

THE IMPACT OF THE SUSTAINABLE MACROLOGISTICS INFRASTRUCTURE ON THE SUSTAINABLE SUPPLY CHAINS'S STRUCTURES

DEMBIŃSKA Izabela, TUNDYS Blanka

*University of Szczecin, Faculty of Management and Economic of Services, Department of Logistics,
Szczecin, Poland, EU, izabela.dembinska@wzieu.pl, blanka.tundys@wzieu.pl*

Abstract

The principles of the sustainable development, in particular those are derived from the ecological area, more and more and increasing extent determine the organizational and functional aspects of the supply chain. The contemporary supply chains must be not only resilient, agile and smart. They must be ecological and social responsible. The condition for the functioning of the supply chain is the logistics macroinfrastructure. Development and growth of the macroinfrastructure must reflect the needs of modern supply chains. Assigning an eco-friendly attributes to the supply chains should be required, to development and growth of the macrologistics infrastructure. It also should be consistent with generally accepted of the ecological imperatives and constructed with the respect for the environment. The aims of this article is to find the ecological determinants of the growth and development of the macrologistics infrastructure and an indication of their impact on the structure of the sustainable supply chains. The article has an epistemological character.

Keywords: Macrologistics infrastructure, sustainable development, sustainable supply chains

1. INTRODUCTION

Sustainable development has become a determinant of the new current of changes in the economy, which is opposed to attitude of only the unconditional economic growth. By defining the issues in the report of the World Commission on Environment and Development in 1987, titled Our Common Future, commonly known as the Brundtland Report [1] noted, that the global economic growth should be within the limits of ecological "capacity" of the planet. Starting a new era and a new stage in the socio-economic development, by following the sustainable development. It means meeting the development aspirations of the present generation and is still able to meet the same aspirations for the future generations.

The sustainability of growth thus implies the intergenerational justice and in operational terms means:

- the need to ensure the availability of environmental resources for the economic growth in the future (a problem of amounts),
- the requirement to keep constant the quality of environmental resources (without the degrading the status quo) for future generations (a problem of quality).

Objectively, the rules and assumptions of sustainable development of the economy are determined not only in terms of the function (processes), but they are also set by standards in shaping the infrastructure, and implementation of the business processes, which including the logistics infrastructure. Leading reflection on the logistics infrastructure of the economy or detailing on the field of the macroinfrastructure of the logistics, should be take into consideration first of all the foremost elements of linear infrastructure - it is means: roads, which including the motorways and expressways, as well as the elements of the point of logistics infrastructure - distribution centers, warehouses, terminals, seaports.

The dynamic development of logistic, which is observed for several years, creates the need for growth and development of the logistics macroinfrastructure. Unfortunately, this situation has a negative impact on the environment. Therefore, it has been assumed that it can not cease of the development of logistics infrastructure in such a manner that to reduce her negative impact on the environment (it is worth mentioning, that this is not

desirable). It should be try to the develop of a model, which, on the one hand, will be provide of the economic development and on the other hand will be fulfill requirements of the sustainable development. Therefore, it should be find a compromise of the targets, that seems to be in opposition relative to each other. Creation of a new model, it could be not confined only to the transport infrastructure. The development of logistics processes is explicitly noticeable, and also the infrastructure to enable their implementation. Consequently, in addition to the listed elements transport infrastructure must be taken into account: storage facilities and logistics centers. It is important to be aware of, functional dependency and relationships between transport infrastructure storage infrastructure and logistics centers. This situation is a result of the system approach in the management of logistics processes, which is manifested, inter alia as, optimization of costs through a trade offs mechanism (cost compromise). Considering the issue from a slightly different perspective, it is als important to observe the priority of investments rules, which consists, in fact, that the consequence of the construction, modernization and expansion of roads is an investment in the form of logistics centers and parks. In other words, as first it is formed a linear infrastructure, then appears the elements of the point of infrastructure. This is particularly noticeable in the case of motorways and expressways.

