

CLASSIFICATION OF INNOVATIONS IN SUPPLY CHAINS

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The article studies the main types of classification of supply chains and innovations, identifies the types of innovations that can be applied in supply chains, provides examples of innovations in the supply chains of various organizations and proposes a new criterion for classification of innovations - depending on the place in the supply chain.

Innovative processes have a significant influence on the formation of the supply chain: the greater the number of innovations introduced at the stages of the chain, the faster goods, materials and information pass from the stage of procurement to the stage of implementation, and thus the chain can be considered more perfect.

Supply chains are divided into three types: simple, extended, and maximized supply chains. These supply chains differ in the number of participants. Simple chains consist only of suppliers, producers and consumers of the first level. Extended chains include suppliers and consumers of the second level, and the maximized supply chains include various intermediaries.

To assess the innovation process in the supply chain, it is first necessary to determine and describe the types of innovations that occur in the supply chains as a whole and depending on the type of chain itself.

It should be noted that there is still no single classification scheme for innovations that is universally recognized by all scientists in domestic literature. At the same time, it differs even between such documents as Oslo Manual 2018 and State Innovative Policy and Innovation Activities in the Republic of Belarus Act. However, we can identify the general criteria for their classification common to many authors.

1. Scale of distribution.

The empirical studies divide innovation into two types: innovations at the macro-level and at the micro-level [3].

Innovation at the micro level are applicable to an individual firm, at the macro level – to all the economy sectors, separate regions and states.

We believe that based on this classification, innovations in supply chains cannot be fully attributed to any of these types. Unlike innovations at the micro level, they do not belong to one particular firm, but it also cannot be said that they affect the entire state, the region or the economy sector. The exceptions are maximized supply chains, supply chains of large multinational corporations or enterprises-monopolists in a particular country (for example, innovation in the Belarusian railway will affect the entire industry of railway transportation in the country).

For simple or extended chains consisting of several small organizations, it is advisable to offer a new level of innovation – at the meso-level.

According to another classification, innovations are divided into a transcontinental, transnational, regional, large, medium and small [3].

According to this classification, transcontinental innovations can be implemented in supply chains of large transnational corporations, and organizations supplying their products over long distances (for example, suppliers of exotic fruits).

Transnational innovations are implemented in supply chains that consist of organizations located in different countries.

Regional innovations are used in small supply chains consisting of organizations that are located geographically close to each other (in one country, region and area).

Large, medium and small innovations should not be discussed in the context of supply chains, as they are implemented within the same organization. However, some types of innovations may indirectly affect the operation of the entire chain even when being implemented by only one participant.

3. According to Oslo Manual 2018, innovations are divided into technological (product and process), organizational, marketing and ecological [4].

All types of these innovations are found in supply chains, however, product and process (technological) innovations are more often used only in manufacturing enterprises, and not in the entire chain. However, there are exceptions.

Product innovations indirectly affect the activity of other links of the supply chains. Thus, the change in the physicochemical properties of the products will affect the operation of manufacturing enterprises with suppliers (changing the type or quantity of raw materials purchased, in some cases, replacing a supplier), as well as with the freight forwarding organizations and 3PL providers (because of change of conditions of transportation and storage of products). Overall, this type of innovation cannot be called an innovation applicable to the entire supply chain. However, they can significantly affect the operation of the remaining links after their implementation by manufacturing enterprises.

Process innovations affect the relationship between the participants of supply chains to a lesser extent. Changing the way of production does not affect the other participants of the chain, as the product remains the same as well as the conditions of its transportation and storage. The exception is fundamental change in the mode of production, such as the use of 3D printers to print individual parts. In this case, the type of raw materials change, and as a result, the working conditions with suppliers also change. Process innovations in the supply chain can also include the introduction of blockchain technology to protect information, especially in cases where this technology is implemented for all participants in the chain.

Organizational innovations can affect both the entire supply chain and departments within one organization (for example, changes in the structure of the supply chain, concluding contracts with new suppliers and consumers, using outsourcing).

Marketing innovation affect the supply chain when changes are made in packaging design (transportation and storage conditions may change), as well as changes in pricing strategies (which will affect the work with other participants of the chain), when entering new markets or changing distribution channels (affects wholesale and retail intermediaries, end-users in company trading).

