



## THE MAIN AREAS OF METHODOLOGICAL REFLECTION IN THE SUPPLY CHAINS RESEARCH

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**ABSTRACT. Background:** The most important contemporary methodological problems in the study of supply chains include creating and verifying hypotheses and theories as well as selecting appropriate research schemes. An acceptance of the different ways to explain problems (induction, deduction or abduction) is key. It should be remembered that interesting and useful results can be achieved only with well-formulated questions and research problems. All of these issues relate to the need to strengthen methodological rigor within the research into supply chains.

**Methods:** The primary method employed in this article is critical analysis. This article focuses on the most important issues related to the construction of a theory and its verification, as well as the issue of the pattern of research and the cognitive scheme. In addition, the issue of the correctness of definitions has been developed, as these are often wrongly formulated and do not fulfil their role.

**Results:** The main purpose of this article is to indicate that supply chain research requires a change in the general model of scientific practice, assigning a higher rank to replication research and increasing the role of scientific criticism. Potential drivers of supply chain research are all types of reasoning: deduction (reasoning, checking), reduction and its special case induction (translation, command), and the systematization of knowledge. The knowledge gained from this research is so extensive and varied that its further development is possible through refutation, i.e. thesis making, defence and falsification. The aim of this article is also the systematization and analysis of theories and methodological assumptions in the area of supply chain management.

**Conclusions:** The analysis points to a need to structure the definitions of supply. What needs to be established is a set of basic theories useful in the study of supply chains and the assessment of the assertions formulated with regards to hypotheses. The improvement of methodological assumptions, as well as the search for methodological elements useful in this study, need to be continuously ensured. The scope of the theories used in the research should be broadened, but at the same time, new theories should be examined which also pertain to their usefulness in explaining and creating the concept and practical recommendations. It is suggested that research on supply chains needs to be approached in a slightly broader way than has been done so far in the literature. The methodology is recognized as a system of analysis in a particular area of study or activity. Therefore, the majority of publications retrieved according to this key word refer only to examples of the use of particular methods, tools for researching supply chains, or only some aspects of its functioning. However, methodology can also be understood as a philosophy of science. This approach to supply chain research methodology is an important research gap and a new view on supply chain management.

**Key words:** methodology, theories, reasoning, cognitive scheme, hypothesis, supply chains.

### INTRODUCTION

This article contains an in-depth reflection on the usefulness of the methodological achievements of science for research on supply chains. The most important areas of this reflection have been identified. Such an approach is needed in every type of science. It

is always worth pointing out the most useful and the most relevant methodological recommendations. It is further necessary to determine what this usefulness involves as well as to define the benefits of following these recommendations. Such reflection should furthermore refer to the relevance of the achievements of various schools of economics and to the applicability of different theories

[Gligor et al. 2019]. (These issues, however, require more elaboration and can only be signalled in this article).

The classical school of economics focuses on the competitive struggle and the horizontal integration processes of organizations. This school adopts an assumption that points to the independent nature of individual transactions. In the neoclassical approach and institutionalism, much attention is paid to transactions, yet they have become the main focus of interest only in the new institutional economy and the theory of social exchange. These three schools indicate, among other things, the diversity of objectives in management. On the other hand, research into supply chains is definitely dominated by the perspective of vertical integration. The supplier vs. customer relationships are considered to be crucial, as are the relationships within the network. In other words, various schools of economics have different approaches towards competitive struggle and negotiation, whereas the issue of supply chains requires a strong negotiating perspective.

The negotiation struggle is about sharing the economic benefits of participating in exchanges between different entities. Its subject matter involves the most advantageous terms of the transaction for both parties, and it stems from the conflict of different parties' interests. There is also a very important issue here that is worth pointing out. For many years now, criticism has been levelled at classical economics, indicating the drawbacks of the homo oeconomicus concept [Urbina and Ruiz-Villaverde 2019]. On the other hand, in research practice, the assumption made by classical economics regarding the independence of transactions pose a far more important problem. The research into supply chains clearly shows the interdependence between particular transactions and it covers all aspects of business-to-business relationships. According to a literature review conducted by Spina et al. [2016], transaction cost economics and a resource-based view are the most frequently adopted frameworks.