In considerations can be appear doubts - whether to use the phrase „sustainable logistics macroinfrastructure“ or it would be better to formulate „sustainable growth and development of logistics macroinfrastructure“. The problem is in the fact that it actually has to be a reference to the sustainability- beside it will be a logistics infrastructure, processes of growth and development. Analyzing of the definitions of sustainable development and definition of its areas shows that they are open an not included in the rigid framework. It is confirmed by such examples as: sustainable economy, sustainable economic growth, sustainable tourism, sustainable consumption. The economy, growth and economic development, tourism and consumption are concepts defining the processes i.e. business processes, the processes of growth and development, tourist processes, processes of consumption. The logistics macroinfrastructure is inanimateand should be considered as a thing. Accordingly, the balance of this strategy must be related to the processes, which is a logistic infrastructure and a platform for the aim realization. It must be assumed that the correct term is „sustainable growth (quantitative aspect) and development (qualitative aspect) of the logistics macroinfrastructure“. The aim of the discussion is presented the considerations, they show how to indicate the sustainable development of logistic infrastructure in terms of macro affect and an impact of the construction and functioning of the green supply chains.

2. THE ISSUES OF THE IMPACT OF LOGISTICS MACROINFRASTRUCTURE ON THE ENVIRONMENT

The designation "impact" is commonly used and takes part of discussions relating to the issue of the relationship between the human activity and the natural environment. The impact of logistics macroinfrastructure on the environment can be reduced in terms of:

- a social and economic effects,
- a physical impact on the natural environment,
- an impact on the national heritage.

Socio-economic impacts can be seen in the form of economic benefits in the region that are distributed over a long period. Socio-economic impacts are mostly the result of an increase in accessibility and an increase in mobility. The physical impact of the logistics macroinfrastructure on the environment can be manifested, on the one hand, as the use of the elements to protect the environmental resources and on the other hand, the result in the form of noise, air pollution, water pollution, etc. This situation can be seen as a negative character. While the influence within the meaning of the impact on the national heritage can be interpreted as a visual infringement, the destruction of particularly attractive of historical or archaeological areas and at the same time destroying fauna and flora by changing microclimate.

Considering as the problem the impact of logistics macroinfrastructure on the natural environment, the environment which is protected in this area, strictly speaking, a constituent of resources and elements of logistics macroinfrastructure shall be understood as interacting (affecting) objects. Taking into account the focus of analysis and the impact of assessment adopted in this study, the environment will be the object of the impact and logistics macroinfrastructure will be the object of the interaction. Depending on the direction, the impact will be referred as a top-up, when resources will be serve as a logistics infrastructure top-up's facilities, and generating, in the case where the logistics macroinfrastructure is an object that generates external effects, and it acts as an absorbent of the environment. The development and growth of the logistics infrastructure should be look on the one hand, in the context of the supply in the natural resources, i.e. materials, energy, water, land, they are necessary at every stage of the life cycle: construction, exploitation (using), modernisation and liquidation (design stages is deliberately excluded). On the other hand, at each of these stages of life cycle, logistical infrastructure tends to the form of the external effects in terms of noise, pollution (emissions), areas defragmentation. In Fig. 1 is presented a schematic diagram, which shows the interaction between the environment and logistic macroinfrastructure. It is evident that indicated effects of impacts of logistics macroinfrastructure on the environment are characterized, in principle, as negative effects.

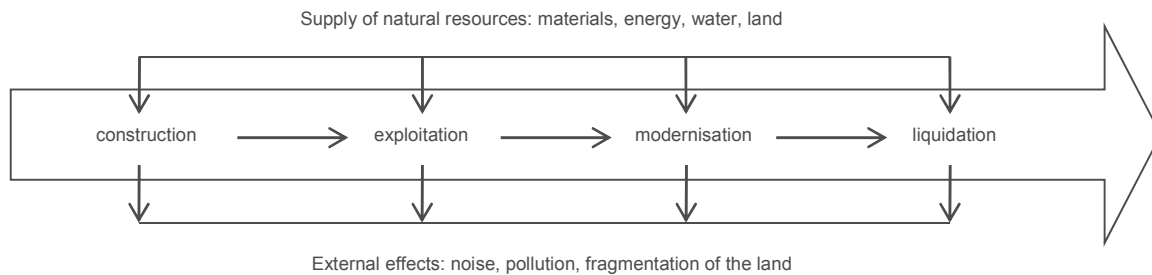


Fig. 1 Model of impacts of logistics infrastructure of the economy on the natural environment
Source: own elaboration

The characteristics of the negative impact of the macrologistics infrastructure on the environment could be performed for diversity in time and space and may include different elements and different ranges. Their selection is based primarily on the purpose for which it will be done. By treating the environment as a collection of the resources, basic area of the impact analysis is determined by the structure of these resources. In the other words, it is tested whether the logistical venture or the object of logistics macroinfrastructure have affects on the particular resource or not. The impacts should be recognized symmetrically. This means, that it should be analyze, on the one hand, top-up of logistical venture or logistics facility in the environmental resources at every stage of the life cycle and on the other hand, negative external effects generated during the implementation of the logistical processes or using and decommissioning of the logistics facility.

