ISM method in research on success factors of Polish and Ukrainian supply chains

Anatoliy Pilyavskyy[1], Anna Maryniak[2], Yuliia Bulhakova[3]

Abstract

The study aims to compare the key success factors of Polish and Ukrainian supply chains (SC) management and to identify the interrelationships between the factors recurring for both parties. The article is based on a case study and uses the Interpretative Structural Model (ISM) method, which is almost unknown in the surveyed markets. The subject adopted for illustration is also poorly recognized. Therefore, the article fills the research gap in the area of methodology and the research topic itself. Based on empirical research, among other things, it has been established that it is possible to identify success factors for SC management that are characteristic of both the Polish and Ukrainian side. The activities within the framework of the "analyst" construct were considered most important in connection with other factors for success. These are supply chain evaluation indicator analysis, preparation and analysis of reports in the area of logistics, identification, and evaluation of risk elements in the supply chain and ordering data and improving data acquisition. Also, it was found that the factors which represent factors with a high power of dependence and a high driving force belong to the transport construction and procedural conditions. Differences in the perception of the success factors of the examined supply chains were also shown and it was proposed to extend the research using methods related to the ISM method or methods supporting it.

Keywords: ISM, success factors, supply chain, the dairy industry.

JEL Classification: L110

1. Introduction

The supply chain is an interesting and dynamically developing field of research, therefore every year more and more elements of theoretical, conceptual, review, empirical quality and empirically quantitative character are created. The research methods used to analyse the supply chain are described in a review document (Panigrahi *et al.*, 2018, Dytczak and Ginda 2015, Erkan and Kalkin, 2019). Our study of the supply chain is focused on the using of the

[1] Corresponding author: Lviv University of Trade and Economics, Department of Higher Mathematics and Quantitative Methods, Tuhan-Baranovskyi Str., 79008, Lviv, Ukraine, apiliavs@mail.lviv.ua.
[2] Poznań University of Economics and Business, Faculty of Management, al. Niepodległości 10, 61-875, Poznań, Poland, anna.maryniak@ue.poznan.pl.
[3] Poznań University of Economics and Business, Faculty of Management, al. Niepodległości 10, 61-875, Poznań, Poland, yuliia.bulhakova@ue.poznan.pl.

interpretative structural modelling (ISM) (Warfield, 1974). As an example of the supply chain we use dairy industry of Poland and Ukraine. The study is the starting point for comparing research results obtained from the using other methods, such as: AHP, Fuzzy AHP, ANP, Fuzzy ANP, DEMATEL, ELECTRE II and VIKOR (see an overview of these methods for example, in: (Wątróbski, 2016; Velasquez and Hester, 2013). The integration of ISM and the methods noted above will be presented in subsequent publications.

2. Operationalisation of research

Collection of research material for the output matrix used in the ISM method can be done through a thorough review of the literature on the subject. An example of such an approach is presented in the study on the construction of a chain resistant for a higher level of sustainability and a competitive advantage (Shin and Park, 2019). The material for creating a structural self-interaction matrix can also be created by collecting primary materials, directly in companies. An example of such an approach can be found in the literature on barrier analysis of green supply chains (Maryniak, 2017). This study is based on both secondary materials. The list of key success factors was prepared based on literature research on supply chain management.

In this way, the broadest list of supply chain success factors that can be found in the literature (Ab Talib *et al.*, 2015, Kumar and Rahman, 2017, Stonkute, 2015) was built. In total, ninety-six test items grouped in twenty-four thematic constructions have been identified. These items were used to identify key success factors in companies.

A five-stage Likert scale was used to assess the factors. Due to the same average for several constructions, their number varies. In total, 14 constructions were selected, which were assessed as the most important for the Ukrainian chain and 15 constructions, which were assessed as the most important for the Polish chain. Each of the constructions consisted of four test items. To increase the validity of the comparative analysis, entities from the same industry and with a similar size of employment were selected for the research. The subject of the research was supply chains on the example of large companies operating in the dairy industry.