The research in question must be carried out in a broad context as part of management science, economics, and in conjunction with

the theory of networks. However, such studies form a very coherent yet separate component of economic sciences. This justifies conducting both the research and the reflection within various fields of the economic sciences.

This article focuses on the most important issues related to the construction of a theory and its verification, as well as the issue of the pattern of research and the cognitive scheme. In addition, the issue of the correctness of definitions has been developed as these are often wrongly formulated and do not fulfil their role.

## **SUPPLY CHAIN MANAGEMENT TERMINOLOGY**

In management sciences, including the study of supply chains, there are two phenomena related to definitions:

- disregard for the definitions of terms,
- complaints about the large number of definitions for individual concepts, e.g. for the supply chain.

Disregard for definitions occurs despite the habit of quoting them by the dozen, and it is associated with the lack of analysis of the relevance of definitions to the purpose and subject of a study. This results in making somewhat bizarre definitions which undoubtedly complicates the research. However, a positive correlation is easily noticeable between the number of definitions and the relevance of specific studies (one might jokingly claim that the phenomena that have not been described by at least 50 definitions are simply irrelevant).

A very important problem is that there is a lot of unnecessary information in definitions. This can be seen in the research into supply chains as well as in management science. When reviewing the definitions of logistics and supply chains, one might get the irresistible impression that the authors wanted to include in the definition at least some basic knowledge about the notions being defined, with particular emphasis on the objectives of management.

Regardless of whether we take into account the true definition or only the nominal one, the expectations are simply too high. To be exact, it might be interesting to recall the definition of the definition. The true definition is a sentence giving the characteristics of an object or objects of some kind, which can be attributed to these and only these objects. The nominal definition, on the other hand, is an expression that in one way or another provides information about the meaning of a word or words (being defined). Here are some examples of definitions of logistics and supply chains that go beyond what is expected of them.

“Logistics is the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfilment of orders.” [Christopher 2016]. Yet, what to call such management if, as is often the case, profitability is maximised only over short periods of time. And what to call flow management where there are many errors that increase the costs and reduce profitability?.

"In our view, logistics management is an activity that creates a comprehensive concept of logistics projects, taking into account their course both within the organization and its partners, and the coordination of the implementation (in the broad sense) of this concept by appropriate organizational units using appropriate management and control instruments". Such perfection is hard to come by.

Christopher [2016] suggests the following definition of supply chains: “the management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole.” These requirements are fulfilled by a small group of supply chains. This does not give a definition but points to the desired attributes.

The concept of an "integrated supply chain" is also difficult to define, since in any supply

chain there must be some kind of cooperation between suppliers and customers. It is difficult to determine the level of cooperation that allows us to refer to a supply chain that is already integrated. Furthermore, a chain to chain competition between two rival supply chains could be considered [Nobari et al. 2019, Wu et al. 2019]. The concept of an integrated supply chain also raises a new approach to simultaneously considering facility location and inventory management problems [Diabat and Deskoors 2016]. Problems in integration and close collaboration in supply networks are often of an organization's own making. Recently, some studies have started to scrutinize these topics, such as the role of third party organizations in lowering power differences and social distance, the importance of power in defining supply base structure [Ateş et al. 2015], power dynamics in dyads [Lacoste and Johnsen 2015] and the factor of power imbalances for supply chain collaboration in general [Brito and Miguel 2017] and in the context of sustainability [Touboulic and Walker 2015]. It is particularly crucial to extend the view from a dyadic to a network perspective [Carnovale et al. 2017, Cudziło 2018, Foerstl et al. 2016]. Looking at each of these perspectives can lead to various definitions of integrated supply chains.

## CONSTRUCTING AND VERIFYING THEORIES

Many theories can be used to build the theoretical basis for supply chain research.

A comprehensive set of theories useful for research on supply chain improvement was identified by Ketchen and Hult [2007]:

- theory of transaction costs,
- agency theory,
- resource dependency theory,
- institutional theory,
- game theory,
- network theory,
- social capital theory,
- strategic choice theory.

As well as those mentioned Spin et al. [2016] have chosen:

- knowledge-based theory,

- contingency theory,
- social exchange theory,
- information processing theory and
- dynamic capabilities.

