Features of Identification of Hybrid Projects of Public Security Systems and Their Process Management

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Abstract. *An analysis of scientific works defining methodologies, methods and models of managing development projects and the functioning of security systems concerning separate branches and territories, as well as approaches to the implementation of hybrid projects of public security systems has been performed. It has been established that there is a need to conduct research on the development of scientific and methodological identification of hybrid projects of public security systems and their management processes. Nine identifying features of hybrid public safety projects are outlined. The proposed characteristics identifying hybrid projects of public security systems are based on their initiation and implementation of management processes. The hierarchical model of the structure of hybrid projects of public security systems is substantiated. It provides for the consideration of hybrid projects of public security systems at three levels which outline the purposeful and continuously managed interaction between individual processes and their elements. It is substantiated that the purposefulness and manageability properties of hybrid projects of public safety systems significantly affect the indicators of their value and underlie the development of tools for determining the value of these projects. Further research requires the development of tools to determine the value of hybrid projects of public safety systems.*

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Introduction

Today, project management is used in many areas of human activity.[1] At the same time, it is a very important and effective means of developing security systems and the territory of the state. The reform of the administrative-territorial system initiated in Ukraine presupposes the reform of the security systems of the population living in certain territories.[2] Yet, several levels of security which relate to the

[1] Chernetskyy V, Sklepovych I, Voloshynskyy B, Creation of units of voluntary fire protection. Ivano-Frankivsk, 2016; Borysov A, Mukshynova T, Organization of voluntary fire protection in the states of Central Europe, Emergency situation, 2017; Voluntary fire-fighting service of Germany: history of VFFS of Germany, 2012.

[2] Nazarenko V, Voluntary fire-fighting service of abroad as a constituent of organizational and legal mechanism of public administration by fire safety: experience for Ukraine, 2013; Trush O, Experience of formation and functioning of the civil security systems of the EU member-countries at Western Europe, 2010; European Comission. European Civil Protection and Humanitarian Aid Operations, EU Civil Protection Mechanism, 2018; Cabinet of Ministers of Ukraine, Regulations on voluntary fire brigade (command), 2009; Kovalchuk V, Volun-

systems of state, regional and public protection should be identified. At the same time, public security systems, which, according to the new administrative-territorial structure of Ukraine, apply to united territorial communities, should be considered basic. For the effective functioning of the relevant public safety systems, a number of hybrid projects (HPs) should be implemented, and coordinated from a single centre — fire and rescue forces (FRFs) in the communities. All of the above indicates the relevance of the implementation of HPs in individual communities that need to develop scientific and methodological principles of their management. Regarding the implementation of HPs on the territory of individual communities, one of the unsolved tasks is to substantiate the peculiarities of the HP identification of public security systems and their management processes.

Analysis of literature data and statement of the problem

Currently, many methods and models of project management are known, which relate to the development of both organisations and individual sectors of economy. At the same time, scientists have paid a lot of attention to the classification of projects and their management processes.[3] The performed research concerns both various spheres of material production, and the general theoretical bases of management. As for the HPs of public security systems, there are several publications on this issue.[4] However, it is not possible to use the results fully to identify public

teer firefighting organizations in civil defense systems of foreign countries in the context of the tasks of public authorities in the sphere of national security, 2015; Cabinet of Ministers of Ukraine, Strategy of reforming of the State Emergency Service of Ukraine, 2017; Cabinet of Ministers of Ukraine, The order of functioning of voluntary fire protection, 2013; Tryhuba A, Ratushny R, Tryhuba I, Koval N, Androshchuk I, The Model of Projects Creation of the Fire Extinguishing Systems in Community Territories, [in:] *Acta universitatis agriculturae et silviculturae mendelianae brunensis*, 2020, Vol. 68, Issue 2.

