

THE STRATEGIC DIMENSION OF PRODUCT FLEXIBILITY OF A MANUFACTURING PLANT – THE CONCEPT AND ITS APPLICATION

Introduction

The notions of “new economy” and “turbulent times” reflect the entirety of the phenomena and processes taking place in the current socio-economic circumstances¹.

An examination of economic practices shows that the success of an enterprise, understood as an effective use of a specific management instrument, in given conditions (business model²), is measured in terms of efficiency and

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¹ J.M. Lichtarski, *Struktury zadaniowe. Składniki, własności i uwarunkowania*, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław 2011, p. 141.

² According to B. Nogalski business model is a realization of the many nebulous meanings that so far have been attached to the notion of strategy. It gives strategy a definite and, very often, practical sense, suggesting the necessity to make clearly defined choices. Its aim is to create conditions for the development of an enterprise, defined and analysed in the context of its competitiveness, innovativeness and profitability. For more or on business models see: B. Nogalski, *Rozważania o modelach biznesowych przedsiębiorstw jako ciekawym poznawczo kierunku badań problematyki zarządzania strategicznego*, in: *Zarządzanie strategiczne. Modele i kierunki badań*, R. Krupski (ed.), The College of Management and Enterprise in Wałbrzych, Wałbrzych 2009, pp. 33–47. For more also see: B. Nogalski, A. Szpitter, *Model biznesowy jako strategiczne narzędzie w zarządzaniu finansami*, in: *Zarządzanie finansami. Wycena przedsiębiorstw i zarządzanie wartością*, D. Zarzecki (scientific ed.), Zeszyty Naukowe Uniwersytetu Szczecińskiego No. 534, „Finanse, Rynki finansowe, Ubezpieczenia” 2009, No. 17; ISSN 1640–6818; ISSN 1733–2842, p. 586; B. Nogalski, A. Szpitter, *Rada nadzorcza a model biznesu przedsiębiorstwa*, in: *Nadzór korporacyjny a przedsiębiorstwo*, Prace i Materiały Wydziału Zarządzania Uniwersytetu Gdańskiego 2009, No. 1, pp. 301–310 and T. Falencikowski, B. Nogalski, *Creation of Business Models: Designing Issues*, in: *Management Sciences in Kazakhstan and in Poland at the Beginning of the 21 st Century Perspectives for Development and Cooperation*, scientific editors:

efficacy³. According to B. Nogalski⁴, an undoubtedly important factor which determines those two agents is the strategy adopted and implemented by a business⁵. Strategic flexibility, i.e. the capability to modify the strategy⁶ and actions according to the changes in the business environment using the possessed competences and abilities⁷ as effectively as possible, becomes of key importance.

One must agree with the statement that gaining and maintaining the competitive advantage⁸ by a business, which conditions its effective operation on the market, is expressed by a higher operation strategy than that of its competition, which in turn allows it to achieve above-average, sector-wide profitability.

If manufacturing plants in Poland want to compete effectively with the foreign companies which enter our market intensively and extensively, and with their strong and established positions, they ought to shape their attitude to the ever-changing conditions and needs of the market purposefully and flexibly⁹.

In the face of the above, it is the authors' opinion that the ability to adapt the possessed physical, financial, human and information resources is of special importance. Resources and their possession, or rather access to them in fact, are of key importance to flexible reactions of any organisation¹⁰.

P. Buła, J. Czekaj, H. Łyszczarz, Bakyt U. Syzdykbayeva, Cracow School of Business, Cracow University of Economics, Cracow–Astana 2012, pp. 263–279.

³ A very important determinant of management is the assurance of smooth, efficient and effective achievement of the goals of an organization.

⁴ B. Nogalski, *Rozważania o modelach biznesowych przedsiębiorstw jako ciekawym poznawczo kierunku badań problematyki zarządzania strategicznego*, in: *Zarządzanie strategiczne. Modele i kierunki badań*, R. Krupski (ed.), The College of Management and Enterprise in Wałbrzych, Wałbrzych 2009, p. 39.

⁵ Being aware of the multitude of definitions accentuating the various dimensions of strategies, it is worth noting S. Sudoł's definition, which says that a strategy is the concept of operation in a longer perspective which takes into account the expected changes in the business environment as well as the expected changes in the resources and conditions for operation of a business. See: S. Sudoł, *Przedsiębiorstwo. Podstawy nauki o przedsiębiorstwie. Teorie i praktyka zarządzania*, TNOiK, Toruń 1999, p. 214. Wider considerations concerning the strategy of a business are presented in A. Sopińska's work, alongside the description of its genesis and essence. See: A. Sopińska, *Wiedza jako strategiczny zasób przedsiębiorstwa. Analiza i pomiar kapitału intelektualnego przedsiębiorstwa*, Publishing House of the Warsaw School of Economics, Warszawa 2010, pp. 15–24.

⁶ A mistaken choice of any strategy, whether for the whole organization or whether of the functional strategy, may lead to many negative consequences for the current operation of a business and for its future. In: G. Gierszewska, *Zarządzanie wiedzą w przedsiębiorstwie*, Publishing House of The Warsaw University of Technology, Warszawa 2011, p. 222.

