

# SAFETY IN THE PUBLIC SERVICES SUPPLY CHAINS – THE CASE OF EMERGENCY MANAGEMENT

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**Introduction/background:** The concept of the public service supply chain has become increasingly popular in the science and practice of public governance. Complex supply chains are formed consisting of many organizations from different sectors. Coordination of such chains is not straightforward and deals with many organizational, social, relational, and situational challenges. This makes safety issues increasingly important.

**Aim of the paper:** This article aims to develop a framework of the public service supply chain safety management. The usefulness of this framework was presented on the example of emergency management.

**Materials and methods:** This article was prepared based on a critical literature review and a structured interview questionnaire conducted with 15 emergency management experts.

**Results and conclusions:** As a result, safety management issues in the public services supply chains were described, the emergency supply chain was characterized, and the framework of the public services supply chain safety management was developed.

**Keywords:** public service supply chain, safety management, emergency management operational risk, relational risk.

## 1. Introduction

The issues of configuration and coordination of the public services supply chains are nowadays a new and intensively developing research area. The possibilities of using the principles of operation of supply chains to deal with the complexity of activities in the public sector, as well as to improve the processes of public service provision, are increasingly recognized. Research on this topic concerns, among others, public procurement (Vecchi, Cusumano, and Boyer, 2020; Amann et al., 2014), public-private partnership (McCarter, and Fudge Kamal, 2013), smart technologies (Szymczak, 2015; Meijer, and Bolívar, 2016), or the use of lean management (Arbjørn, Freytag, and de Haas, 2011). They are undertaken from the perspective of the functioning of various areas of public management, such as criminal justice (Seepma, de Blok, and Van Donk, 2020; Odlanicka-Poczobutt, 2016), healthcare

(Leksono, and Suparno, 2018; Esain et al., 2016; Twaróg, 2014), emergency management (Peterson, Young, and Gordon, 2016; Ficoń, 2011; Malindžák, and Olejarz, 2017), or humanitarian relief (Van Wassenhove, and Pedraza Martinez, 2012; Banomyong, Varadejsatitwong, and Oloruntoba, 2019).

However, the functioning of the public services supply chains is not free from the risk of external threats, inter-organizational misunderstandings, or problems connected with leading activities in collaborative networks. These problems refer to challenges associated with governing turbulences (Ansell, and Trondal 2018; Ansell et al., 2017). Issues contained improper customer service, waste of public money, long time cycles of activities, or poor inter-organizational communication may occur (Nkwanyana, and Agbenyegah, 2020; Mafini, 2016). However, research in this field is fragmentary. Although the theory of high-reliability organizations has been in use for a long time (Laporte, and Consolini, 1991; Roberts 1989), there is still an absence of analysis on resilience, resistance, and reliability in public service delivery (Berthod et al., 2017). The consequences of the Covid-19 pandemic highlighted the weaknesses, vulnerabilities, and lack of flexibility of public services supply chains (Lemke et al., 2020; Qin et al., 2021). For this reason, there is a need to reconsider and reconfigure these chains, taking into account the dynamics and turbulence of changes and safety issues. These are problems that create new research opportunities.

Emergency management is a particularly representative area in this respect, as it creates exemplary conditions for understanding the public services supply chains in particularly high-risk conditions (Gazley, 2013; Comfort, 2007). This is due to the complexity of the supply chains in emergency management. Each emergency is different: it occurs in various places and times, its scope and intensity are different in each case, and various people are at risk. Such various situational conditions make it necessary to configure the service supply chain differently in each case, even if it is the same type of threat. Besides, it is the area where the most advanced research on the functioning of supply chains is carried out, compared to other areas of public governance (Peterson, Young, and Gordon, 2016; Van Wassenhove, and Pedraza Martinez, 2012; Peck, 2006). The scientific achievements in the field of emergency supply chains could be valuable to research safety issues in public services supply chains in turbulences. On this basis, this article aims to develop a framework for public services supply chain safety management. The usefulness of this framework was presented on the example of emergency management.

## **2. Research method**

This article has a conceptual nature and was prepared on the basis of three theories: public service delivery, service supply chain, and safety management.

