Gradus Vol 3, No 1 (2016) 350-354.
ISSN 2064-8014

NETWORKS

Imre Egri[*]

College of Nyíregyháza, Hungary

Keywords:
Please do provide up to 5 keywords (1 in each row)

Cikktörténet:
Received 31 Jan 2016
Revised 28 Febr 2016
Accepted 31 March 2016

Abstract
Building on the theoretical bases of nets and networks, this paper aims to systemise and typify the networks operating in social and economic life and accordingly analyse the nets and networks that can be identified in logistics. The most recent achievements of mathematics, economics and information technology as well as the globalisation set new challenges to logistics, which it can handle on the basis of the above mentioned networks only. This paper highlights the potential forms and relations of logistics networks.

1 Introduction

In recent times, economy-related disciplines such as mathematics, information technology and humanities introduced innovations that have made the theoretical technical findings directly utilisable and desirable in economic terms. One of these fields is the science of networks, whose application is in its prime today. Thanks to information technology, new types of networks have become parts of our everyday lives as well as parts of economic and cultural life. On the basis of the classics, Euler, Erdős and Rényi, the findings of the network theory can be interpreted not only in terms of mathematics but in the language of economics, too. Barabási *(2013)* has made network theories the object of everyday use in the field of human relations in politics.

By today, networking and thinking in networks has become an integral part of logistics, too. In historical terms, military logistics perhaps starts with the Ancient Greeks. Alexander the Great, Napoleon and world wars made this approach successful. With the development of mathematics and the emergence of modern industry, logistics has become essential in the fields of industry and production. Economic paths such as the product and the value path can be specified and interpreted with the network approach *(Egri, 2015).*

2 Mathematical bases

Mathematics and network elements such as vertexes, edges and numerousness within mathematics, can be identified both in terms of mathematics and visually in logistics. Considering mathematical bases, in the topology discipline, network theory and logistics have relied on Boole Algebra and most recently to the relations of the Mandelbrot Sets well-known to mathematicians. In logistics they can be applied due to the dynamic development of information technology.

In graph theory a graph (system of lines) can be defined as a set of peak (node) and arch (edge and branch), where a point belongs to a certain edge ending. In accordance with this, various structures can be depicted *(Kulcsár, 1998)*. These structures form the elements of macrologistics (the system of roads, railways, maritime and air routes, pipelines, information channels, etc.). Also, the elements of in-plant logistics (micro-production) can be described with the graph theory. We can interpret controlled and non-controlled terms. Controlled terms include road, circle, loop (a unit length of circle) and the highly connected graph. Non-controlled terms are edge, chain, connected graph

[*] Tel.: + 36 20 367 1567
E-mail address: egri.imre@nye.hu

and entire graph. We can also distinguish partial graphs, sub-graphs, trees and chord branches. The connection matrix depicts the relations between the hubs and the roads. The tree formation can be selected from one graph by combining two nodes. Also, we can talk about the loop matrix, where the direction is characterised by the consecutive order of arches. The elements of the network transported into the plane can form a tree figure. However, they can also take a spatial form. One can depict chords, and production cells can form a separate sub-system. The Mandelbrot Set shows the mathematical expression of the above graph theory, where this system of lines corresponds to the representation of a complex number. If the Mandelbrot Set is considered as an own graph system that has some kind of a thickening point (centre) and the end points generate new end points (arches), then it harmonises with a figure similar to logistics systems. Therefore, we can also show a product path from the logistics chain, together with all the economic paths. This gives both the left and the right sides of the production supply chain and distribution chain. On the basis of the previous sketchy mathematical argumentation, the whole production and logistics path can be illustrated in mathematical and IT terms *(Egri, 2012; Duleba et al., 2013).*

3 Networks

Nets and networks have always existed and will always exist. The reason for this is that they are elements of both human activities and nature.