⁷ A.M. Hitt, D.R. Ireland, E.R. Hoskisson, *Strategic Management – Competitiveness and Globalization*, 6th edition, Thomson South-Western Int. 2005, p. 15.

⁸ Among the main paradigms of customer orientation in management is the assumption that customers' expectations and needs are determinants of business operations. Implementation of that concept leads to the adaptation to those expectations.

⁹ D. Nowak, *Zarządzanie międzyorganizacyjnymi relacjami kooperacyjnymi w przedsiębiorstwach przemysłowych*, Publishing House of Poznań University of Economics, Poznań 2012, p. 5.

¹⁰ R. Krupski (ed.), *Elastyczność organizacji*, Publishing House of Wrocław University of Economics, Wrocław 2008, p. 87.

The present article deals with this issue. It has a character of a creative synthesis based, on the one hand, on a detailed analysis of the theory of the problem and, on the other hand, on the authors' previous research. The considerations mentioned above have led to the decision that manufacturing plants will be at the core of interest. They are characterised by excellent flexibility, which reflects their ability to spot market opportunities that manufacturers may use through a quick reconfiguration and integration of the manufacturing process as well as the implementation of a finished product that is adjusted to the needs of the market.

Thus the general aim of the elaboration is to present – in its theoretical, cognitive and practical aspect – the issues connected with product flexibility of a manufacturing plant. It is the authors' intention:

- to conduct literature queries in the subject of the flexibility paradigm of a manufacturing plant, which – as is the authors' supposition – will allow them to present the flexibility criterion as a key success factor.
- to propose a resource model of a flexible manufacturing plant.
- to define the relation between resources and the flexibility of a manufacturing plant.
- to refer the resource model of a flexible manufacturing plant to economic practice.

By analysing the specificity of the resource model of flexibility management and presenting the main conditions influencing that specificity, the authors will suggest their recommendations in this respect. For management practitioners they may serve as a basis of diagnosis and be an inspiration to develop strategies of implementation of that model.

1. Three dimensions of product flexibility – the concept of the resource model

1.1. Flexibility – the systematic consideration

The emergence of the need of flexibility as well as the growing demand of flexibility have their universal grounds in changes¹¹. Changes¹² affect particular and general elements of the market environment of an organisation as well as its resources, processes and internal structures. The changes taking place in its international environment, caused by progressing globalisation, as well as the changes brought about by the development of information technologies should be stressed here. At the same

¹¹ G. Osbert-Pociecha, *Elastyczność organizacji – „tańczenie” w turbulentnym otoczeniu*, The Open University of Economics, Wiedza.info.pl.

¹² Changes in the immediate environment cause changes in a business, which, in the authors' opinion, leads to the necessity to break away from the traditional perception of an organization and its management.

time the pressure to improve its effectiveness (very often the point is not only to improve its effectiveness in terms of its sales or capital profitability but also, for example, to maximise the value of the business) or to gain and maintain the competitive advantage in an appropriately long period of time is increased. It forces businesses to search for new methods or tools to achieve those goals.

A business that operates in specific conditions shaped by its environment has to take into consideration the environment's demands, especially ones which stem from the expectations of its customers and from the challenges of its competitors. This means that it must adapt its structure and the level of the resources at its disposal to those requirements. This also, and perhaps even above all, includes, the production technology, bearing in mind, however, that the basic determinant of the chosen technology are the expectations of the market, technological background capabilities as well as the financial and technical potential of the business. The choice of technology then must be a compromise between what is desired (the needs of the market in particular) and what is feasible (first of all the financial capabilities of the business)¹³.

Flexibility is then the most desired feature of a manufacturing plant, an important condition for its operation and a determinant of its development. Therefore it is vital to enquire about its essence.

In the literature concerning the subject matter one may encounter many definitions of flexibility. A comprehensive interpretative analysis of various authors' suggestions was presented by R. Krupski¹⁴ and G. Osbert-Pociecha¹⁵, who had searched for a resultant of various concepts of adapting organisations to their changing environments. According to the analysis a uniform and commonly accepted definition of flexibility has not been arrived at yet. One may find general and detailed definitions in the literature which describe only its selected aspects or which refer to just about any organisation (Table 1).

In order to keep the size of the present work within reasonable limits it is necessary to present the flexibility deliberations brought up in this article synthetically. While initiating a discussion on the matter the authors' own definition was formulated, corresponding to the aims of the elaboration. The authors' definition of flexibility: „refers to a product, to effective, smooth, and efficient management of the resources necessary for its swift implementation as a response to the challenges of demand volatility and customers' expectations, which, in perspective,

¹³ R. Rutka, *Organizacja*, in: A. Czermiński, M. Czerska, B. Nogalski, R. Rutka, J. Apanowicz, *Zarządzanie organizacjami*, TNOiK „Dom Organizatora”, Toruń 2002, p. 195.

¹⁴ R. Krupski, *Elastyczność organizacji*, Publishing House of Wrocław University of Economics, Wrocław 2008, pp. 15–17.