A critical review of the literature was used to achieve the purpose of the article, which is to develop a framework for public services supply chain safety management (Grant, and Booth 2009). It was used to learn about the safety issues of the functioning of the public services supply chains. The Scopus and the Web of Science databases were used for the research. These are databases containing publications of high scientific value, reviewed by independent experts and ensuring high-quality results (Newbert, 2007). The search words were "supply chain", "public service delivery", "threat", and "safety". On this basis, the framework of safety management in public services supply chains was developed.

The usefulness of the developed framework was presented on the example of emergency management. For this purpose, the legal acts and regulations, and obligatory operating standards were taken into account. Empirical research was also carried out to verify the level of risk resulting from organizational and relational circumstances. A structured interview questionnaire conducted in January and February 2019 with 15 emergency management experts from blue-light organizations who had at least 10 years of practical professional experience. This study identified the level of operational and relational problems in the emergency supply chain.

In the course of the conducted analyses, public services and the process of their delivery were characterized. The public services supply chains and safety management in these chains were also described. The conducted research and analyses allowed both the systematization of knowledge in the field of the functioning of the public services supply chains and the development of a new, holistic approach to the study of supply chain safety management. These results were supplemented with empirical research conducted in the area of emergency management. On their basis, threats related to the leading joint activities in emergency management were identified, and the usefulness of the developed framework was presented.

## **3. Public service delivery**

Public services are defined as specified goods, offered by the public sector, that are generally available for everybody. They have a value that is not decreased by subsequent users, regardless of the number of people using it. The classification of public services concerning the nature of tasks performed by public administration includes (Kožuch, and Kožuch, 2011, p. 41):

- Administrative services and e-services: issuing documents other than administrative decisions, permits, concessions; entering into databases; issuing permits and decisions under the code of administrative procedure; issuing permits and concessions related to the economic activity regulated by the state.
- Social services and e-services: healthcare, education, culture, recreation, social security and care, housing, public safety.
- Technical services: transport (services and infrastructure), water supply, removal of wastewater, waste management, maintenance of cemeteries, energy supply (electricity, gas, heating), maintenance of public greenery.

The public service delivery process is complex and not easy. It is defined as “a series of highly localized actions by agents in public agencies or private enterprises to provide needed goods and services to citizen beneficiaries in a way that meets their expectations” (Caceres et al., 2016, p. 1). Difficulties in the public services delivery result from their wide range and complexity of their implementation process. This process is shaped by legal regulations, political conditions, and the specificity of the functioning of public organizations responsible for its course. These organizations function at governmental (central) and local government levels. However, the issues of public management and public service delivery are primarily the domain of local governments. The proximity of local governments to society allows them for quick undertaking activities aimed at meeting local needs. The central level tasks are, in turn, legislative and regulatory activity, shaping public policies, periodic monitoring of the effects of undertaken activities at the local and regional state level, and launching State Reserves if necessary.

It is also worth noting that public organizations differ significantly from private organizations (Seepma, de Blok, and Van Donk, 2020; Boyne, 2002). The difference in their functioning results, first of all, from directing activities at providing high-quality public services, not generating incomes. Public investments are made thanks to taxes and fees collected from society and are carried out under legal regulations, on publicness, transparency, and economic basis. These investments do not generate revenues, but add value to public services.

However, public organizations cannot deliver public services to a society based only on their competencies and resources. The difficulties related to this process, the degree of its complexity, as well as the ever-changing social needs, make it necessary to include organizations from all sectors in the process of public service delivery (Bryson, Crosby, and Stone, 2006; Frączkiewicz-Wronka, 2009; Osborne, Radnor, and Nasi, 2012). For this purpose, many solutions are used, but the most common are public procurement and public-private partnership (Vecchi, Cusumano, and Boyer, 2020; Amann et al., 2014; McCarter, and Fudge Kamal, 2013). Public procurements are procedures for spending public funds on services, supplies, and construction works carried out on the basis of contracts between the authority and the performer from the private sector. In turn, public-private partnership is a form of

cooperation between entities from the public sector and entities from the private sector, in which tasks and risks related to the performance of a specific public service are divided. The effect of this partnership is the delivery of a specific public service, the implementation of the task by a public organization, and the profit for a private entity. Both public procurement and public-private partnership constitute legal mechanisms of involvement of private sector organizations in undertakings related to the delivery of public services and consequently affect the creation of the public services supply chains.

