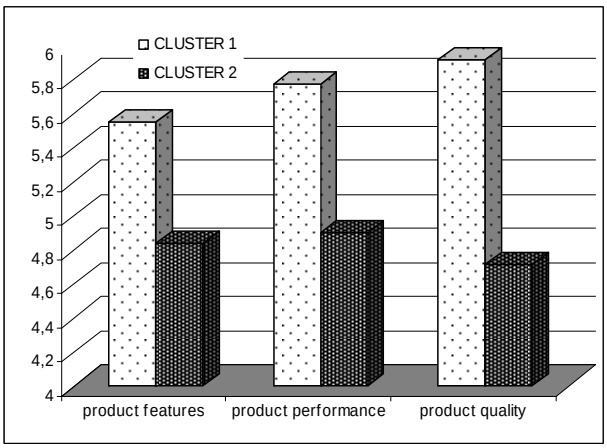

Fig. 4. Average raw data scores of independent variables comprising factor 3.

Figure 4 presents a gap between clusters in average raw data scores of variables comprising factor 3. A considerable difference is found regarding product quality (1.2 points of scale item). Quite a noticeable difference is also observed in product performance variable (almost 0.87 points of the item).

Two remaining factors which were classification criteria of manufacturing companies played less significant role.

Figures 5 and 6 illustrate the obtained average raw data scores of variables comprising factor 2 and factor 4 in two clusters.

The inspection of Figs. 5 and 6 suggest that the highest average difference in space of two factors indicates a variable: flexibility to change output volume but it is still very low (0.32 point of scale item). The lowest difference (thus the highest similarity) is found between two clusters considering cost-oriented variables (direct manufacturing costs – 0.22 points, total product costs – 0.20 points and raw material costs – 0.18 point of Likert scale item).

A preliminary analysis of these survey results provided some interesting insights into factors which differ a research sample.

First, the variables connected to delivery performance and product-related elements significantly diversify a

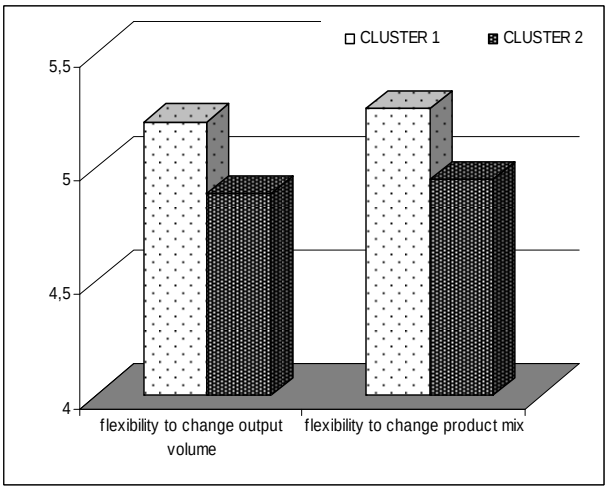

Fig. 5. Average raw data scores of independent variables comprising factor 4.

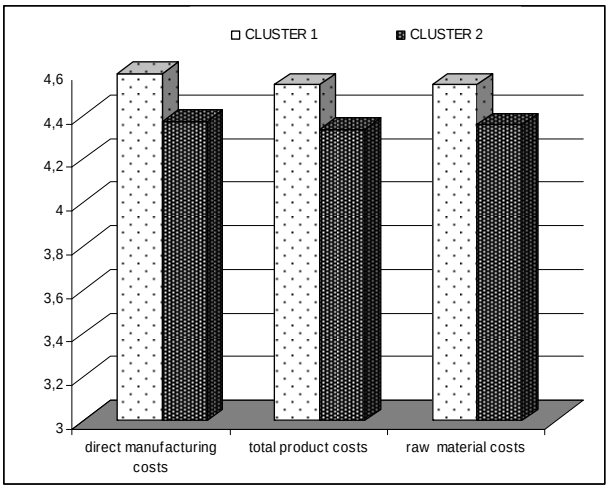

Fig. 6. Average raw data scores of independent variables comprising factor 1.

research sample. It means that there are companies which differently compare their activity towards major competitors in terms of order fulfillment speed, delivery speed, delivery as promised, delivery flexibility, product features, product performance and product quality.

Second, the analyzed cases are quite similar considering orientation on costs and general companies' flexibility. The similarity of companies regarding direct manufacturing costs, total product costs and raw material costs seems to be quite obvious, as the cost orientation and striving to reduce costs of operations is still perceived by almost all companies as a primary market weapon. The cost leadership strategy is a fundamental competitive strategy used by companies against their market rivals. In this sense a prevailing part of firms consider to be well prepared to the competitive market fight in terms of costs of operations and therefore those companies compare alike their performance with major competitors.