¹⁵ G. Osbert-Pociecha, *Elastyczność organizacji – atrybut pożądaný a niezidentyfikowany*, „Organizacja i kierowanie” 2004, Vol. 6, No. 3–4; G. Osbert-Pociecha, *Zdolność do zmian jako siła sprawcza elastyczności organizacji*, Publishing House of the Wrocław University of Economics, Wrocław 2011; G. Osbert-Pociecha, *Elastyczność organizacji – „tańczenie” w turbulentnym otoczeniu*, op.cit.

grant the manufacturer with development possibilities, whereby product flexibility of a manufacturing plant is determined by information transformed into knowledge which allows it to see market opportunities that manufacturers find in possibly swift reconfiguration and integration of the manufacturing process”.

Table 1. A review of the definitions of “flexibility” as perceived by selected authors

Author	Definition
J.S. Evans	An ability to adapt, mobility, an ability to modify, to improve, a skill, an agility, smoothness, formability, resilience, etc. Each of these dimensions of flexibility might be a response to a threat coming from the changes mainly in the environment of an organisation or be a form of pressure on that environment.
H.I. Ansoff	The qualities of an organisation which allow it to cope with the changes in its environment (instead of influencing them the organisation attempts to respond to them – mainly by increasing the liquidity of its resources).
D.J. Eppink	A characteristic of an organisation which makes it less sensitive to unexpected external changes or finds a better position for it to respond to those changes effectively.
R. Krupski	It is described by two dimensions of spacetime: reaction speed (creation) and level of adaptation to the environment. The basic types of flexibility: reactive, adaptive and inert, anticipative, creative.
M. Juchnowicz	An ability and a potential readiness to adapt to various, new and changing conditions, tasks or situations of a cognitive and social character, as well as an ability to initiate such changes.
S. Trzcieliński	An ability to expand the repertory of actions irrespective of whether those actions are a response to the changes in the immediate environment or whether they are caused by other circumstances.
G. Stigler	A manufacturing quality which permits to use various production modes.
G. Osbert-Pociecha	An ability to introduce changes under the influence of internal or external impulses in such a way that conditions to compete on the market are created and chosen efficiency targets are implemented without affecting the consistency limits of an organization which guarantee the achievement of its synergistic effect.

Source: Authors' own work based on: G. Osbert-Pociecha, *Elastyczność organizacji – “tańczenie” w turbulentnym otoczeniu*, The Open University of Economics, Wiedzainfo.pl; rafalkrupski.pl; S. Trzcieliński, *Przedsiębiorstwo zwinne*, Publishing House of Poznań University of Technology, Poznań 2011; M. Juchnowicz (ed.), *Elastyczne zarządzanie kapitałem ludzkim w organizacji wiedzy*, Difin, Warszawa 2007.

In that context the attempts made in this work at terminological organisation are of purely cognitive character, which makes it possible to capture common areas, dependences and research approaches. Besides, systematization of various approaches to the same issue increases opportunities of a comprehensive analysis as well as becomes an inspiration for further research.

In conclusion, the authors are making a point that the term flexibility is a multi-dimensional construct, which makes it difficult for authors who represent both

management science as well as other related sciences, technical ones above all, to define it and to interpret it. It is the authors' opinion that there has been a methodological confusion, which sometimes leads to opinion clashes and even arguments about what flexibility actually is and, as a result, what methods to employ to examine it and then develop it.

A specific confusion concerning the notion of product flexibility is caused by the following factors:

- there are numerous definitions of the term flexible/flexibility,
- flexibility is referred to specific resources,
- the management science is of an interdisciplinary character, it is influenced by various research trends,
- a transfer of scientific achievements from other countries may be noted without clear information on the country of origin of those achievements or on the significance of the discussed notions.

1.2. The development of the resource model – conditions for product flexibility

The school of strategic resource management is undergoing a dynamic development¹⁶. On the one hand, as K. Obłój¹⁷ points out, attempts are made to eliminate its various shortcomings, such as: tautology, metaphorical ontology, or lack of operationalization; on the other hand though, R. Krupski¹⁸ says that it absorbs new areas of theoretical and practical activity, which leads to connections with other perspectives, acquisition processes and resource development.

It is the authors' opinion that the resource approach to flexibility management in a manufacturing plant is close to strategic management because it refers to flexibility as a strategic resource¹⁹ pertaining to the concept of key competences as a basis for the development of competitiveness of manufacturing organisations²⁰. This

¹⁶ R. Krupski, *Badanie zasobów przedsiębiorstw z perspektywy strategicznej*, „Organizacja i Kierowanie” 2012, No. 1A (149), „The Organisation and Management”, Science Committee at the Polish Academy of Sciences, Warsaw School of Economics, p. 131.

¹⁷ K. Obłój, *Pasja i dyscyplina strategii. Jak z marzeń i decyzji zbudować sukces firmy*, Poltext, Warszawa 2010, p. 147.

¹⁸ R. Krupski, *Badanie zasobów przedsiębiorstw z perspektywy strategicznej*, op.cit., p. 131.