#### **4. Characteristics of the public services supply chains**

The public services supply chains can be understood as networks of organizations from different sectors using their resources for contributing to the creation of public value. Their task is to deliver high-quality public services based on the principles resulting from the general theory of the service supply chain. According to this theory, „the service supply chain is the network of suppliers, service providers, consumers and other supporting units that performs the functions of transaction of resources required to produce services; transformation of these resources into supporting and core services; and the delivery of these services to customers” (Baltacioglu et al., 2007, p. 112). Under this definition, the operations undertaken in the service supply chain are aimed at transforming the resources of individual organizations into core and supportive services, which together create value for the customer (Baltacioglu et al., 2007; Wang et al., 2015; Kauf, 2017). Concerning public services, this includes the provision of core services such as social assistance, healthcare, delivery of media, maintaining public transport, or organizing cultural events. This may also require to delivery of supportive services, e.g. maintenance of technical infrastructure, medical examinations, delivery of garbage bags, developing textbooks for schools, etc. The delivery of public services is generally not possible without taking into account the flows of tangible resources necessary for the implementation of core processes, e.g. equipment and work clothes of public service providers, tools for the maintenance of technical infrastructure, communication equipment, etc. (Wang et al., 2015; Baltacioglu et al., 2007). However, in most cases, flows in the public services supply chains are intangible. For this reason, their functioning differs significantly from traditional supply chains where the flows of tangible resources are mostly analyzed. Many other differences arise from the characteristics of the services and apart from intangibility their include (Arlbjørn, Freytag, and de Haas, 2011; Baltacioglu et al., 2007):

- Simultaneity, because customers must be present for the service to be provided.
- Heterogeneity, because services cannot be standardized and are perceived differently by the customer each time.

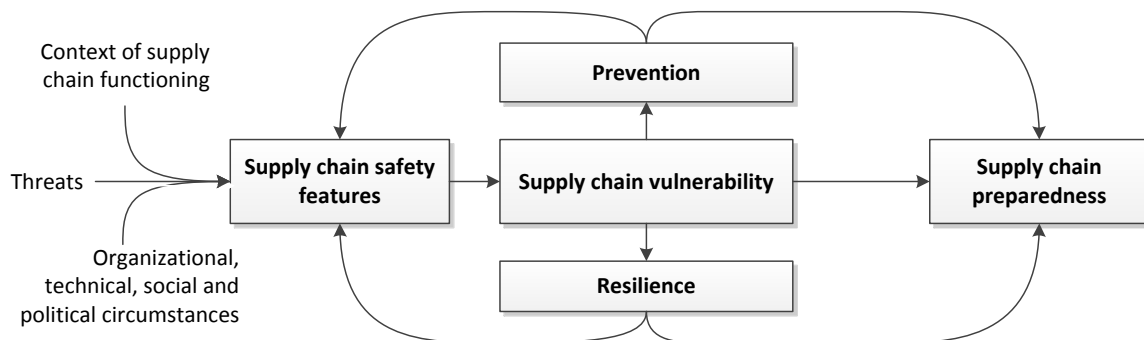
- Impermanence causing potential missed opportunities.
- Labor intensity resulting from the importance of involving human capital in the process of creating services.