3. SUSTAINABLE SUPPLY CHAIN - THEORETICAL APPROACH AND CONCEPTUALIZATION OF THE TOPIC

The development of the business concepts and directions of development of the economies contribute to changes in the structure as well the rules of creating the supply chains. The growing importance of environmental and social aspects in the business results has more impact of the construction of the supply chain with regard to this perspective.

The origin and development of this type of chains is based on assumptions of adapting on the concept of supply chain management, expanding definitions of the aspects of sustainability. Based on the approach Carter and Rogers [2] we can say that a framework of the sustainable supply chain management: moving toward a new theory. It belongs to the classic definition add integration issues covering aspects: social,

environmental and economic. It should also add that as well Srivastava [3]. It refers to the concept of sustainability (balancing) defining them as: "the potential for reducing long-term risks associated with resource depletion, fluctuations in energy costs, product liabilities, and pollution and waste management". In the context of today's discussion it is important to indicate, that Skidar [4], understands sustainability as "a wise balance among economic development, environmental stewardship and social equity". Most of the definition of SSCM includes a consideration of the environmental, economic and social issues while improving the long-term economic performance of the supply chains [5]. Sustainable supply chain is the process of integrating a strategic approach, which aims to improve long-term economic efficiency and customer satisfaction taking into account social, environmental and economic. Supply chain management is categorized into three main aspects of sustainable development; the environmental and social criteria must be met by the supply chain (business units) and the competitiveness of the chain, which will help to meet the needs of the customer [6,7,8,9].

Sustainable Supply Chain Management (SSCM) should be considered from macro-viewpoint. In this point of view is it "the strategic, transparent integration and achievement of an organization's social, environmental and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual and its supply chain" [4]. Environmental and social problems present in the entire supply chain and must be analyzed and monitored by any companies. SSCM is integrating environment thinking into supply chain management, including: product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers and end-of-life management of the product after its useful life (recycling, close loop).

Before sustainable strategies will be implemented into the supply chain, the various players must ensure the following points, which act as influencing factors during the implementation of sustainability [10]:

- understand the concept of sustainability, government and social policies and legislations,
- ensure they have the potential to implement sustainability in terms of cost, quality and culture,
- financial capabilities, since social/green production methods are expensive at adoption,
- appropriate organizational culture and avoidance of resistance to change,
- find key sustainable suppliers who support the principle of environmentally and socially friendly systems.

Implementing of the sustainable rules to the supply chain to take action in the following areas [own elaboration based on[11]:

- re-organization of the supplier management and their integration,
- review the sourcing of raw materials so as to ensure sustainability,
- follow the changes of government legislations and external support factors,
- create in the organizational structure a dedicated department that ensures social, ethical and environmental considerations,
- changing of the organizational culture and employee involvement,
- implementing of reuse and recycle specifications for the products,
- included the Key Performance Indicators (KPI) infused through the supply chain,
- implementing of Carbon management across the supply chain,
- create of quality and safety system protocols,
- use of methods of reduces costs through periodic cost analysis.

The main focus in logistics, traditional was efficiency and cost reduction. In the point of view of sustainability the most important is environment with emphasis on the transportation [12]. Very important is synergy between organizations in the supply chain, which have the same aims and philosophy. Only this situation could lead to environmental performance, minimization of waste and cost savings/reducing. Fig. 2 shows the concept of sustainable supply chain management.