Environmental innovations are often introduced by each member of the chain separately. For example, the installation of filters in the production plant to reduce emissions or the use of electric cars. However, lately a situation arises when a company, dominant in the supply chain, encourages other participants of the supply chain to implement this type of innovation. An example is the Danish company Maersk Line, operating in international ocean transportation. The company has included 1500 of its suppliers in the Responsible procurement program, which encourages organizations to consider environmental, social and ethical factors when making a purchasing decision. In 2012, Maersk has already reached the 2020 target to reduce CO₂ emissions by 25% per container compared to 2007 levels [5].

4. According to the enterprises' attitude to innovation development there are [1, 2]:

- innovations developed by the enterprise itself;
- joint innovations – developed in collaboration with other organizations;
- acquired innovations – developed by a third party.

In joint development, two or more organizations work together to create new products, services, improve processes, etc. For example, fertilizer company Yara International has teamed up with Kongsberg to create the ship Yara Birkeland, which will transport fertilizer between three ports in southern Norway. It is believed to be the first autonomous and fully electric cargo vehicle, and is estimated to save up to 40,000 trips by truck per year [6].

Acquired innovations are developed by a third party or another participant of the chain, and then implemented by enterprises of the other participants. An example is an Indian consulting corporation Infosys, which opened a digital innovation center in Germany. The center was created in order to help customers of the corporation in Europe with their digital transformation with cloud services such as the Internet of things (IoT), 5G, artificial intelligence and machine learning. It is expected that the center will become a bridge between the business and leading educational institutions in Germany and will help businesses in the region with the development and implementation of innovations [7].

5. However, the supply chains can also be divided into separate links – suppliers, manufacturers, consumers, trade and logistics intermediaries, etc. And each of these links implements their own innovations. In this regard, we propose the introduction of a new classification of innovation in the supply chain.

Procurement includes innovations at the initial stage of the supply chain, which are implemented by the suppliers of raw materials, as well as innovations that affect the relationship of the producer and the supplier. Manufacturing innovations are introduced in production and manufacturing organizations.

It should be noted that this division of the innovations is relative and may vary depending on which organization is accepted as focal in the supply chain. For the bakery, a procurement innovation is the introduction of a new flour processing technology by the flour mill, and for the flour mill this innovation will be a manufacturing innovation.

Accordingly, consumer innovations are innovations that are introduced at the final stage of the supply chain, i.e. at the stage of selling finished products to consumers, as well as innovations that affect the conditions

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of work of industrial enterprises with consumers. An example is the use of Internet sales (e-marketing), as well as the introduction of AI technologies for the analysis and prediction of consumer demand, customer support using online chat bots and the introduction of augmented reality technologies in stores [8].

Wholesale and retail innovations are intermediates between production and consumer innovations, and are associated with the work of wholesale and retail intermediaries, if they are present in the supply chain.

Transport innovations are associated with the work of the organization's transport fleet, or with the work of a third-party carrier.

Warehouse innovations are introduced in the warehouses of the focal company or third-party warehousing service providers.

Depending on the number of participants in the supply chain, there can be other types of innovation. For example, the maximized supply chains include consulting, legal, insurance and other organizations, which implement their own innovations.

Based on the above, we present a generalized classification of innovations in the supply chains in table 1.

Table 1. – Classification of innovations in supply chains

Classification criteria	Types of innovation
Scale of distribution	Micro level, meso level, macro level
	Transcontinental, transnational, regional, large, medium, small
The area of implementation	Technological (product and process), organizational, marketing and environmental
The enterprises' attitude to innovation development	Developed by the enterprise, joint, acquired
The place in the supply chain	Procurement, manufacturing, consumer, wholesale, retail, transport, warehouse and other innovations

Note: own elaboration based on the studied literature

A distinctive feature of this classification is the identification of innovations applicable specifically to supply chains, as well as the proposal of a new classification criterion and new types of innovation depending on their place in the supply chain. This classification in the future will allow us to evaluate the effectiveness of innovations, as well as to determine the direction and select methods for managing the innovation process in the supply chain.

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