This industry is poorly described in logistical terms regardless of the research methodology used and there are hardly any studies using this method in dairy industry (Mor *et al.*, 2018). The ISM analysis was conducted according to the procedure broadly described in the literature of the subject and with the use of "R-3.6.1-win" package, widely known in statistics.

3. Dairy industry in Poland and Ukraine

Considering the 10 largest players on the Ukrainian and Polish market in terms of turnover, it can be concluded that the level of concentration on the Polish market is higher (Latifundist Media, n.d.; Forum mleczarskie, n.d.). Export of milk production in Poland is characterized by an upward trend, while in Ukraine the trend is the opposite, with Polish export almost four times more (State Statistics Service of Ukraine, 2017; GUS, 2017). Generally, the condition of the Polish market is much better, but both markets are speculative due to large product price fluctuations. Polish dairy farms have relatively good production potential, modern technologies, and large-scale production. The situation on the Ukrainian market is unpredictable due to the lack of commonality of the agrarian policy, the lack of a strategic development plan for the dairy industry on the national level and due to speculations related to the opening of the land market. In addition to the common factors indicated by both parties (which are described in the next subsection) as significant, different factors are also indicated in Poland and Ukraine.

It can be stated that in the Polish supply chain under investigation, success factors relating to the external environment are much more important. For example, the Polish side needs to determine the nature of the supply chain, i.e. the extent to which the chain is to be lean, resilient, pro-environmental or agile. It is therefore a strategic view from the perspective of the entire supply chain. The interview conducted on the Ukrainian side shows that there is a lower awareness of the typology of chains. It is to be expected that in the future, regardless of the analysed industries and countries, the ability to create the right structure of supply chain hybrids will be increasingly important for shaping the competitiveness of chains. In the future, decision-makers will therefore have to improve their knowledge not only of the four basic types of supply chains mentioned above, but also of the other supply chain hybrids that constitute these chains. For example: resilient (robust) supply chain (Singh *et al.*, 2019), league supply chain (Fadaki *et al.*, 2019), tight supply chain (Buil and Piera, 2008), sustainability supply chain (Bappy *et al.*, 2019), modular supply chain (Shahparvari *et al.*, 2018).

For the Polish side, it is also important whether individual links in the supply chain are located in regions with a stable legal, political, economic, climatic/seismic situation. Again, this is a more strategic view of supply chain management compared to the Ukrainian perspective. This statement is also relevant to the marketing dimension. Interviews of the Polish chain have shown that it is important for its management to examine customer/consumer requirements in

terms of logistics service levels, create environmental reports, establish promotional activities with partners in the supply chain and set a coherent strategy for the entire supply chain.

In terms of financial and cost aspects, the Ukrainian supply chain is more inwardly oriented (scrupulous accounting for logistics operations, estimating the profitability of investments in the area of logistics or analysing the level of logistics costs). In the case of the Polish chain, the financial dimension about external stakeholders is more emphasized (i.e. financial stability of suppliers and recipients, availability of loans to make logistic investments, possibility to use EU funds). As a result of the conducted research, it was also noted that the conditions in which the Ukrainian supply chain activities, such as: crises, lack of trust between the participants of the supply chain, lack of partner relations, high economic and political risk and turbulence of the environment – increase the importance in logistics activities of IT integration with contractors and in processes taking place within the company. According to the respondents, increasing the level of computerization of the supply chain will increase its transparency and facilitate its stability.

Moreover, the Ukrainian respondents also emphasize the priority of having highly qualified managerial and operational staff in the area of logistics. This is connected with a large wave of emigration of Ukrainian employees to the logistics sector in Poland and to Polish manufacturing companies, in which logistics plays an important role.

4. Test results

In the further part of the study for empirical research, the success factors of supply chain management that are important for both the Polish and Ukrainian sides were identified. Matrix is set out in Table 1. The presented SSIM data outlines the relationships between the factors in terms of i (rows) and j (columns) and their respective relations. A simple notation using the symbols: V, A, X, O is used to denote each of the separate relationships (Hughes *et al.*, 2019).