¹⁹ Aspirations to manage the available resource effectively, fight with wastefulness and minimization of loss have been at the core of organisers' and leaders' concern for years. For more: B. Nogalski, P. Niewiadomski, *Szczupłe wytwarzanie – paradygmat lidera kosztowego w przedsiębiorstwie wiedzy*, „Przegląd Organizacji” 2012, No. 8, p. 15–19.

²⁰ According to G. Gierszewska the achievement of and first of all maintaining a global competitive advantage is increasingly difficult. Therefore new unique competences must be built on the basis of organisations' knowledge. See: G. Gierszewska, *Zarządzanie wiedzą w przedsiębiorstwie*, Publishing House of the Warsaw University of Technology, Warszawa 2011, p. 11.

view is shared by K. Krzakiewicz, assuming that flexibility is a factor which influences the processing of strategic information and, as a result, the structure and content of managers' mental images on the subject of strategic problems²¹. Flexibility also appears as one of the key criteria in the modern concepts of organisation effectiveness. This aspect is also present, among others, in the Balances Scoreboard as an element of grounds for organisation development²².

The far-reaching and rapid economic transformations of recent years make every enterprise devote more and more attention to those management instruments which determine their competitiveness²³. A guarantee of success on the increasingly competitive and volatile market is a quick and flexible realisation of implementation processes. The main aim of any industrial enterprise is to produce, in a short time, goods which are characterised both by high quality and low total costs. Thus the suggested possibility to achieve a market success in the present-day economic conditions is the appropriate selection and effective use of all the available resources included in production sub-systems contained in a manufacturing enterprise. The complex nature of flexibility is in direct relation with the multitude of factors (context variables), which it is shaped by, which determine its scope and manifestation intensity as well as its results²⁴. Therefore the implementation perspective is particularly interesting, because the most important determinants of a new product development are the main levers of a long-term success of a business. In face of the above the implementation area of research should focus on those mechanisms and elements which designate the actions of a business, build its competitive advantage, and thus its success. A new paradigm of a flexible business is adapted then which assumes that the following are of the vital importance for implementation processes: production resources (technology²⁵, means of production, work items), knowledge resources, and financial resources (see Picture 1). These factors determine the dynamics of the product portfolio, and thus the adaptation to the turbulent circumstances. According to the authors, the factors mentioned above determine product flexibility and the level of their characteristics implies the ability to notice market opportunities which arise from finding a product niche as well as from the quick reconfiguration

²¹ K. Krzakiewicz, *Kognitywne kompetencje menedżerów w aspekcie zarządzania strategicznego*, in: *Praca kierownicza w nowoczesnym zarządzaniu*, K. Krzakiewicz (ed.), Publishing House of the Poznań University of Economics, Poznań 2011, p. 106.

²² R.S. Kaplan, D.P. Norton, *Strategiczna karta wyników. Jak przełożyć strategię na działanie*, PWN, Warszawa 2007, pp. 122–138.

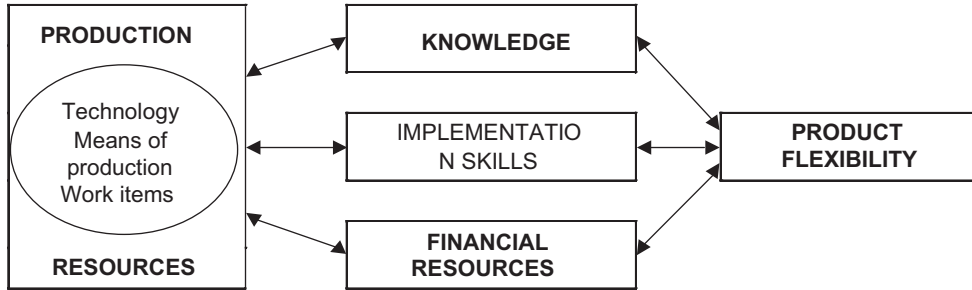
²³ Z. Banaszak, S. Kłós, J. Mleczo, *Zintegrowane systemy zarządzania*, PWE, Warszawa 2011, p. 9.

²⁴ G. Osbert-Pociecha, *Zdolność do zmian jako siła sprawcza elastyczności organizacji*, op.cit., p. 262.

²⁵ Technology, i.e. the way a task is done. It is the technology applied in a given manufacturing plant that decides on machines, tools, materials, etc. It means that the choice of means of production and work items is determined by technology.

and integration of the manufacturing process, which leads to a quick launch of the finished product.

Picture 1. Product flexibility as a resource function



Source: authors' own work.

The considerations presented in this work show clearly that a flexible business is a customer-oriented business, it is able to and wants to co-operate with its internal and external environment, which in turn manifests itself in a high level of communicativeness and in the readiness to change and reconfigure its previous actions. The guidelines for product flexibility of a manufacturing plant are different, they vary depending on the area of activity; for flexibility is characterised by individualism. In this part of the work the authors have presented their own model of product flexibility, using their own definition as a basis, pointing their own guidelines in reference to manufacturing plants in the sector of agricultural machines. The authors are aware of the fact that it is not an easy task to fully identify the various factors, their direction and the power of their influence, especially as those determinants, as G. Osbert-Pociecha points out²⁶, are dynamic by nature (variable in time) and the relations taking place among them are of a feedback character.