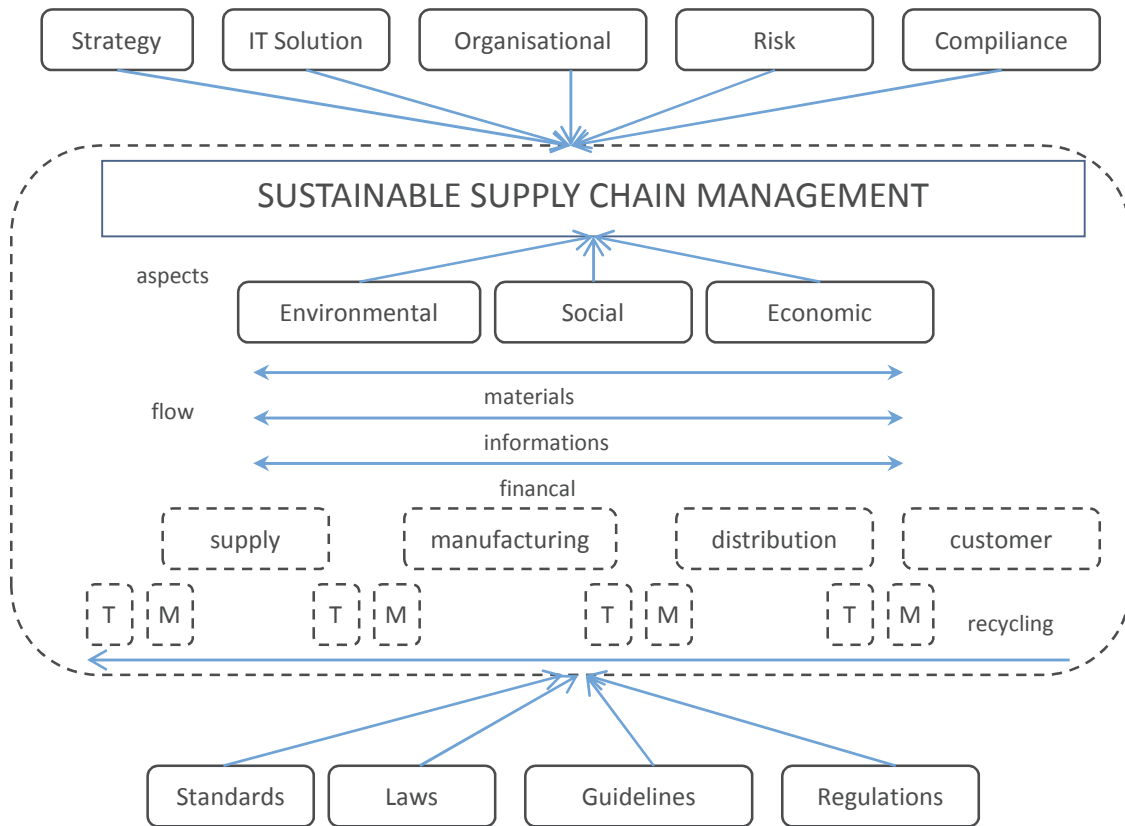


Fig. 2 Conception of the Sustainable Supply Chain Management
Source: own elaboration