Transaction cost theory provides a general framework for the analysis of production costs and market costs, while agency theory is associated with the managerial revolution. Institutional theories and the theory of social capital fall within the humanist approach. Networks theory distinguishes between suppliers and customers in the overall buying/selling relationship, while game theory focuses on the benefits to the parties of a transaction. Finally, resource dependence theory is the basis for the analysis of resources on a network-wide scale.

All of the aforementioned theories have already passed the stage of checking their usefulness for explaining supply chain phenomena. It is to be expected that, as supply chains themselves develop, other theories will have to be used. For example, if reindustrialisation processes intensify and thus supply chains change radically, broader theoretical work will be needed to explain the phenomenon.

In supply chain research, just as in all management sciences, detailed statements, hypotheses and generalisations are formulated. Therefore, there are sentences with both a large and small quantifier and sentences with different levels of assertion (certainty that they are true). The sentences with a small quantifier are detailed sentences (e.g. some companies treat supply chain management as the basis for competition – the word "some" is important here). On the other hand, most sentences with a large quantifier (e.g. all companies competing in supply chains) have a low level of assertion [Ciesielski 2017].

In the research, a significant role is played by so-called historical generalizations – referring to the entity, which is a general historical name, or its scope is additionally limited by coordinates of time and space (e.g. in 20th century Poland, no small company has used the supply chain in competition). It is worth mentioning that many eminent

methodologists believe that all sentences relating to theory are merely hypotheses. This approach seems appropriate for management science. With such an assumption, the so-called "Aydukevich's rule" must be observed. According to this rule, every sentence should be proclaimed with the force that reflects its justification. Comments on a theory determine, to a large extent, how hypotheses or detailed claims concerning supply chains are to be verified. These methods boil down to the confirmation or disconfirmation thereof, i.e. to the strengthening or weakening of the level of justification of the relevant claim. Glaser and Strauss [2017] address how the discovery of theory from data – systematically obtained and analyzed in research – can be furthered. The discovery of theory from data, i.e. grounded theory, fits empirical situations and provides relevant predictions, explanations, interpretations and applications [Hoddy 2019; Kaufmann and Denk 2011].

A commonly accepted basic scientific research scheme is shown in Figure 1.

This scheme includes building theories based on facts, deducing predictions from theories, and checking theories by confronting predictions with facts. This means going through stages: facts, theories, predictions, facts. If at the beginning of the cycle (at the facts stage) a false assumption is made (e.g. with regard to business objectives and strategies), all further steps and stages of the scheme, and in particular the deduction from the theory, may be false. This is the case, for example, with research into the pro-ecological behaviour of companies. The next step – the deduction of theoretical predictions – may or may not lead to the detection of a false conclusion. Deduction is a reliable type of reasoning, the direction of which is consistent with the direction of implications. Unfortunately, it can rarely be used in economic research. Robert Northcott [2019] states that the need for prediction is entangled with the methodological role of orthodox economic theory.