The specificity of the public service supply chains is publicness and transparency of the processes carried out in them. As a result, their structure and relations are open, implemented based on applicable legal regulations, system solutions, and partnership agreements. The specificity of service supply chains and the activities undertaken in them are presented in the literature in the form of models. From among the existing service supply chain models, two have been selected that significantly affect the development of research in the area of public service delivery. Although they refer to services in the general sense, they can be successfully applied in the study of public service processes. Both are based on the Supply Chain Operations Reference Model (SCOR) (Baltacioglu et al., 2007; Ellram, Tate, and Billington, 2004). In the model developed by Ellram, Tate, and Billington (2004), the traditional focus on production is abandoned and the flow of information is a key process visible at all stages of supply chain management. As in production-focused supply chains (Lambert, and Enz, 2017), this model proposes functions necessary for effective supply chain management (Ellram, Tate, and Billington, 2004), which include: capacity management, demand management, customer relationships management, supplier relationship management, service delivery management, and cash flow management. The second model developed by Baltacioglu et al. (2007) takes into account the characteristics of services, as well as the inability to involve agents and dealers in the process of their delivery. Therefore, the customer and the end consumer are the same nodes in this model. The role of the supplier and sub-supplier was presented similarly. As a result, the model of Baltacioglu et al. (2007) is of a direct supply chain and comprises three nodes: supplier, service provider, and consumer. It is also worth noting that in this model not only the service provider but also the supplier can provide public services to the consumer, and both the service provider and the consumer are jointly involved in the process of creating the services. This model also considers the following management functions performed in specific phases of the supply chain: information flow and technology management, demand management, capacity and resources management, supplier relationship management, service performance management, order process management, and customer relationship management.

Both presented models are useful in the analysis of public service delivery processes, e.g. criminal justice (Seepma, de Blok, and Van Donk, 2020; Odlanicka-Poczobutt, 2016), healthcare (Leksono, and Suparno, 2018; Esain et al., 2016; Twaróg, 2014), or humanitarian relief (Van Wassenhove, and Pedraza Martinez, 2012; Banomyong, Varadejsatitwong, and Oloruntoba, 2019). They contribute to a better understanding of these processes and emphasize the impact of proper management on reducing operating costs, increasing the quality of services offered, as well as increasing customer satisfaction by implementing processes more effectively.

## 5. Safety management in the public services supply chains

Safety issues have long been researched in the literature on supply chain management (Wang et al., 2015; Hussain, Al-Aomar, and Melhem, 2019; Mollenkopf, Ozanne, and Stolze, 2020). Analyzes in this area are carried out concerning the strategies taken as well as operational processes, their vulnerability, protection, resilience, and preparedness (Essig et al., 2013; Maruchek et al., 2011). Although the scientific achievements in the field of supply chain safety management have been developed mainly concerning traditional supply chains, this issue is becoming more and more popular with service delivery (Baltacioglu et al., 2007; Ellram, Tate, and Billington, 2004; Choudhury et al., 2020), including public services (Arlbjørn, Freytag, and de Haas, 2011; Esain, et al., 2016). Research trends on this subject are illustrated in Figure 1.



**Figure 1.** The issues of safety research in service supply chains. Developed based on Essig et al., 2013, p. 42.

According to Figure 1, the features of service supply chain management are influenced by the type of threat; external organizational, technical, social, and political conditions; the context in which a given chain functions. The features refer to the level of complexity of the service supply chain structure (including the number of nodes and links between them), processes implemented (the scope of flows depends on the type of public service), as well as the level of partnership and the scope of inter-organizational collaboration. These features shape the vulnerability level of the service supply chains. It determines the extent to which this chain may fail to meet the challenges resulting from the existing threats and emerging complexity (Haimes, 2011; Turner et al., 2003; Chodyński, 2014).

Activities aimed at reducing the level of vulnerability contain prevention and resilience building. Prevention focuses on identifying potential threats, preparing action plans, developing alternative activities, training employees, etc. Resilience, on the other hand, means the ability of the service supply chain to adapt to new operating conditions by resisting and introducing changes (Essig et al., 2013; Sienkiewicz-Małyjurek, 2015). Undertaken activities as a result of prevention and resilience strengthen the features of the public services supply chain and limit its vulnerability. The cyclical nature of these activities and the constant striving to reduce the