2. The model of product flexibility and the practice of manufacturing plants

2.1. Research assumptions

The research that is discussed in the present work has been conducted in the Spare Parts and Agricultural Machines Production Plant (Zakład Produkcji Części Zamiennej i Maszyn Rolniczych), based in the village of Września, the voivodeship of

²⁶ G. Osbert-Pociecha, *Zdolność do zmian jako siła sprawcza elastyczności organizacji*, op.cit., p. 262.

Greater Poland. The main area of activity of the business in question is the production process²⁷ of modern machines for agriculture, their components and spare parts.

The authors obtained the data necessary to do the research on the basis of a documentation analysis (materials cards, technology drafts, assembly documentation), on the basis of a directed interview with the manager of the plant (who is responsible for implementation processes) as well as participatory observations.

The subject of the research was the implementation process of a new product, i.e. the suspension of a trailer (Picture 2), which is used as a spare part or a component in a production process. In order to facilitate the information flow among the individuals concerned with the research the authors suggested using a symbol of the part and gave it the number 203 910 200.

The aim of further deliberations is to refer the authors' resource model of product flexibility to the practice of a specific manufacturing plant. It is the authors' intention to develop a methodology for an assessment of resource capabilities of the manufacturer in the context of the model as well as to model the resources in the implementation process of the trailer.

Picture 2. The implemented trailer suspension



Source: P. Niewiadomski, *Instrukcja obsługi. Rozrzutnik Obornika ZPCZ-T-088*, Spare Parts and Agricultural Machines Production Plant, Września 2010, p. 19.

²⁷ Its essence (speaking in general and simple terms) is the processing of a raw material into the finished product, wherein the “raw material” is any material (object) processed and released in its changed form as the finished product, while the “finished product” is any final product of a company which is going to undergo further processing or use in another company or is directly going to satisfy consumers' needs.

2.2. The method of assessment of implementation capabilities of a manufacturing plant

The method of assessment of implementation capabilities of a specific product (Picture 3) relies on the ability to determine the requirements a particular manufacturing plant must face when accepting such a challenge. It defines and selects subjective and objective factors. In its first stage it is necessary to determine all the possible variants of the implementation process and to choose solutions in the context of production capabilities. However, because of the assumed economic criteria (profit maximization)²⁸, the producer's aim should be to develop a manufacturing process within the framework of existing resources. The producer gains maximal profits because minimal investment is a guarantee of a quick and high return on the implemented product. In a situation where production capabilities of a manufacturing plant do not allow to implement a particular product (resource barriers) then the producer may choose between two implementation variants: 1) purchase of necessary resources (knowledge, technology, means and objects of work), which results in incurring an extra cost, 2) the use of co-operative possibilities (e.g. virtualisation production). Naturally, in extreme circumstances there exists the possibility of renunciation of the product implementation but in the authors' opinion it is the producer's task to seek solutions within the variants which ensure implementation capabilities as they are the only factors which foster the development and increase the market value of a particular organisation.

2.3. The modelling of the resources necessary in the implementation process of a trailer suspension in a perfectly flexible manufacturing plant

K. Adamiecki considered the changes taking place in industry at the end of the 17th century, called the Industrial Revolution, as a crucial period in the history of mankind. According to Adamiecki "man, who for many hundreds and thousands of years had only been making use of his own muscles and of those of domesticated animals, harnessed to work within that short period of time incredible amounts of natural energy. He handed manual labour over to machines and as a result stopped being a beast of burden"²⁹. He noted that by handing over most of his tasks to a machine he changed his method of work and "his own way of life". He could manufacture