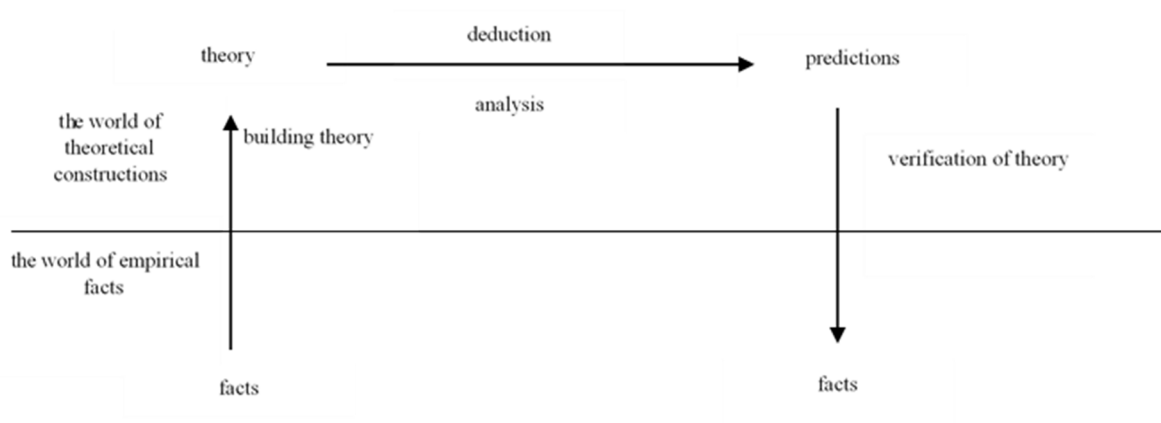


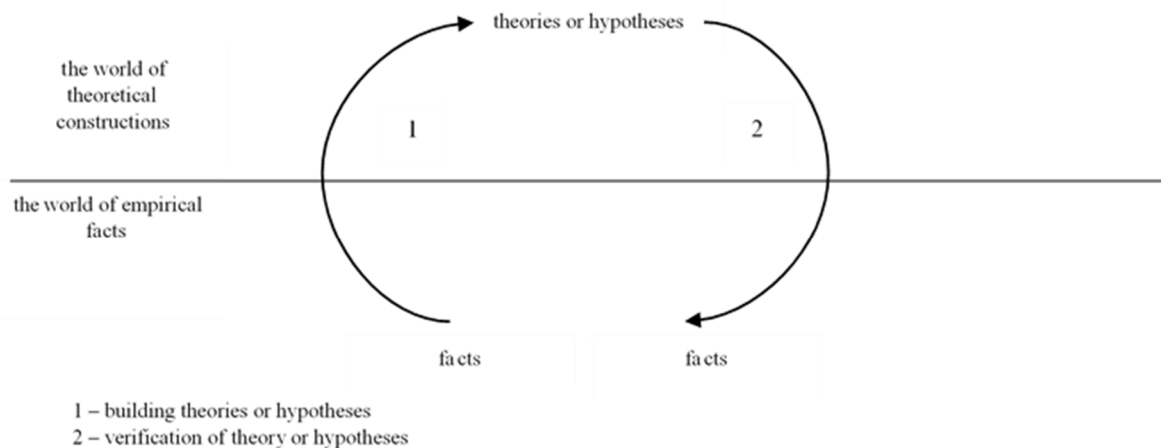
Fig. 1. Basic research scheme

It is difficult, if not impossible, to apply the above scheme in management sciences, and in particular, in the study of supply chains. Therefore, in the research practice of economic sciences, a "limited" research scheme is frequently used.

This limitation boils down to an omission of the step of deducing from theory. Thus, it is composed of two steps: building theories or hypotheses and verifying them. As in the basic scheme, reasoning begins at the level of facts. Verification is completed at the same level,

though the theory being built is verified by confronting it with the facts, and not, as in the basic scheme, by confronting the predictions with the facts. A limited scheme is shown in Figure 2.

Deletion of this step means that the falsity of the facts from which the scheme originates may not be detected. The omitted step constitutes a significant barrier against the effects of falsification of the subject of research.



Source: the author's own work

Fig. 2. A limited scheme of research

In a limited scheme, verification often involves searching for more cases that are consistent with the theory, compared to the number of cases that were used to build the hypothesis. In addition, it should be considered whether the hypothesis is not simply

a historical generalization, localization or a detailed opinion, i.e. it is true only in specific conditions (in a limited time and place).

It should be remembered that the phenomena discussed here may be enhanced,

for example, by the epistemological attitude of the researcher or by the theorisation of research. Moreover, each sentence can be interpreted differently. At the basic level of research, the epistemological attitude is expressed, among other things, by a general approach to economic phenomena, including the type and strength of relevant factors as well as the likelihood of their occurrence. A broader issue concerning the subject matter of research is also important for the study on supply chains [Craighead et al. 2016]. This applies to all management sciences and economics and is based on the universal acceptance of the assumption of the universality of normal distribution.

In these sciences, it is generally accepted that the factors influencing the subject of research and the phenomena occurring in it are characterized by normal distribution. Gaussian distribution is characteristic of a situation where a large number of small random factors occur. However, one may also find the following views [Taleb 2015]: “In social life, almost all processes take place through shocks and changes that are rare but fraught with consequences; in the meantime, social research focuses almost exclusively on typical cases, using first and foremost the ‘normal distribution’ that results in as much as nothing. Why? The normal distribution ignores large deviations. It can’t take them into account, and at the same time it gives us a false certainty that we have tamed the uncertainty.” It cannot be ruled out that there are many reasons for such a position. The organisation's environment sometimes changes rapidly. The organisations themselves are also sometimes subject to processes that fall within the concept of the “black swan” promoted by Taleb. These issues need to be analysed at the level of social sciences. They go well beyond the scope of the discussion in this article but may be relevant to those sciences. At the moment, it is impossible to draw clear conclusions in this respect. Reindustrialisation may be the “black swan” for supply chains. If reindustrialisation acquires a global character, dramatic changes will occur in manufacturing, trade and, in particular, in the movement of goods.

