Logistics business models and evaluation methods in networked economy

Az értekezés tézisei angol nyelven

Results and achievements of the thesis

1. Drawing on Hungarian and international scientific literature, as well as my previous research I studied and systematized the main phenomena of networked economy and determined the logistic ones. I also identified the apparently contradictory phenomena-pairs in the supply chain. Furthermore, I proved that information is not only a supporting medium but also the object and goal of the flows. I found evidence that hierarchical network-description, -analysis, -evaluation methods, together with sequential logistics definitions are inadequate in regard to exact evaluation and optimalization. It is due to the fact that apart from the peculiarities of coordinated connected entities, the characteristics of the connections are also crucial. Additionally, in logistics besides and instead of sequence, parallelism is also typical of the processes of value creation owing to the emergence of network and informatics infrastructure. As a result of parallel connections, value chains are succeeded by value networks, thus, new service forms and solutions are needed. An increasing number of network nodes have to be made appropriate for serving as consumer points and in many cases as production points at the same time. In broadening and reinterpreting the notion of logistics, I introduced a network-based logistic conception comprising the aforementioned systematized phenomena.

2. Taking the new complex science of networks as a basis, with the help of existing networks and data queues, I analyzed, proved and precluded the scale-freeness of five logistic networks and observed the consequences of scale-freeness with regard to measurement and management. These are the following:
Physical transport and distribution networks tend to be scale-dependent rather than scale-free networks.

Connection networks on the physical networks are different graphs, which are scale-free and bear resemblance to the so-called 'small-world' networks. Therefore, duality can be observed in network properties.

Connection networks are influenced by the physical network and the scale, the mapping of the physical network.

Without full knowledge of the topology and the properties of individual connection topologies, the network cannot be efficiently organized and managed.

I concluded that in the case of scale-free logistics networks the intervention resources have to be focussed on the central points of the networks. Moreover, since geographical and infrastructural restrictions have to be taken into account, the analysis of network connections has to be included in the depot location models.

3. I carried out investigations and calculations on two distribution systems (as well as on the graphs produced by their mapping) in order to prove that network-optimization tasks (e.g. depot location problem) done on the real graph of the network and the currently used simplified linear network modelling provide differing results due to the misconception of performance evaluation (distance evaluation). On the basis of the two investigations I pointed out the otherwise not obvious fact that transport performance optimization carried out on real transport distances produced different results, consequently, optimization methods implemented on the real structure of the network result in different outcome.

4. I also applied simulations in order to observe failure tolerance (breakdown tolerance), an important aspect of network properties, in the case of the avalanche-like breakdown of transport networks. Thus, it can be proved that the impact of cascade-like collapses in a network can be reduced by reducing the breakdown tolerance, i.e. failure tolerance, of the discrete access points. Consequently, besides the quality, stability and tolerance of transport routes, production points as discrete sources also play a crucial role in the sustainable operation, stability and failure tolerance of the system. The importance of the abovementioned phenomenon with respect to logistics is that breakdown tolerance should be taken into account when determining the quality of a supply chain. A production point or the whole supply chain can come to a standstill not only because there are no transports to the production point (or in the supply chain), but
also because production cannot be retooled if transports decrease. In this case, due to the logistic connections, which are being networked, the transports are transferred to other transport routes or transport modes and the avalanche-like breakdown of the system can emerge. The reason for this can be found in the characteristics of transport systems and also in the characteristics and failure tolerance of the sources and drains.
5. I assembled, systematized and evaluated the relevant approaches, concepts and indicators of performance measurement and I determined some peculiarities of logistic tasks applied for modelling and performance measurement. I proved that the source of problems lies, in many cases, in the condition system itself, i.e. in the modelling of the problem. I interpreted logistics performance with respect to service level, economic efficiency and customer satisfaction. I pointed out that measurement deficiencies and various phenomena identified in this paper have three significant impacts on the network. I proposed a coherent index mapping process which determines the process and measurement levels in different steps between customer needs and expenditures. The elements and levels of the conceptional model: Customer needs, Service level, Status-change, Performance indicators, Naturalies, and Expenditures. This concept includes and explains the aforementioned notions of sustainability criteria, customer satisfaction and company efficiency.