[3] Bashynsky O, Garasymchuk I, Gorbovy O *et al.*, Research of the variable natural potential of the wind and energy energy in the northern strip of the ukrainian carpathians, in: 6th International Conference: Renewable Energy Sources (ICoRES 2019). E3S Web of Conferences 154, 06002, 2020; Tryhuba A, Ratushny R, Bashynsky O, Shcherbachenko O, Identification of firefighting system configuration of rural settlements, [in:] Fire and Environmental Safety Engineering. MATEC Web Conf. Volume 247 (FESE 2018); Tryhuba A, Ratushny R, Bashynsky O, *et al.*, Planning of Territorial Location of Fire-Rescue Formations in Administrative Territory Development Projects, [in:] CEUR Workshop Proceedings. Published in ITPM, 2020; Tryhuba A, Tryhuba I, Bashynsky O *et al.*, Conceptual model of management of technologically integrated industry development projects, [in:] 15th International Scientific …, *op. cit*.

[4] Tryhuba A, Tryhuba I, Ftoma O, Boyarchuk O, Method of quantitative evaluation of the risk of benefits for investors of fodder-producing cooperatives. 14th International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT), 2019; Tryhuba A, Boyarchuk V, Tryhuba I, Boyarchuk O, Ftoma O, Evaluation of Risk Value of Investors of Projects for the Creation of Crop Protection of Family Daily Farms. *Acta universitatis agriculturae et silviculturae mendelianae brunensis*, 2019, Vol. 67, Issue 5; Tryhuba A, Boyarchuk V, Tryhuba I, Ftoma O, Forecasting of a Lifecycle of the Projects of Production of Biofuel Raw Materials With Consideration of Risks. International Conference on Advanced Trends in Information Theory (ATIT), 2019.

security systems and their management processes due to the fact that they contain a number of shortcomings. In particular, they do not provide for the disclosure of signs of identification of public security systems, which provides a justification for the components and their impact on the management of these projects. For this purpose, it is necessary to carry out the corresponding research, to offer scientific and methodical bases whose integral part is a hierarchical model of the structure of HPs of public security systems.

Unresolved parts of the general problem

Having analysed the scientific works with the developed methodologies, methods and models of project management development and the functioning of security systems that relate to individual industries and territories, we can confirm their importance for the theory of project management. However, they do not provide an opportunity to qualitatively identify the HPs of public security systems and their management processes. This is due to the fact that there are no clear signs of identification of HPs implemented by individual FRFs, their components or their impact on project management processes.

Aim and tasks of the study

The aim of the research is to substantiate the peculiarities of the identification of hybrid projects of public security systems and their management processes.

In order to achieve the given aim of the publication, it is necessary to solve the following tasks:

— to suggest the signs of identification of HPs implemented by individual FRFs, and their components, and to identify the impact on project management processes;
— to substantiate the hierarchical model of the structure of HPs of public security systems and the relationship between the processes and components of these projects through the factors that characterise them.

Signs of identification of hybrid projects of public security systems, their components and features of influence on management processes

Management of HPs implemented by individual FRFs is possible provided they are identified. This requires justification of many of the relevant features. To reveal the features and identification of HPs, it should be noted that they are determined by life processes that are independent of the project managers in the FRF area, and of climatic conditions, which change cyclically over time for a particular administrative area and largely determine the life cycles of these projects. All of the above indicates that the processes of life in the area of the FRF's climatic conditions are

components of the design environment, which determine the type and timing of the implementation of the HPs implemented by an individual FRF. In addition, the types of HPs are one of the signs of their identification.

Table 1. Signs of HP identification implemented by individual FRFs, their components and their impact on project management processes

The name of the identification sign	Component	Impact on project management processes
Seasonality of HP	Cyclical climatic conditions, seasonality of work in facilities located in the area of the FRF.	Predictability of time of occurrence and life cycles of HPs.
Parameters of objects that are protected from emergencies by a separate FRF	Potential hazards that cause emergencies, their types and projected scale.	Requirements for the time and content of the HPs. Type and amount of resources for HP implementation.
Climate conditions	Variability of meteorological phenomena during the implementation of HPs that cause the spread of emergencies.	Types and terms of HP implementation.
Production conditions	Distance from the objects protected from emergencies to the FRF, type and condition of roads.	Requirements for the duration of the HP.
The state of settlements	Density of buildings and population in settlements.	Intensity of HP initiation in separate settlements.
Probabilistic nature of the time of occurrence of needs in the implementation of HPs	Stochastic manifestation of adverse living conditions and climatic conditions in the area of the FRF.	The need for statistical methods and models for HP management.
Optimal time of HP implementation	Parameters of objects that are protected from emergencies by a separate FRF and features of life processes.	The need to ensure the timely implementation of HPs within the allocated time limit.
Collateral damage due to late implementation of the projects	Parameters of objects that are protected from emergencies by a separate FRF and features of life processes. Density of buildings and population in settlements.	Untimely completion of HPs causes a decrease in their value.
Influence of the time of completion of previous HPs on the time of appearance of the order for the next projects	Stochastic manifestation of adverse living conditions and climatic conditions in the area of the FRF.	The need to reconcile the time of completion of previous HPs with the time of launch of subsequent projects.