## THE RELEVANCE OF THEORIES

The final criterion for the value of a theory is its practical applicability [Mokhele 2018]. In the last part of this study the issue of concepts, recommendations and postulates of supply chain management was discussed. The question arises as to whether the achievements hitherto made in supply chain research allow for the use of the concept of cognitive schemata in this field. A cognitive schema is an integrated network of knowledge, beliefs and expectations concerning a specific format or aspect of reality. Managers, advisors and scientists assign different meanings to different concepts and even use different sets of concepts [Reinhold and Beritelli 2016, Simpson et al. 2015]. There are also many different opinions (e.g. process reengineering is very useful in all conditions vs. the BPR concept, which causes mainly losses), models or management frameworks and the level of their maturity could also be different (e.g. Schweiger [2015] presented a concept of an original Purchasing and Supply Management Maturity Framework). Each of the participants of the management process needs to formulate cognitive schemas regarding all its components (e.g. we have to keep large stocks as this guarantees short delivery times vs. it is possible to keep small stocks and still be able to deliver quickly). In short, a cognitive schema is a network structure referring to a specific action. It contains interconnected rules of conduct, for example the conduct of competitive struggle. In its assumptions, the theory of cognitive schemas applies to management as well.

The management concept is a different cognitive schema which, in principle, is also a good one. It may be limited to indicating the needs and benefits of benchmarking or it may be based on a single opinion, e.g. ‘make or buy’ decisions, which are of great importance for the competitiveness of a company, and must be made following a thorough analysis and continuous monitoring of their effects (outsourcing). The concepts of LM (lean management), BPR (business process reengineering), and TBM (time-based management) are also of a cognitive nature as they apply not only to the whole organization, but also to the network. The field of supply

chain risk management (SCRM) has provided academics and managers with a range of useful models and frameworks to identify, assess and mitigate potential disruptions. At the core of these frameworks are implicit assumptions of rational decision-making. Failure to account for behavioural factors, such as risk perception and social preferences, may therefore lead to inaccurate risk management models and sub-optimal decision-making [Sarafan et al. 2019].

New concepts should be considered positive when they:

- propose cognitive patterns that are more in line with reality,
- ensure a better choice of topics and information and a better interpretation thereof,
- are independent of current managerial styles.

It must be clearly stated that the intensive development of research into and management of supply chains has already led to the formulation of many recommendations and demands, from the company's logistics systems to global supply chains. The concept of supply chain management is transformed into cognitive schemas which address all relevant issues. In the past, normative knowledge about the management of supply chains was included in the approach to these networks. Researchers stressed the need to apply a systemic, process and network approach [e.g. Wieland et al. 2016].

The strategic role of supply chain management was stressed. There were guidelines for building relationships within networks. The rapid development of knowledge already entitles us to define the general concept of supply chain management as a cognitive schema. The concept of supply chain management has two features that distinguish it from all the normative knowledge in the area of management:

- it uses numerous values contained in such concepts as LM,
- it intertwines the developed methods of analysis and management (e.g. SCOR) with the evolving normative knowledge.

The latter is particularly conducive to the emergence of best practices. The success of the Toyota Production System (TPS) is a good argument in support of the above considerations. Despite its name, TPS is a comprehensive concept of business management with clear references to network management. It should be stressed that TPS was created in opposition to the manufacturing systems that prevailed after World War II. Toyotism is the opposite of Fordism. In the 1950s, the world's leading car manufacturers relied on economies of scale. They wanted to produce a large number of cars in large batches. Due to the small domestic market and export difficulties, Toyota had to reject such thinking. A different approach was adopted in the form of the "one-piece flow" rule. The manufacturing and logistics system should be built in such a way that small batches of different products can be produced one by one. According to the name, the goal was to produce smaller and smaller batches at low cost. On one hand, the benefits of the economies of scale were lost, but other ones were gained, mainly those associated with smaller stocks. Other general principles were also original, for example: the principle of searching and solving contradictions [Liker 2005]. The basic concepts of TPS (e.g. the MUDA) have been incorporated into other management concepts, primarily to LM [Schniederjans et al. 2018]. The relation of TPS to all classical concepts and principles of management is also noteworthy.