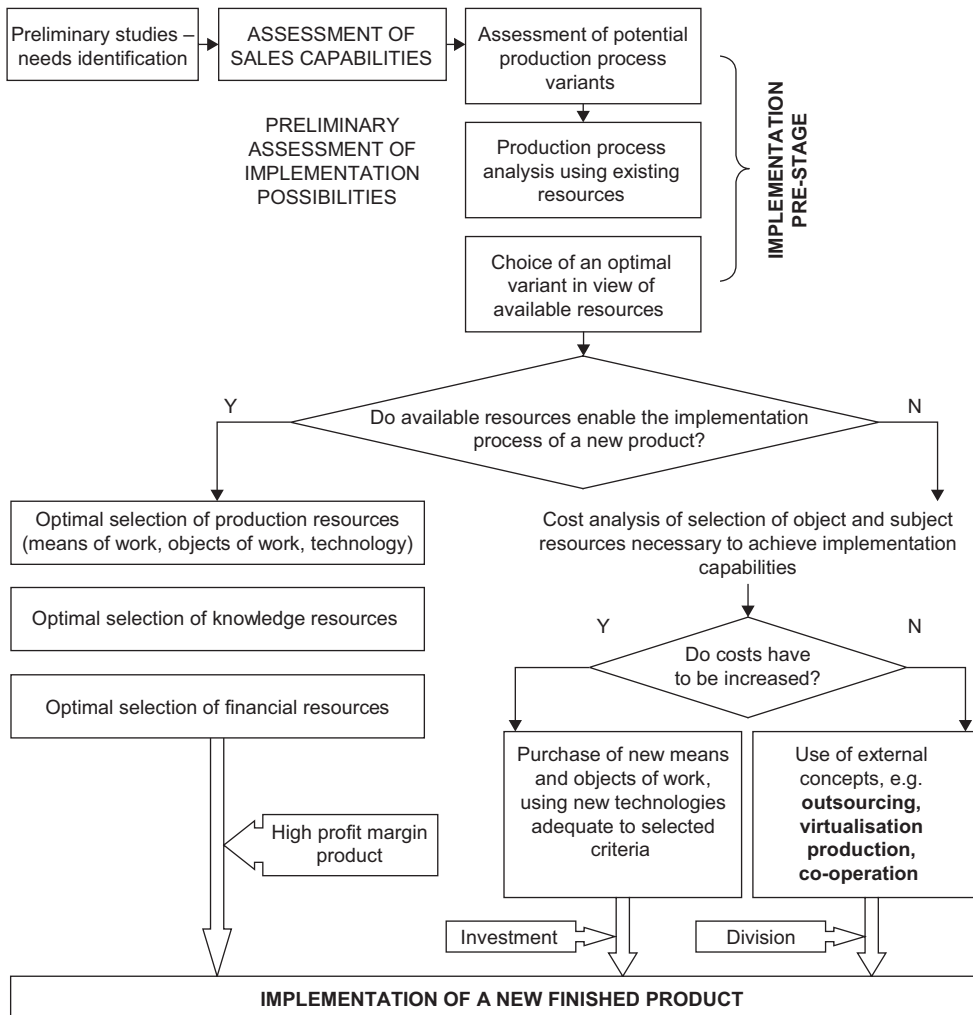
²⁸ The so called *productivity* is one of the approaches to management and organization issues. Its aim is to implement a permanent and comprehensive method of assessment of a manufacturing plant actions in terms of achieving the best technical and economic results, eliminating redundant or unsold production, accumulation of stock, etc. It leads to increased effectiveness and lower production costs.

²⁹ K. Adamiecki, *O nauce organizacji*, PWN, Warszawa 1981, p. 178.

many more products in a shorter time and with very little assistance. New material resources (means of work, objects of work, technology) changed work methods and became a basis of the development of manufactures.

The deliberations presented above show that the resources and their possession, or rather access to them, are of key importance for flexible behaviours of manufactures. Product flexibility associated with the material side of implementation processes results first of all from the characteristics of production means.

Picture 3. The method of assessment of a manufacture product flexibility



Source: authors' own work.

The data obtained as a result of observations confirm the authors' initial assumptions, which said that it is the material and personal factors (knowledge engineers) that influence product flexibility of a manufacture. Using a used up machine, lack of a certain body of knowledge, using an inappropriate or low-quality (incompatible with specifications) material, tool or technology makes it impossible to achieve a flexible implementation process.

In the implementation process of the trailer suspension (Table 2) modelled for the purposes of the present work an appropriate material (column A) must be used in appropriate amounts (columns C and D), which is purchased at a certain cost (column F).

Table 2. Objects of work and financial resources in the implementation process of a trailer suspension

Part No.: 203 910 200		Part name: Suspension		Purpose: Trailer	
OBJECT OF WORK				FINANCIAL RESOURCES	
Material	Size/ITEM (mm)	Quantity/ITEM (item)	Weight/ITEM (kg)	Material purchase price (PLN)	TOTAL (PLN)
A	B	C	D	E	F
Sheet metal	1250x450x6	1	27	2.31/kg	62.37
Sheet metal	300x65x6	4	0.94	2.31/kg	8.69
Sheet metal	300x200x5	2	2.4	2.31/kg	11.09
Sheet metal	200x30x5	4	0.24	2.31/kg	2.22
Rolled rod diam.120	L-20	2	1.78	2.89/kg	10.29
Pipe 159x17.5	L-450	1	–	290.00/m	130.50
Pipe 127x16	L-385	1	–	171.00/m	65.84
Square rod 90x90	L-700	2	44.52	3.17/kg	282.26
Pipe 36x4	L-500	2	–	12.5/m	12.50
				MATERIALS COST (PLN):	585.76

Source: authors' own work based on research.

In a given production process certain machining operation are necessary to be conducted (Table 3) (column H), therefore the manufacturer must have an appropriate stock of machines at their disposal (column G), and be equipped with certain tools and instruments (column I). Technology, understood as the science or a field of knowledge dealing with material or objects processing methods, as well as with methods of manufacturing finished products, and with machines, appliances, tools

used for processing and production³⁰, is determined by materials, their purpose and properties. Therefore constant improvement of technologies and their use in a manufacture become necessary.