Table 1. Structural self-interaction matrix (SSIM)

j / **i**	**T**	**SL-S**	**SL-R**	**PC**	**I**	**S/W**	**A**	**R**	**CL**
Transport (T)	0	V	V	A	0	0	A	0	X
Service level – suppliers (SL-S)		0	0	A	V	A	A	0	A
Service level – recipients (SL-R)			0	A	V	A	A	0	A
Procedural conditions (PC)				0	V	X	A	A	A
Inventory (I)					0	A	A	0	A
Storage/ Warehouse (S/W)						0	A	0	0
Analytics (A)							0	V	V
Relations (R)								0	X
Chain length (CL)									0

In order to convert the SSIM into the binary reachability matrix, based on the principles of transgression [4] (Shakerian *et al.*, 2019). To obtain the ISM model, the final reachability matrix must be partitioned. Therefore, each success factor is listed, and its reachability, antecedent, and intersection noted (Peeters *et al.*, 2019).

To develop a conical matrix, the factors are clustered together in the same level across rows and columns of the final reachability matrix (Table 2) (Peeters *et al.*, 2019).

Table 2. Summary of iterations for level partitions

Variable_Names	Reachability set	Intersection set	Level
Inventory (I)	A5	A5	I
Service level - suppliers (SL-S)	A2	A2	II
Service level – recipients (SL-R)	A3	A3	II
Transport (T)	A1 A4 A8 A9	A1 A4 A8 A9	III
Procedural conditions (PC)	A1 A4 A6 A9	A1 A4 A6 A9	III
Storage/ Warehouse (S/W)	A6	A6	IV
Relations (R)	A8 A9	A8 A9	IV
Chain length (CL)	A8 A9	A8 A9	IV
Analytics (A)	A7	A7	V

The next step was *MICMAC Analysis.* Based on dependence power and driving power matrix, it is desirable to seek a method by which we can draw up the hierarchical relationship among them and also establish which of the myriad indicators are "stand-alone" ones in their impacts, which ones do not hold true, and which ones generate secondary and higher order impacts. Cross impact matrix multiplication applied to classification (MICMAC) can be used as the best tool to meet the purpose (Yang *et al.*, 2017).

As a result of the conducted analyses, it can be said that "transport" and "procedural conditions" success factors are located in the cluster, which represents factors with a high power of dependence and a high driving force (Fig. 1).

[4] If the (i, j) relationship in SSIM is V, the corresponding binary relationship is 1 for (i, j) and is 0 for (j, i).
If the (i, j) relationship in SSIM is A, the corresponding binary relationship is 0 for (i, j) and is 1 for (j, i).
If the (i, j) relationship in SSIM is X, the corresponding binary relationship is 1 for both (j, i) and (i, j).
If the (i, j) relationship in SSIM is O, the corresponding binary relationship is 0 for both (j, i) and (i, j).

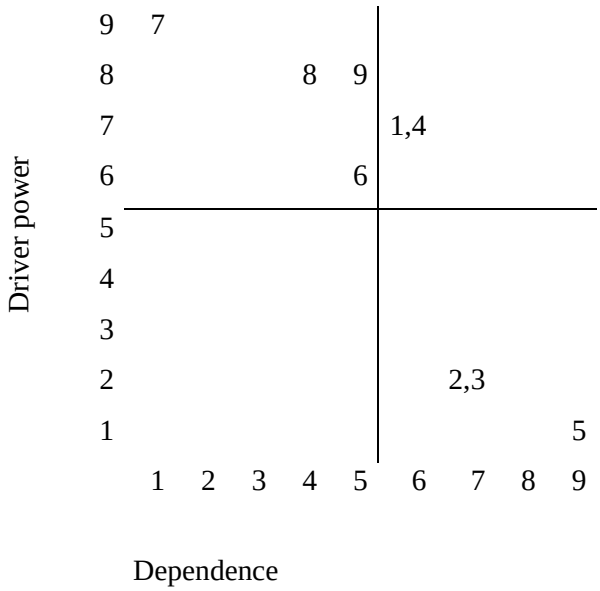

Figure 1. MICMAC diagram

The final digraph was acquired by removing the indirect links. The last diagraph is appeared in Fig. 2 (Kumar and Rahman, 2017).