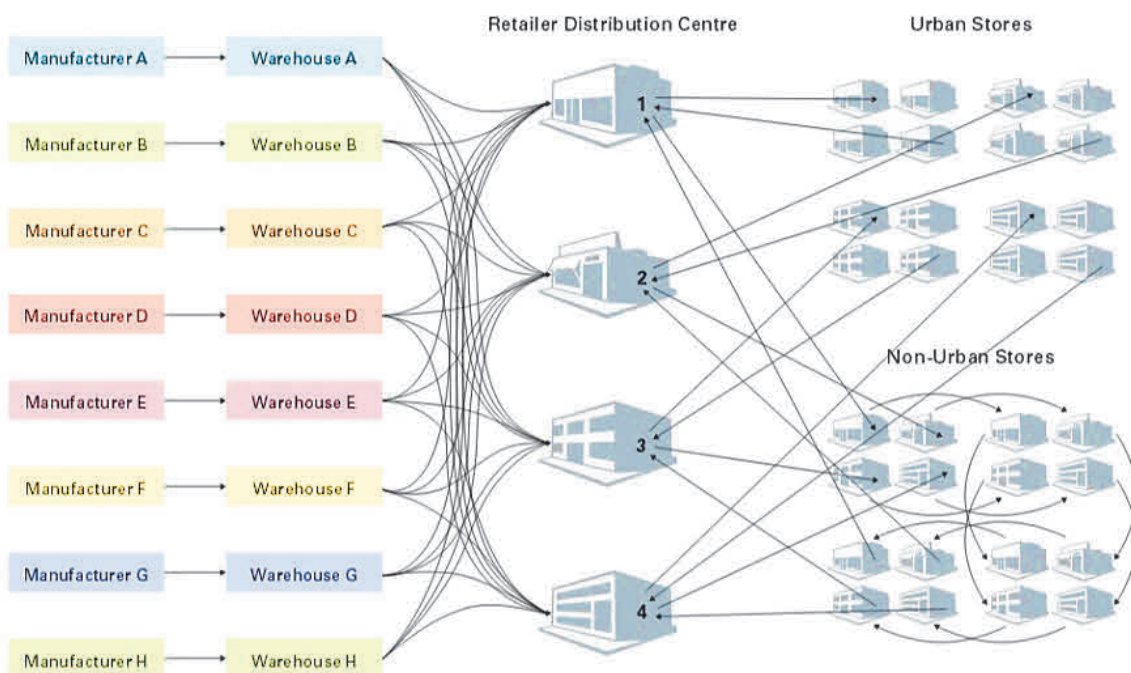
4. IMPACT OF THE LOGISTICS MACROINFRASTRUCTURE'S GROWTH AND DEVELOPMENT ON THE SUPPLY CHAINS STRUCTURE

Considering the impact of logistics infrastructure on the natural environment, it is important to remember what place it occupies in the economy, what tasks it performs and what role it plays. This implies a look at the place and the role of logistics macroinfrastructure in the supply chain. Logistics infrastructure does not exist for itself, and therefore its impact on the natural environment has its macroeconomic reference points. Their analysis, however, is not a specific justification for the negative impact of logistics infrastructure on the environment. Allows you to create a complete picture of the problem resource management, in which impacts of logistics infrastructure on the natural environment are recognized in correlation with the tasks fill in the economy.

If one assumes, first, that growth (quantitative aspect) and development (qualitative aspect) of logistics infrastructure of the economy should carried out in accordance with the rules and principles of sustainable development (sustainable growth and development of logistics macroinfrastructure), and secondly, assuming that the logistics macroinfrastructure is an integral part of sustainable supply chains, and thus absolutely determines the processes it undergoes, such approach to the problem forced to ask the question: whether and how sustainable growth and development of logistics macroinfrastructure affects the structure of the supply chain. So the question can be further expanded: to what extent a sustainable growth and development of logistics macroinfrastructure, influencing the structure of the supply chain, at the same time contributes to a better performance of the principles and objectives of sustainable development.

The distinction between modes of transport, road transport is the greatest, not to say clearly dominant, but there is a part of the implementation of logistics processes in the supply chain. Therefore, seeking answers to the first question in the context of linear infrastructure should take into account motorways and expressways. The obvious is the relationship that if logistics systems are develops an increasing demand for transport, and this causes the demand for road infrastructure. Construction of a new, expansion (adding another lane), modernization of roads, increasing the density of the network, all this has a positive effect on the quality parameters of logistic processes, primarily shortens the duration of the transport process by increasing road capacity/networks, thereby reducing congestion. In addition it increases the availability of logistics infrastructure. Seeing at the same time the negative impact on the environment one must consider how to develop road infrastructure according to the needs of the economy in line with the environmental requirements. There have been many mistakes. Poland is a good example. In recent years the road infrastructure in this country has grown up, and very dynamic - built nearly 2000 km of highways. Looking at the map, their course in many cases is parallel to the old road, which has a direct impact on land consumption of road infrastructure. The old roads have not been liquidated. Of course dense transport network for the functioning of the supply chain is indicated, but are all connections in the network effectively used? So, do we always have to start building a new road, or is it better to expand existing, thus reducing land consumption of the road network. However, if you need to build a new section of the road (new route), an alternative to the existing road, we should pay attention to the possibility of using land along the old road.