Table 3. Means of work, technology and financial resources in the implementation process of a trailer suspension

Part No.: 203 910 200		Part name: Suspension		Purpose: Trailer	
MEANS OF WORK/TECHNOLOGY			FINANCIAL RESOURCES		
Means of work	Operation ³¹	Additional equipment		Work cost (PLN) item	
G	H	I		J	
Universal lathe	Lathing ³²			27.80	
Universal milling machine	Milling ³³			5.30	
Band-saw	Cutting			2.00	
Pillar drill	Drilling			1.00	
Plasma cutter	Burning			20.00	
Welder	Welding			20.00	
Edge press	Folding			2.00	
Paint shop	Painting			2.00	
				WORK COST ³⁴ (PLN):	80.10
				OTHER COSTS ³⁵ (PLN):	64.08
				TOTAL (Tab. 1 – F) + (Tab. 2 – J) (PLN):	729.94

Source: authors' own work based on research.

³⁰ T. Pszczołowski, *Mała encyklopedia prakseologii i teorii organizacji*, The Ossolineum, Wrocław–Warszawa–Kraków–Gdańsk 1978, p. 246.

³¹ A manufacturing operation is a set of standardised actions which are performed repeatedly regardless of the type of the final product. The essence of the calculations is the register of processing costs, i.e. direct labour and general costs, according to the operations included in the process of a product or service manufacture. The processing cost is assigned to physical units of the product which undergo processing at every position where operations are done. As we know there are many varieties of the same product. What makes them different in the manufacturing process is the specific set of manufacturing operations which must be done for the final product to be finished.

³² Chip machining – most common form of external and internal surfaces processing of objects. While lathing the main movement is performed most often by a spinning object, whereas the auxiliary movement is the flat movement of the tool.

³³ The kind of cutting processing where the rotation is performed by the tool and the sliding motion is done by the object being processed.

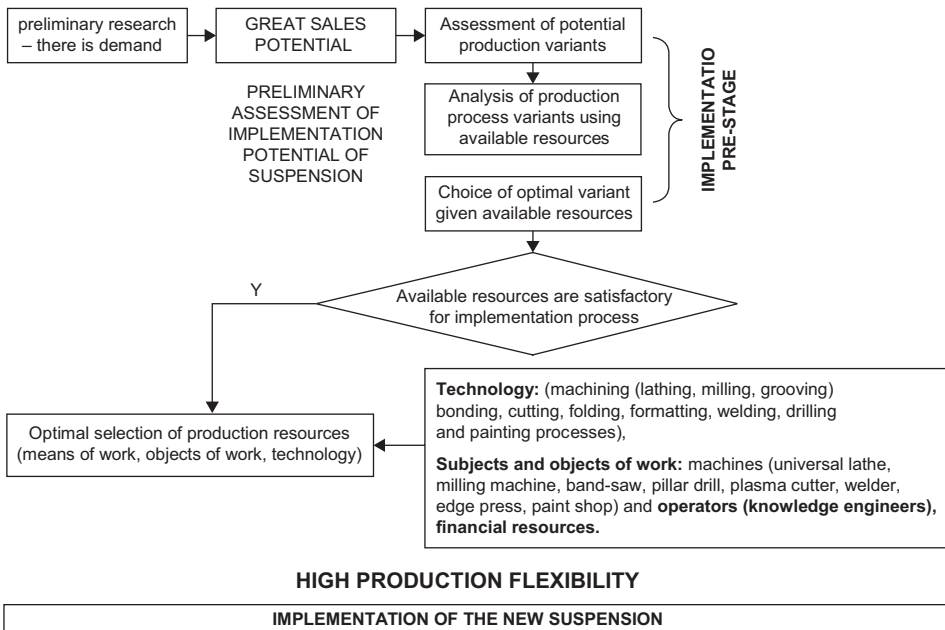
³⁴ They are designated for a given specification of materials necessary to manufacture a given unit of the product.

³⁵ In the presented cost group the following are included: the cost of special tools, energy, depreciation, taxes and fees, social security and other expenses such as business trips or representation. A basic formula is used to calculate those expenses: **other costs = work costs x 80%**.

2.4. The assessment of product flexibility of a manufacture – research results

In the implementation process of the trailer suspension modelled for the purposes of the present work the manufacture where observations were conducted has at its disposal both objective and subjective factors, which allow it to take advantage of its own resources only (Picture 3). It makes it possible to lower the cost of product implementation considerably and shorten it, which is of immeasurable importance in the agricultural sector due to the seasonal character of purchases³⁶. When making a decision to implement a trailer suspension the producer has to take the following criteria in to account: the necessary objects of work (Table 2), means of work and the technology (Table 3) as well as the financial resources and know-how for each of these areas.

Picture 4. The method of assessing the production flexibility of the researched manufacture – authors’ own research



Source: authors’ own work.

³⁶ A lengthy inflexible implementation process may generate additional expenses, which is a manifestation of prodigality. If the producer does not implement their product at an appropriate moment then on occasions they must postpone their sale even for a year. This is the case of harvesting machines where the demand lasts not longer than one month.