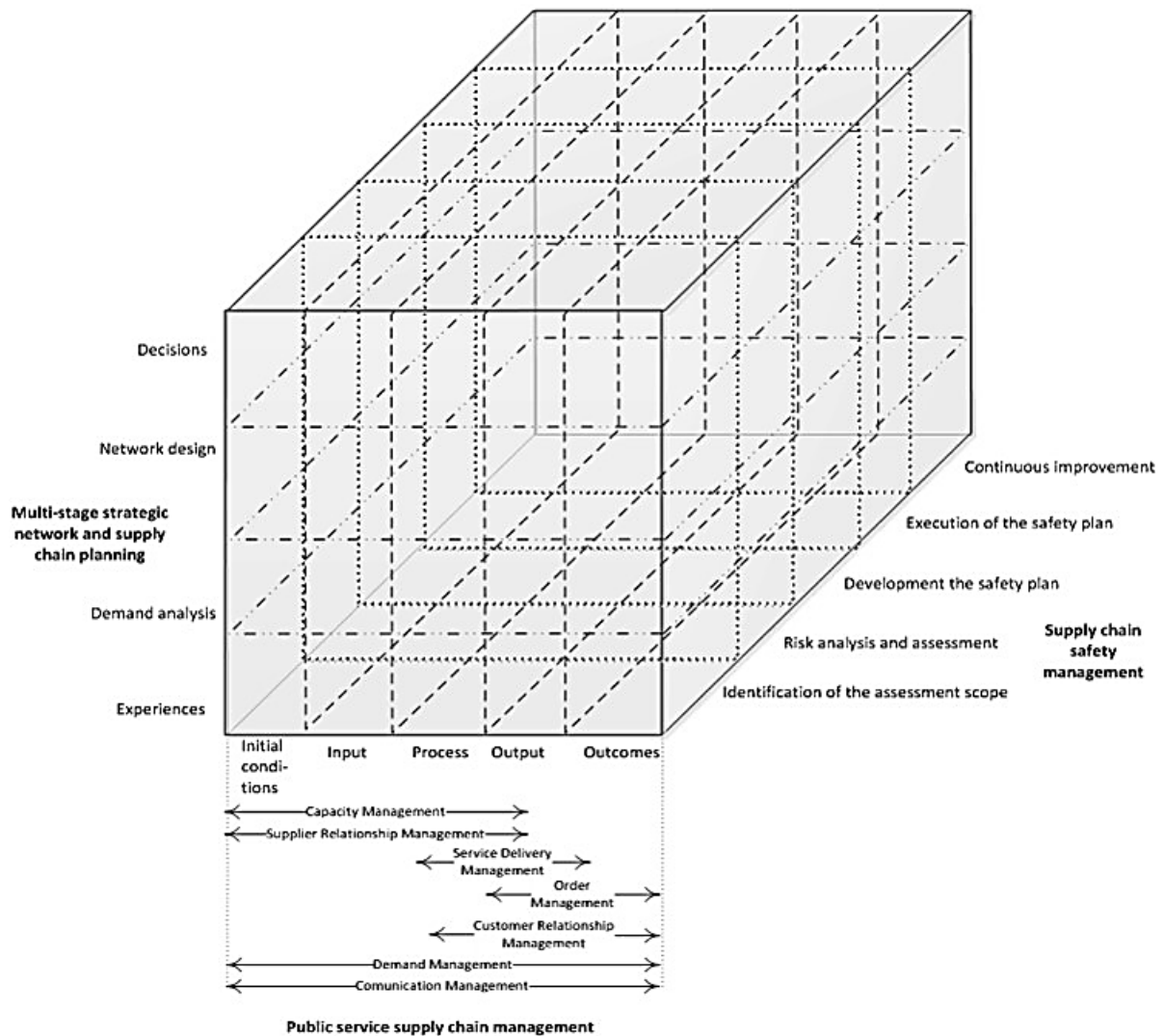
vulnerability of the service supply chain affect the level of preparation of this chain in case of threats. This is the goal of safety management in the public service supply chain. In this respect, both structural and behavioral components of management are taken into account (Lambert, and Enz, 2017; Rajani, and Heggde, 2020).

It is also important that the safety management in the public service supply chain is carried out on the basis of the following main stages (ISO 28001:2007): identification of the assessment scope, conduction of the assessment, development of the safety plan, execution of this plan, and continuous improvement. The first phase is to identify which part of the supply chain is being analyzed. Conduction of the assessment includes the identification of potential threats, risk analysis, and development of mitigation approaches. On this basis, the safety plan is prepared. It is used to monitor the level of implementation of the planned processes and introduce improvement actions. The activities planned and taken for implementation in the safety plan are individual in each case, as they depend on the type of threat and the context in which the public service supply chain operates. After an emergency occurs, safety plans are modified based on new experiences and knowledge.