As a result of the analysis of relations and dependencies of success factors important for both the Ukrainian and Polish sides, it turned out that the "analytics" is a key success factor in supply chain management. Therefore, it is important to perform an indicator analysis of the supply chain evaluation, prepare and analyse reports in the area of logistics, identify and evaluate risk elements in the supply chain and organize data and improve their acquisition.

Second, ex aquo, there are constructions such as: "chain length", "warehouse management" and "stakeholder relations". Under the "supply chain length" construct, respondents indicated that it is important to build short chains, both geographically and in terms of the number of links. Elimination of unnecessary mileage and intermediaries has an impact on costs and sustainability. In terms of "warehouse management", the priority issue is: flexible disposal of warehouse space by using the space of external companies, accessibility to modern logistics centres, using highly qualified services of a logistics operator, as well as proper planning and equipment of warehouses. In the area of "relations" construction, the following elements were pointed out: cooperation with transport, forwarding and logistics organisations and with authorities creating projects affecting legal aspects of logistics and creating positive relations with the local community and creating positive relations with regional authorities.

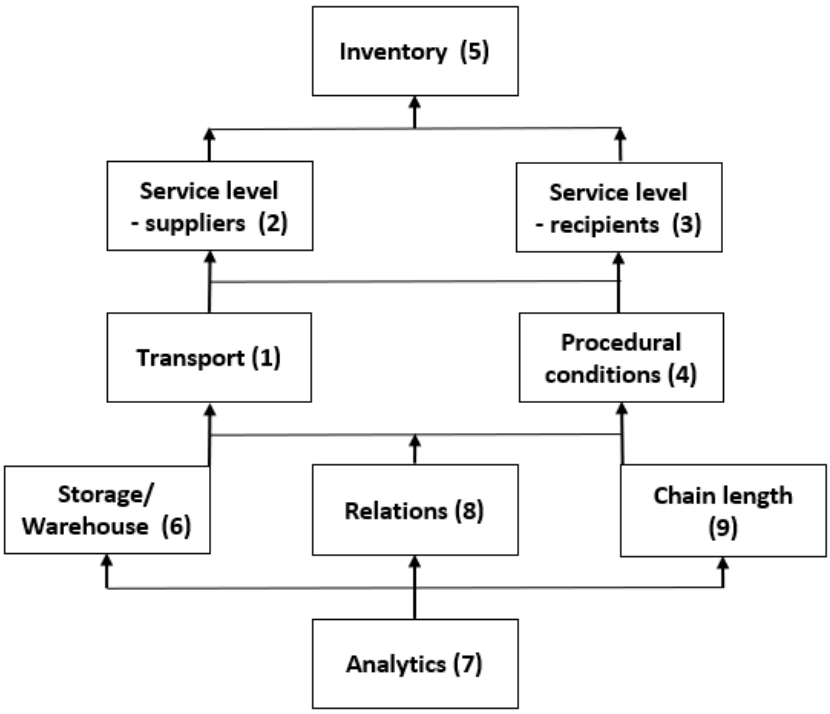

Figure 2. Model based on ISM technique – success factors in the Polish and Ukrainian dairy supply chain

Further important for the competitiveness of the supply chain are "transport" and "procedural conditions", i.e., for example, the ability to track the flow of goods in the supply chain, efficient transport services on the supply and sales sides, the optimisation of transport routes and (as a second structure), it is important to standardise and describe supply chain processes, have different certifications, maintain a high level of security in the supply chain and meet legal requirements for supply chain management.

5. Conclusions

The study compares for the first time the key success factors of Polish and Ukrainian supply chain management (SC) and identifies the interrelationships between the recurring factors for both parties. The ISM method is useful in this kind of research, but it is very rarely used in Central and Eastern Europe both on its own and in combination with other methods supporting it (for example, which belongs to the group of decision-making methods with multiple criteria – MCDM).

The study also conducted a comparative analysis of Polish and Ukrainian supply chains, which are embedded in the dairy industry. It was found that the Ukrainian side focuses more on internal success factors of supply chain management, while the Polish side pays more

attention to external factors. A group of factors important for each of the examined chains was also identified, with the most important being the testing elements related to the "analytics" project.

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