It has been stressed on numerous occasions in the present work that every manufacture or factory is a production system. Its material and human elements are used to implement various production processes. When implementing a new product it must be borne in mind that the available resources of the production system may vary from the resources necessary to implement the production process – the manufacture loses its flexibility, i.e. a reconfiguration or integration of the production process do not create the capabilities to implement the new product.

The manufacture discussed in the present work has a well-equipped stock of machines (which was confirmed by document analyses and observations), which includes e.g.: lathes, milling machines, edge presses, sheet metal guillotines, band-saws, welders, drills, grinders, slotting machines, broaching machines, benders, hydraulic and mechanic presses, plasma cutters, etc., objects of work which offer a great span of production possibilities, a unique technology and competent staff (knowledge engineers), which according to the criteria assumed in this work testifies to its product flexibility.

Conclusion

Striking a balance between two opposing tendencies³⁷ seems to be an important problem that businesses face nowadays. On the one hand, flexibility, innovativeness, and creativity in preparing development concepts for businesses are gaining in significance, which is always connected with creators, visionaries, brave and frequently uncompromising strategists. On the other hand, the role of the communication of developmental concepts and engaging a wider circle of people and resources in it are increasingly important, which is clearly connected with participation in strategic management. In order to understand the way a business changes it is necessary to get to know and understand the general social and economic trends³⁸. After all, a modern business is part of a wide socio-economic arrangement, in which it co-exists.

The aim of the work, to present the issues of product flexibility of a manufacture in its theoretical, cognitive and practical aspects, has been achieved. Literature was queried in respect of the flexibility paradigm of a manufacture, which – in the authors' opinion – led to the presentation of the flexibility criterion as a key success factor. A resource flexibility model of a manufacture was suggested, which was referred

³⁷ A. Kaleta, *Przywództwo strategiczne – warunek sukcesu czy bariera rozwoju współczesnych przedsiębiorstw*, in: *Problemy pracy kierowniczej we współczesnym przedsiębiorstwie*, K. Krzakiewicz (ed.), TNOiK, Poznań 2008, p. 37.

³⁸ B. Nogalski, A. Szpitter, A. Mazur-Jelonek, *Identyfikacja i diagnoza procesu kierowania zmianą organizacyjną w restrukturyzacji przedsiębiorstw dystrybucyjnych polskiego sektora energetycznego*, in: *Problemy pracy kierowniczej we współczesnym przedsiębiorstwie*, K. Krzakiewicz (ed.), TNOiK, Poznań 2008, p. 103.

to economic practice, including the case of a specific manufacture which was characterised by perfect flexibility, where a swift reconfiguration and integration of the production process and thus the implementation of the finished product in the form of a trailer suspension was possible using the resources at hand.

The authors consider it necessary to do further and deeper research in this area. The problems solved in the consecutive chapters of the article may be a subject of separate elaborations and analyses, which will undoubtedly influence the effectiveness of manufacture management.

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THE STRATEGIC DIMENSION OF PRODUCT FLEXIBILITY OF A MANUFACTURING PLANT THE CONCEPT AND ITS APPLICATION

Abstract

The area of interest in this publication are manufacturing facilities, that are characterized by excellent flexibility, which reflects their ability to recognize market opportunities that manufacturers are provided with due to a quick reconfiguration and integration of their manufacturing processes, and thus implementation of finished products tailored to the needs of the market.

The overall objective of this paper is to show, in terms of theoretical, cognitive and practical aspects, the issues related to product flexibility of a manufacturing plant.

This article is a creative synthesis based, on the one hand, on a detailed analysis of the theory of the problem, and on the other hand – the authors' own research, carried out to-date.

KEY WORDS: MANUFACTURING FACILITIES, FLEXIBILITY, RECONFIGURATION AND INTEGRATION OF THEIR MANUFACTURING PROCESSES, THE MARKET

STRATEGICZNY WYMIAR ELASTYCZNOŚCI PRODUKTOWEJ ZAKŁADU WYTWÓRCZEGO – KONCEPCJA I ZASTOSOWANIE

Streszczenie

Przedmiotem zainteresowania w niniejszej publikacji są zakłady wytwórcze charakteryzujące się doskonałą elastycznością, którą odzwierciedla umiejętność dostrzegania szans rynkowych, jakie daje wytwórcom możliwie szybka rekonfiguracja i integracja procesu wytwarzania, i tym samym implementacja wyrobu gotowego dostosowanego do wymagań rynku.

Celem ogólnym pracy jest zatem przedstawienie, w aspekcie teoretycznym, poznawczym i praktycznym, zagadnień związanych z elastycznością produktową zakładu wytwórczego. Niniejszy artykuł ma charakter twórczej syntezy opartej z jednej strony na szczegółowej analizie teorii problemu, a z drugiej – na dotychczasowych badaniach własnych autorów.

SŁOWA KLUCZOWE: ZAKŁADY WYTWÓRCZE, ELASTYCZNOŚĆ, REKONFIGURACJA I INTEGRACJA PROCESU WYTWARZANIA, RYNEK