Source: Authors' own elaboration.

The next sign of HP identification is the parameters (Z_n) of the objects that are protected from emergencies by a separate FRF in the given production conditions. These objects are characterised by their features which determine the type of emergency, their scale, *etc.*[5]

The deviations of the parameters of the objects and their structure underlie the requirements for the time and content of the implementation of the relevant HPs. They are the basis for the division of objects protected against emergencies into their types and potential hazards[6].

Elimination of emergencies is carried out in separate production conditions, which are characterised by the distance from the objects that are protected from emergencies to the FRF, the type and condition of the roads, the density of the buildings and the population in the settlements, *etc.* Production conditions affect the duration of delivery of the FRF to the facilities where the emergency occurred, and determine the requirements for the duration of the HP.

Another important feature that allows HPs to be identified is the density of the buildings and population in the settlements. They determine the intensity of HP initiation in some settlements.

One of the features that allows HPs to be identified is the probabilistic nature of the time of the need for emergency response. It is caused by the stochastic manifestation of unfavourable living conditions and climatic conditions in the area of the FRF. This indicates the need for statistical methods and models for HP management.

The next sign of HP identification is the optimal term of HP implementation, which is determined by the parameters of the objects that are protected from emergencies by an individual FRF and the peculiarities of life processes. They determine the need to ensure the timely implementation of HPs.

One of the most important signs of HPs is casualties caused by the untimely implementation of projects. This is determined by the parameters of the objects

[5] Hulida E, Pasnak I, Koval O, Determination of the Critical Time of Fire in the Building and Ensure Successful Evacuation of People. *Periodica Polytechnica Civil Engineering*, 2019, Vol. 63, Issue 1; Tryhuba A, Boyarchuk V, Tryhuba I, Boiarchuk O, Pavlikha N, Kovalchuk N, Study of the impact of the volume of investments in agrarian projects on the risk of their value (ITPM–2021). *CEUR Workshop Proceedings,* 2021, Vol. 2851; Boyarchuk V, Ftoma O, Francik S, Rudynets M, Method and Software of Planning of the Substantial Risks in the Projects of Production of raw Material for Biofuel. *CEUR Workshop Proceedings*, 2020, Vol. 2565; Tryhuba A, Boyarchuk V, Tryhuba I, Ftoma O, Tymochko V, Bondarchuk S, Model of assessment of the risk of investing in the projects of production of biofuel raw materials. 15th International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT), 2020.

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that are protected from emergencies by individual FRFs and the peculiarities of life processes, as well as the density of the buildings and population in individual settlements. They affect the untimely completion of HPs, which reduces the value of these projects.

Another important feature that allows HPs to be identified is the influence of the time of completion of previous HPs on the time of appearance of the order for the implementation of subsequent projects. It is caused by the stochastic manifestation of unfavourable living conditions and climatic conditions in the area of the FRF. This, in turn, affects the need to reconcile the completion time of previous HPs with the start time of subsequent projects.

Thus, the nine key characteristics of HPs, which allow them to be identified, are the basis for their initiation and implementation of management processes of these projects.