Public services delivery takes place in various areas and contexts of operation, and the supply chains are configured individually in each case. Differences occur in the planning, organizing, coordinating, and verifying activities depend on the situational circumstances. Moreover, the type and scope of undertaken activities also determine the area of public governance, e.g. health care, public transport, waste management, water and sewage systems, or emergency management. Apart from different operating conditions, the configuration of the entities involved in the delivery of specific public services is different in each situation. The diversity and variability of the conditions of public services result in many threats, and a multi-dimensional approach to safety management in is essential (Fig. 2).

The framework of the supply chain safety management in emergencies presented in Figure 3 is based on the models of service supply chain of Ellram et al. (2004), Baltacioglu et al. (2007), and Caceres et al. (2016).





**Figure 2.** The framework of public services supply chain safety management. Own elaboration on the base of Ellram, Tate, and Billington, 2004; Baltacioglu et al., 2007; Essig et al., 2013; Sienkiewicz-Małyjurek, 2015; ISO 28001:2007; Timperio et al., 2016; Sienkiewicz-Małyjurek, 2019; Caceres et al., 2016.

The first dimension of the developed framework relates to the characteristics of service supply chain management. Initial conditions include the type and scale of the threat; social, political, and economic conditions; legal regulations; and resources. On this basis, activities are prepared and the supply chain is designed. The next two phases include the outputs of the performed activities and outcomes, which mean long-term consequences. The following functions occur in the various stages of service supply chain management (Ellram, Tate, and Billington, 2004; Baltacioglu et al., 2007): capacity management, supplier relationship management, service delivery management, order management, customer relationship management, demand management, and communication management. These functions are aimed at acquiring the resources necessary for the implementation of processes and ensuring the effectiveness of their flows in the supply chain.

The second dimension indicates that the public service supply chain is individually configured in each case depending on the type of threat and related needs. It is based on a multi-stage strategic network and supply chain planning (Timperio, 2016). In this regard, the following are important: previous experience in dealing with a specific threat; analysis of demand from a social, organizational, technological, and relational perspective; network design including all network nodes and links between them, as well as decisions on resource deployment and coordination of activities. This dimension allows the public service supply chain to be adapted to situational and social needs.

The individuality of each supply chain makes it difficult to predict what problems may arise during the implementation of operations. In addition to dealing with threats, the public service supply chain also strives for an efficient and safe course of processes. For this reason, the third dimension of the developed framework refers to supply chain safety management. It consists of the application of principles aimed at protecting the supply chain from threats, operational, and relational problems. In this respect, the analyzes consist of (Essig et al., 2013; Sienkiewicz-Małyjurek, 2015; ISO 28001:2007):

- determining to what extent or parts of the supply chain the safety management will apply;
- carrying out an analysis and assessment of the risk of threats, as well as preparation and implementation of the necessary preventive actions;
- developing and implementing a safety plan;
- continuous improvement of the safety plan, adequately to the emerging challenges and situational conditions.

The merger of the three dimensions of safety research in the public service supply chains allows for considering this issue from the operational and relational perspective. As a result, it is possible to identify various threats in individual phases and processes of public service delivery, as well as the links between them. This approach can contribute to a better understanding of the multidimensional nature of safety management in the public service supply chain.