## CONCLUSIVE REMARKS

In this article, the authors point to the need to approach the research on supply chains in a slightly broader way than has been done so far in foreign literature. The methodology is recognized as a system of analysis in a particular area of study or activity. Therefore, the majority of publications retrieved according to this slogan refer only to examples of the use of particular methods, tools for researching the supply chain, or only some aspects of its functioning. However, methodology can also be understood as a philosophy of science. Then the literature in this field is very limited. This approach to the methodology of researching supply chains is

presented by the authors of this article as an important research gap and a new view on supply chain management.

The overall result of this study is an indication of the need for a greater methodological order in the research on supply chains. More specifically, this primarily concerns the need to step up efforts to further systematise the scientific problems associated with the research in question. The same postulate should be directed towards organizing theoretical foundations. The third postulate is equally important; methodological problems in research and deliberations in the area of supply chains should not be avoided. As already mentioned, this concerns the perspective of the supply chains themselves and their role in the economy.

Research into supply chains has been ongoing for a relatively short time. Nevertheless, the knowledge gained from this research is so extensive and varied that its further development is possible through refutation, i.e. thesis making, and their defence and falsification. This requires a change in the general model of scientific practice, assigning a higher rank to replication research and increasing the role of scientific criticism. The use of all types of reasoning and the systematisation of knowledge are also potential drivers of supply chain research. To begin with, it is enough to boldly pose hypotheses and build hypothetical models of selected phenomena related to supply chains.

The improvement of the methodological assumptions, as well as the search for methodological elements useful in this study, needs to be continuously ensured. In future work, the scope of the theories used in the research should be broadened. But at the same time, new theories should be examined which also pertain to their usefulness in explaining and creating the concept and practical recommendations.

## ACKNOWLEDGMENTS AND FUNDING SOURCE DECLARATION

The Poznań University of Economics and Business statutory fund.

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## NAJWAŻNIEJSZE OBSZARY REFLEKSJI METODOLOGICZNEJ W BADANIACH NAD ŁAŃCUCHAMI DOSTAW

**STRESZCZENIE. Wstęp:** Do najważniejszych, współczesnych problemów metodologicznych w badaniach łańcuchów dostaw należą: tworzenie i sprawdzanie twierdzeń oraz teorii i wybór schematów badania. Kwestią krytyczną jest też akceptacja sposobów wyjaśniania (indukcja, dedukcja lub abdukcja). Trzeba przy tym pamiętać, iż wartościowe rezultaty można uzyskać tylko przy dobrze sformułowanych pytaniach i problemach badawczych. Wszystkie wymienione kwestie wiążą się z potrzebą wzmocnienia rygorystyki metodologicznej w badaniach związanych z łańcuchami dostaw.

**Metody:** W artykule podstawową metodą jest analiza krytyczna.

**Wyniki:** Dokonano systematyzacji i analizy teorii i założeń metodologicznych w obszarze zarządzania łańcuchami dostaw.

**Wnioski:** Analiza dowodzi, że w pierwszej kolejności należy zlikwidować bałagan w definiowaniu łańcuchów dostaw. Można odwołać się do teorii grafów i używać prostej definicji: zbiór przedsiębiorstw i relacji między nimi, w którym firmy są dla siebie dostawcami i odbiorcami. Trzeba także rozwijać zbiór podstawowych teorii przydatnych w badaniach łańcuchów dostaw i ocenić poziom asercji formułowanych hipotez. Należy stale dbać o ulepszanie założeń metodologicznych i szukać elementów metodologii przydatnych dla omawianych badań. Warto zwiększać zakres teorii wykorzystywanych w badaniach. Ale jednocześnie należy ustalić pochodzenie wykorzystywanych i nowych teorii i ich przydatność w procesie wyjaśniania i tworzenia koncepcji oraz rekomendacji dla praktyki.

**Słowa kluczowe:** metodologia, teoria, łańcuchy dostaw

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