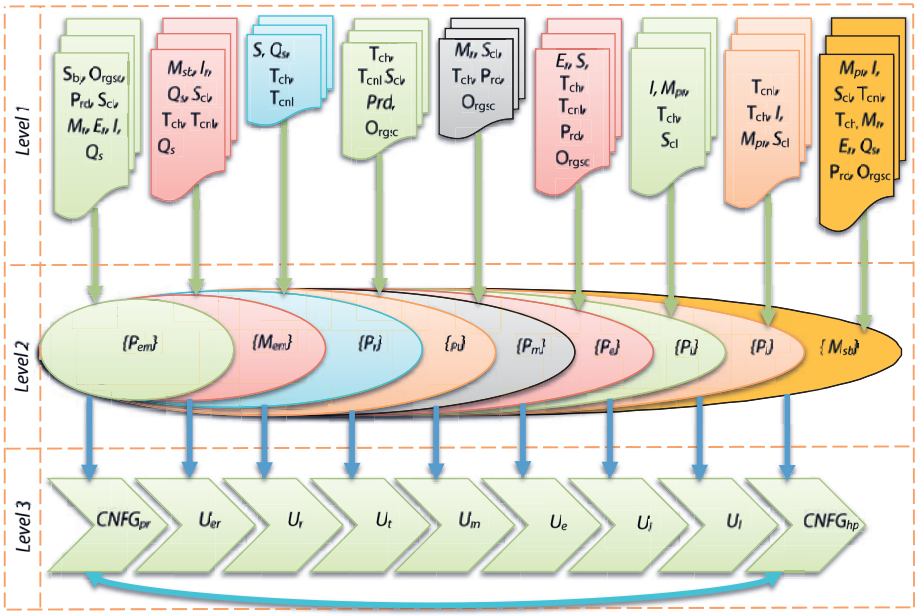
The management of the processes of functioning of the FRF should be considered simultaneously with the management processes of the respective HPs which are implemented by these formations. In addition, it is impossible to implement HPs without simultaneously considering the functioning of the FRF. The quality of the HP management processes depends on their coordination with the functioning of the FRF. The maximum value from the implementation of the HPs can be achieved by simultaneously considering two groups of management processes. It is extremely important to coordinate these processes with each other. This makes it possible to assess the impact of indicators of the value of HPs on the organisational and technological performance of the FRF. This, in turn, indicates that such management of HPs is systemic.

Hierarchical model of the structure of hybrid projects of public security systems and the relationship between the processes and components of these projects

In each separate FRF, several HPs which are caused by the corresponding processes can be implemented at the same time. The basis of individual HPs may be one or more emergencies, the elimination of which requires the implementation of many processes that determine the core actions (tasks) in these projects. In general, the set of actions in the HPs, the processes that shape them, as well as the factors that characterise them, can be reflected in the corresponding hierarchical model of the structure of these projects (Fig. 1).

Using a hierarchical model to structure HPs (Fig. 1) ensures that the factors (level 1) are the basic components that underlie the formation of processes (level 2) that, in turn, ensure appropriate management decisions regarding the implementation of the HPs (level 3). In this case, the set of control processes $\{P_c\}$ of the HPs is considered to be autonomous, which occurs at the final level of this structure. At the same time, these processes occur due to numerous other processes related to the emergency response $\{P_{emr}\}$, the implementation of logistics processes $\{P_l\}$ and resource provision processes (rescuers $\{P_r\}$, technical $\{P_t\}$, material $\{P_m\}$, energy $\{P_e\}$ and information resources.

Figure 1. Hierarchical model of HP structure



Factors that determine the need to perform actions (tasks) in projects (level 1), processes (level 2), and results (level 3) of project implementation: S_{cl}, T_{cnl}, T_{ch} — social, technological and technical groups of factors, respectively; $S_{bj,}$ P_{rd}, O_{rgsc} — subject, production and organisation-scale groups of factors, respectively; M_{sb}, M_{pr}, I, Q_{s} — managerial-subject, managerial-project, information and standard-quality groups of factors, respectively; M_{r}, E_{r} — material-resource and energy-resource groups of factors, respectively; $\{P_{em}\}$, $\{P_{r}\}$, $\{P_{l}\}$ — sets of emergency response processes, rescuers and logistics processes, respectively; $\{P_{t}\}$, $\{P_{m}\}$, $\{P_{e}\}$, $\{P_{i}\}$ — sets of processes of technical, material, energy and information supply, respectively; $\{M_{er}\}$, $\{M_{hp}\}$ — sets of emergency response management processes and HP management processes, respectively; $CNFG_{pr}$, $CNFG_{hp}$ — product configuration and HP configuration, respectively; U_{er}, U_{l} — management decisions on emergency response and logistics processes, respectively; U_{r}, U_{t}, U_{m}, U_{e}, U_{i} — відповідно management decisions to provide rescuers, technical, material, energy and information resources, respectively. Each of these groups of processes is determined by a set of factors, the quantitative value and controllability of which are decisive in relation to the implementation of these processes.