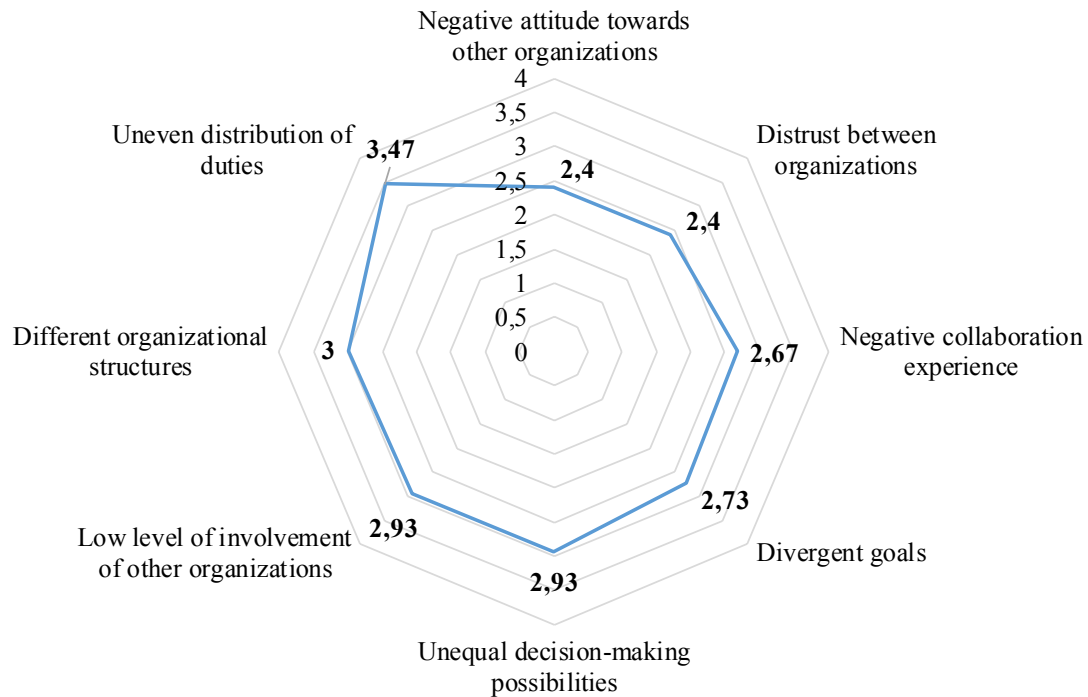
## **6. Safety management in emergency supply chain**

Emergency management is a deliberate act carried out by authorities at all levels of the state. It consists of preventing emergencies, preparing to take control over them through planned actions, reacting in the event of an emergency, and restoring the infrastructure (Waugh, and Straib, 2006; Sienkiewicz-Małyjurek, 2012). Activities in this area are taken in the case of such threats to human life and health, the environment, and property that occur on a large scale and require the implementation of coordinated actions of many organizations. These are,

for example, natural disasters, pandemics, technological threats, terrorist attacks, etc. Many entities participate in such activities: public administration, fire brigades, police, ambulance services, army, border guard, construction supervision, transport supervision, non-governmental organizations, private enterprises, local communities, and others. They form supply chains aimed at achieving a common goal - helping the injured, and saving the environment and property. Emergency supply chains are analyzed primarily from the perspective of their structure (Kumar, and Havey 2013; Afshar, and Haghani 2012), performance (Deng et al., 2016; Van Wassenhove, 2006), and relationships connecting individual nodes (Kovács et al., 2012; Dubey et al., 2020). The developed framework (Fig. 2) brings these perspectives together and analyzes them for potential risks.

Risks resulting from the situational conditions and vulnerability level are analyzed in emergency management plans in detail (C/2019/8929; PE/90/2018/REV/1). In Poland, public authorities focus on 19 types of threats, including (NCMP, p. 45-47): flood, epidemic, chemical contamination, disturbance in the energy and gas systems, heavy snowfall, hurricanes, large-scale fires, droughts, radiation contamination, etc. There are assigned the tasks and responsibilities of entities included in the emergency management structure in the form of a security matrix to each of these threats. On their basis, emergency response procedures, modes of activating the necessary forces and resources, and variants of plans are developed. However, risk analyzes related to inter-organizational relations are occasionally undertaken.

Organizations involved in emergency management have to face many challenges, such as the unpredictability of demand, time pressure, a wide range of requirements for the supply of services and resources for implementing them, as well as lack of resources (Timperio et al., 2016; Sienkiewicz-Małyjurek, 2019; Sienkiewicz-Małyjurek, 2012). Decisions are made in conditions of uncertainty and constant change. In such conditions, apart from emergencies, complex problems may arise related to the coordination of joint activities of many autonomous organizations. It is essential to ensure high quality of inter-organizational collaboration in an emergency supply chain, enabling efficient flow of resources and information. The results of empirical research on the risks associated with the collaborative issues in emergency supply chains are illustrated in Figure 3. The factors taken into account were assessed on a 5-point Likert scale.