Looking at the structure of the supply chain from the perspective of the point of logistics infrastructure, it must be noted a trend. On the one hand still arrives at new warehouse space for rent, but on the other hand, we can see a move away from building by customers their own warehouses, and therefore we see a process of centralization of storage. Besides it will develop a process of centralization of warehouse space which is in the hands of developers through the development of vertical cooperation between them (**Fig. 3**). As with the road infrastructure, the solution is not to build densest network, but its optimum adaptation to the needs of the efficient functioning of supply chains (analogous: an increase in labour productivity does not necessarily result from hiring more workers, only with better organization of their work). These changes will lead to a leaner supply chain structures, and thus are an expression of respect for the ecological conditions of their development.



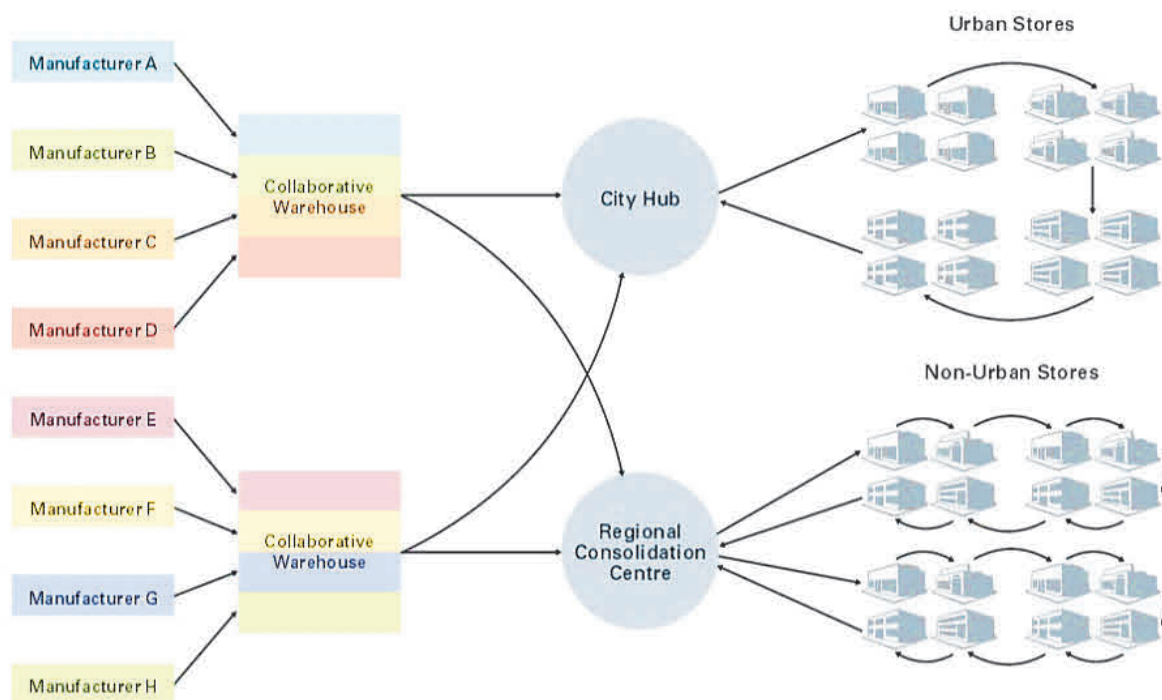


Fig. 3 Centralization of storage processes in the supply chain
Source: [13]

5. CONCLUSION

The question raised in the article was only signaled. Identifies the main concerns and relationships. The authors are aware that it requires a deeper analysis of both theoretical and empirical. However, you can bet the following conclusions:

- The requirements of sustainable development will determine the development of the logistics infrastructure of the economy.
- In case of shaping the development and growth of the logistics infrastructure of the economy according to the principles of sustainable development there is the need to adopt principles and the policy instruments of the European Union. So far the White Book take part into account the problem of negative impact of transport on the environment, but this is in terms of process. The problem of the negative impact of the logistics macroinfrastructure on the environment is unnoticed, and thus the negative effects of its growth. The problem is even more serious that transport policy (logistics) European countries calls for the growth and development of road and warehouse infrastructure.
- There is a relationship between the increase of macro structure of the logistics infrastructure and supply chains. The increase of the linear and point infrastructure conducive to the development of networks between the supply chain links.
- The concept of the sustainable supply chains is based on inter alia on the lean supply chain assumptions. If sustainable supply chains standards to be met, one of the conditions is to carry out sustainable development of the macrologistics infrastructure in the supply chain. First of all, it should continue the process of centralization of storage.

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