3.1 Natural nets

In nature one can identify the system of powers and relationships ranging from the organisation of atoms to the organisation of the universe, the galaxies. The closest to us are certain elements of the visible world, like nearly all elements of hydrography and natural geography. Accordingly, the system of rivers, the flows in the oceans, the big air circulation systems, or the big systems of the living world including the migration of birds, the procession of shoals and the routes covering the life cycle of the animal world can all be described with aspects of the network science. All this nearly always serves as the basis for the practical elements of economic networks, too, including navigation, sea fishing and even agriculture. The application of network sciences can be a new area in the exploitation of renewable natural resources (wind power plants, hydroelectric power stations).

3.2 Personal nets (human nets)

The most ancient network is the family network based on ties of blood, which has still not been analysed in due depth by the modern world. During history, the organisation theory create various kinds of organisations that today can be identified well to the nets. In his theory, Barabási highlights the well-traceable principles of human relationships, on the basis of which the economy and policy can identify the revealed principles well. The human nets, which are connected and adjusted to the natural nets well, have by nature comprehended and systemised human relationships from time immemorial. Actually, power nets, and ultimately the state, too, can be originated from here. Nowadays the Internet doubles the system of human relationships and brings about new dimensions that make human relations more direct. (E.g. on Facebook any person can establish a direct relationship with anyone.) This implies indescribable perspectives in the culture and the human world. The whole humanity may act as one single global net, which marketing already takes advantage of.

3.3 Organisational nets

The different areas of human life have created specific organisational forms. Therefore, networks typical of science, culture, power and certain human activities could have emerged from the previous nets and partly originating from them. They mostly have their own special organisation theories, which are risky to be mixed with each other. The system of relations and nets of the religions have specific purpose system and surviving ability. Power as primary aim comprises the specific net

system of the state and public administration. Organisational nets can be interpreted as the net of nets. A specific organisational and net type can be attributed to each system of purposes. The consciously established net systems may significantly increase the efficiency and effectiveness of power, culture, science etc. Organisations that fail to network become isolated, grow at a restricted pace and are less able to adapt to new challenges. The specific purposes generate specific organisations and nets here, too, and bringing a system into another one also causes conflicts.

3.4 Economic nets

Economic purposes, economic growth, economic continuance and even the profit purposes have developed a specific economic net system and organisational structure. The networks of economic life form a dynamically developing system within the nets on their own. If we take the world economy as one single global system, we can find horizontal nets parallel to each other and the vertical system thereof in it. Illustrating these horizontal systems as paths, the following paths can be identified.

Proprietary path

Property is the possessor of licences granting the exclusiveness of access to property (as an object) among the people. These rights can be attached to persons and organisations. In practice, rights comprise a system representing a complex system of interests in today's economic life. An interesting developmental aspect of the system is the emergence of economic organisations holding possession of themselves. Within the organisation, the most important right of disposal is the proprietary right. Increasing the efficiency of today's international economic organisations is significantly promoted by the optimisation of the proprietary net. The networks allow for connecting resources that are far from each other and whose proprietors are isolated. The system of shares moving, the globalisation of proprietary packages can multiply the efficiency of firms operating as an international net *(Karmazin, 2015)*.

Product path

The product path determines the stages of coming a product into existence primarily on a technical, technological basis, together with the necessary and essential labour and technological processes based upon the laws of nature. Ultimately, the product path determines the optimal size and technological minimum of the production units and the network thereof. The efficient technology, together with continuous development and innovation, requires larger and larger units and generates larger and larger networks. At present, networks of the same technology merge and integrate (commercial networks). The other economic networks develop from the product path.

Value path

The product prepared during the product path has a continuously increasing value through the added labour, materials energy and intermediaries. The structure of this value increasing path is also based upon the elements of the economic net, and can be characterised with the statements of the network theory. Each phase of the product path (production, trading, innovation, etc.) generate different amounts of added values. Therefore, the value-based networking aims to comprehend and integrate these phases. These days basic material production, processing, commerce and the financial sector are being integrated on a network basis.