**Figure 3.** Risks associated with collaborative issues in emergency supply chains. Own elaboration.

The results presented in Figure 3 indicate that the threats related to the joint activities in the emergency supply chain are primarily operational. The uneven distribution of duties and different organizational structures are of fundamental importance. The first factor results from individual entities' statutory competences, and therefore it is difficult to eliminate. The help of other units in areas where they are not experts may create additional problems and threats resulting from the lack of appropriate skills. On the other hand, dissimilar organizational structures may limit integrating and synchronizing the emergency supply chain. Among the relational factors, the low level of engagement in the implementation of joint activities is dominant. In addition to the threats mentioned above, it may also be necessary to conduct projects in highly urbanized areas and conditions of damaged infrastructure. In such circumstances, a multi-dimensional approach to safety management in the emergency supply chain is essential. On this basis, the stages of safety management according to the developed framework (fig. 2) could be started from analysis of the context of threat (place, time, range of impact, consequences) and operations (number of participating organizations, differences between the resources needed and possessed). Secondly, the situational, operational and relational risks analysis is needed. On this basis the supply chain design and its management functions could be designed and customized to the context of activities. Simultaneously, it is necessary to develop of safety plans and their verification. These plans and supply chain design should be continuously improved based on experience and demand analysis.

## 7. Discussion and conclusions

The complexity and turbulence of contemporary situational conditions create the need for quick adaptation of public service delivery processes to social needs and coping with threats. Therefore, there is a need to continually reconfigure and increase the flexibility of public services supply chains. Besides, the context of the functioning of public services supply chains makes safety management increasingly important. The need for safety management implementation to public services supply chains is due to the growing uncertainty of the activities context.

The developed framework of the public services supply chain safety management (fig. 2) results from the growing complexity of providing public services processes and the need to involve many organizations, institutions, and individuals from all sectors in these processes. The application of this concept contributes to a better understanding of safety issues and more effective public service delivery. This framework includes contextual conditions and adjusting the service supply chain management functions to them, organizational requirements, and the prepared safety plans based on potential threats and the activities context.

The main finding of the research presented in this article is a multi-dimensional approach to safety management in public services supply chains. In this approach, it is not enough to take into account only direct threats that result from situational conditions and adapt actions to them. It is necessary to consider network design, formal and informal relationships between entities, possibilities of reconfiguration of the resource base, organizational interdependencies, and changes in demand.

In the case of emergency management, the activities are implemented under high uncertainty and risk. Such chains create high requirements in planning and preparing activities, adaptation to external conditions, ensuring quickness and synergy of actions, or coping with uncertainty. Considering the issues of safety management leads to monitoring the course of processes on an ongoing basis, reducing losses, and increasing joint actions.

The conducted empirical studies in emergency management indicate that operational threats may have a very significant impact on the course of activities. These threats include primarily: uneven distribution of duties and different organizational structures. Moreover, such relational threats as low level of involvement and negative collaboration experience may generate risks of failure of joint actions. For this reason, a multi-dimensional approach to safety management is needed. It could allow us to identify different types of threats, find links between them and develop appropriate safety plans.

However, this article has some limitations result from its conceptual character. The developed framework includes certain assumptions based on a merge of three theories: public service delivery, service supply chain, and safety management. Possibilities of using this framework have been outlined only on the example of emergency management in Poland.

For this reason, it is necessary to continue research on public services supply chain safety management both conceptually and empirically. However, despite these limitations, the conducted research has added value to the public governance theory. They can also be useful for policymakers responsible for public service delivery processes. Thanks to the understanding rules of functioning the public service supply chains, and the multi-dimensionality of safety issues, public managers can more easily identify threats in implemented processes. It is the basis for making appropriate decisions. As a result, the effectiveness of public services supply chains can be enhanced.

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