REFERENCES

[1] Porter, M.E. (1985). *Competitive Strategy: Creating and Sustaining Superior Performance*, Free Press, NY.

[2] Teece, D., Pisano, G. (1994), *The dynamic capabilities of firms: an introduction*, Industrial and Corporate Change, Vol. 3 No. 3, pp. 537-56.

[3] Hayes, R. H. Wheelwright, S.C. (1984). *Restoring Our Competitive Edge: Competing through Manufacturing*, Wiley, New York, NY.

[4] Skinner, W. (1969). *Manufacturing. The missing link in corporate strategy*, Harvard Business Review, pp. 136-145.

[5] Gresswell, T., Childe, S., Maull, R. (1998). *Three manufacturing strategy archetypes – a framework for the aerospace industry*, in Bititci, U. and Carrie, A. (Eds), *Strategic Management of the Manufacturing Value Chain*, Kluwer, Dordecht, pp. 53-61.

[6] Acur, N., Gertsen, F., Sun, H., Frick, J. (2003). *The formalisation of manufacturing strategy and its influence on the relationship between competitive objectives, improvement goals, and action plan*, International Journal of Operations & Production Management Vol. 23 No. 10, pp. 1114-1141.

[7] Prahalad, C.K., Hamel, G. (1990). *The core competence of the corporation*, Harvard Business Review, Vol. 68, No. 3, pp. 79-91.

[8] Kisperska-Moron, D. (2007). *Management differences in supply chains of manufacturing companies: An international study*, Proceedings of Annual Logistics Research Network Conference, Liverpool.

[9] Slack, N., Chambers, S., Johnston, R. (2001). *Operations Management*, 3rd ed., Prentice-Hall, Harlow.

[10] Swink, M., Way, H.M. (1995). *Manufacturing strategy. Propositions, current research, renewed directions*, International Journal of Operations & Production Management, Vol. 15, No. 7, pp. 4-26.

[11] Hayes, R. H. Wheelwright, S.C. (1984). *Restoring Our Competitive Edge: Competing through Manufacturing*, Wiley, New York, NY.

[12] Adam, E.E., Swamidass, P.M. (1989). *Assessing operations management from a strategic perspective*, Journal of Management, Vol. 15, No. 2, pp. 181-203.

[13] Anderson, J.C., Cleveland, G., Schroeder, R. (1989). *Operations strategy: a literature review*, Journal of Operations Management, Vol. 8, No. 2, pp. 133-58.

[14] Leong, G.K., Snyder, D., Ward, P. (1990). *Research in the process and content of manufacturing strategy*, Omega, Vol. 18, pp. 109-22.

[15] Shubik M., Leviatan R. (1980). *Market Structures and Behaviour*, Harvard Business Press, Boston.

[16] Foxall, G., Minkes, A. (1996). *Beyond Marketing: The Diffusion Entrepreneurship in the Modern Corporation*, Journal of Strategic Marketing, Vol. 4, pp. 71-93.

[17] Charter, M. (1992). *Greener Marketing*, Greanleaf Publishing, Sheffield, UK.

[18] Peattie, K. (1995). *Environmental Marketing Management*, Pitman Publishing, London, UK.

[19] Strong, C. (1997). *The Role of Fair Trade Principles Within Sustainable Development*, Sustainable Development, Vol. 5, pp. 1-10.

[20] Boyer, K.K. (1998). *Longitudinal linkages between intended and realized operations strategies*, International Journal of Operations & Production Management, Vol. 18, No. 4, pp. 356-373.

[21] Gatnar E., Walesiak M. (2004). *Metody statystycznej analizy wielowymiarowej w badaniach marketingowych. (Methods of multivariate statistical analysis in marketing research)*, AE, Wrocław.

[22] Aczel A.D. (1993). *Complete Business Statistics*, Second Edition, Boston, Massachusetts.

[23] George D., Mallery P. (2003). *SPSS for Windows step by step: A simple guide and reference*, 11.0 update 4th edition. Boston, Allyn and Bacon.

[24] Sagan A. (2003). *Przykłady zaawansowanych technik analitycznych w badaniach marketingowych* (The examples of advanced methods in marketing research), Statistica White Paper.

[25] Ketchen D., Shook C. (1996). *The application of cluster analysis in strategic management research: an analysis and critique*, Strategic Management Journal, Vol. 17, pp. 441-458.

[26] Krieger A.M., Green P.E. (1999). *A Generalized Rand-Index Method for Consensus Clustering of Separate Partitions of the Same Data Base*, Journal of Classification, 16:63-89.

Author:

Ph.D., Artur ŚWIERCZEK, Assistant Professor, The College of Labour Safety Management in Katowice, Department of Management and Applied Psychology in Business,

E-mail: aswierczek@wszop.edu.pl.