IT path

Typically, the starting point of the IT path is not production but consumption and market. In this way the IT relation among each element of the product path facilitate efficient production, value-proportionate exchange and value growth. Its elements include placing an order, product information, market and production needs, quantitative and qualitative parameters. Information, which today already has an individual and increasing value, has become the basis for production. The possession of good information may multiply the efficiency of the agents of economic life. IT networks provide prompt information for the producers and agents of economic life. Today the IT path has facilitated the globalisation of production and consumption.

Logistics path

Logistics integrates the above path elements in both in-plant (internal logistics) and out-of-plant (external, international logistics) areas. The technological development of logistics facilitates the total globalisation of production and consumption. The economic nets listed above can increase and do increase the efficiency of economy considerably. The connections and networks generated by logistics cover the global world and comprise an international system that very often overwrites economic activities having been considered efficient earlier. They vertically connect the economic sectors *(Duleba et al., 2013)* and remote geographical areas. Globally standard production, a standard market and standard financing come into existence. Due to their optimisation activities through the principles of logistics and networks, economic nets are able to establish the globally standard economy. Identifying and applying these nets implies the latest opportunities for the growth of economy.

4 Types of networks

The taxonomy above is primarily based upon the chronological evolvement. If we typify the networks according to other aspects, we can reveal new characteristic features of networks. If networks are separated from their related sector described above, and their operational intensity is considered their distinguishing feature, we can specify three large groups of networks.

Static nets

A static net includes any net and the elements thereof that are physically and visually continuously present and ready to operate. In most cases these are elements of economic life taking shape in infrastructure (roads, railways, product paths, etc.).

Dynamic nets

Dynamic nets can be defined as systems of relations that provide only a temporary connection among the elements of the static nets, with the application of static nets (e.g. assets of shipping companies, the pieces of information themselves, etc.).

Virtual nets

Virtual nets are systems of connections in parallel with static and dynamic nets. The existence of these partially alive nets is allowed by information technology, the mutual connection facilities. Virtual nets can be virtual industrial and logistics parks, virtual product paths.

Studying the closedness of nets, we can distinguish closed and open nets. A closed net can be defined as a system which is not free in their co-operation with other networks owing to their connections. An example for this can be the internal relations of a production plant (which can primarily be determined by the technology and the specific management and organising system).

The systems qualified as external, open networks develop their relations flexibly, and their organisational structure can change at a fast pace. Such systems can include market nets, external logistics nets, research financial nets, etc. It is a self-evident endeavour of economic units to establish networks operating on the basis of standard internal rules from open networks (monopolising).

5 Summary

The above typifying of networks, which intends to but presumably fails to be exhaustive, enables us to extend the scope of logistics and the logistics approach to areas where logistics approach has not been applied before.

The latest findings of mathematics and the opportunities of IT provide a framework for network theory to become a useful element of production and production logistics. Today, the clearly identifiable elements of nets and networks make the planning full-scope. This is one of the means of future efficiency increase.

Networks are probably the most important tools of the economic and thus the logistical globalisation besides the technical development. Even small firms can reach the effectivity of big international companies if they create networks not only organisation wise but also technical wise. Hungarian logistics companies have the opportunity to enter the path which has been opened by the

globalisation. This chance is provided by the European Union, by the Atlantic path and the opening actions of the Hungarian government.

References

[1] BARABÁSI A.-L. (2013): Behálózva (A hálózatok új tudománya). Helikon Kiadó, Budapest.
[2] DULEBA S., SHIMAZAKI, Y., MISHINA, T. (2013): An Analysis on the Connections of Factors in a Public Transport System by AHP-ISM. TRANSPORT (VILNIUS) 28:(4)pp. 404-412.
[3] EGRI I. (2012): Újabb matematikai eszközök lehetősége a logisztikai folyamatok vizsgálatában. Logisztikai Híradó, Budapest.
[4] EGRI I. (2015): Hálózatok és logisztika. Logisztikai Évkönyv, Budapest.
[5] KARMAZIN Gy. (2015): Logisztikai szolgáltató központok fejlesztése hálózati kutatások eredményeinek felhasználásával. Logisztikai Híradó, Budapest.
[6] KULCSÁR B. (1998): Ipari logisztika. LSI Oktatóközpont, Budapest.