Source: Authors' own elaboration.

As a result of the implementation of each of the groups of processes (level 2), management decisions are made that directly or indirectly relate to the implementation of the HPs (level 3). In particular, direct management decisions on HPs include those that ensure the formation of the configuration of HPs ($CNFG_{hp}$). For their high-quality execution, it is necessary to implement a number of administrative decisions which belong to the force of a configuration of a product of HPs ($CNFG_{pr}$), as well as their resource provision (involvement of rescuers (U_{r}), machinery and equipment (U_{t}), material (U_{m}), energy (U_{e}) and information (U_{i}) resources).

In order to ensure the implementation of certain groups of processes related to both HPs and their products, and to their resource provision, appropriate

functional components should be created. Without them, the presented groups of processes cannot be implemented. The direct functional components of individual groups of processes are their elements, which can be divided into the following groups (Table 2).

Table 2. Relationships between processes and elements of HPs through the factors that characterise them

Process elements	Processes								
	P_{emr}	M_{er}	P_{r}	P_{t}	P_{m}	P_{e}	P_{i}	P_{I}	M_{hp}
Objects (O)	S_{bj}	M_{sb}	S_{cl}	T_{ch}	M_{r}	E_{r}	I	T_{cnl}	M_{pr}
Agents (A_g)	S_{cl}	S_{cl}	S_{cl}	S_{cl}	S_{cl}	S_{cl}	S_{cl}	S_{cl}	S_{cl}
Primary resources (R_o)	T_{ch}	I_{r}	S_{cl}	T_{ch}	M_{p}	E_{p}	I	T_{cnl}, I	I
Additional resources ($R_д$)	M_{p}, E_{r}, I	T_{ch}, T_{cnl}	T_{ch}, T_{cnl}	T_{cnl}	T_{ch}	T_{ch}, T_{cnl}	$T_{н}$, M_{pr}	T_{ch}, T_{cnl}	T_{ch}, T_{cnl}, M_{r}, E_{r}
P (P_e)	P_{rd}, O_{rgsc}	Q_{s}	Q_{s}	P_{rd}, O_{rgsc}	P_{rd}, O_{rgsc}	P_{rd}, O_{rgsc}	Q_{s}	P_{rd}	P_{rd}, O_{rgsc}, Q_{s}

Source: Authors' own elaboration.

1) objects that are subject to qualitative transformation or relocation. They are characterised by separate groups of factors (S_{bj}, M_{sb}, S_{cl}, T_{ch}, M_{r}, E_{r}, I, T_{cnl}, M_{pr}), which reflect the object of transformation or displacement;
2) agents that provide quality conversion or movement of objects. They are characterised by a social (S_{cl}) group of factors;
3) primary resources for performing transformations or moving objects. They are mainly characterised by a technical (T_{ch}) group of factors, and with their help agents act on objects;
4) provision of additional resources to perform transformations or movements of objects. They are characterised by material (M_{r}), energy (E_{r}) and information (I) groups of factors and they also provide agents' resources for actions on objects;
5) design environment in which the qualitative transformation or movement of objects is performed. It is characterised by production (P_{rd}), organisational-scale (O_{rgsc}) and qualitative-standard (Q_{s}) groups of factors and characterises the conditions in which actions are performed on individual objects.

Thus, the result of the HPs is their products, the configuration ($CNFG_{pr}$) of which is created through the implementation of a number of processes related to the provision and use of resources, as well as their management due to the reasonable configuration of these projects ($CNFG_{hp}$). At the same time, it should be noted that the interaction between individual processes and their elements is purposeful and constantly managed. It is the properties of the HPs in terms of their purposefulness and manageability that significantly affect their value indicators. Regarding the tools for determining the value of HPs, they should be developed.

Conclusions

1. The analysis of scientific works with the developed methodologies, methods and models of the project management of the development and operation of security systems related to individual industries and territories, as well as approaches to the implementation of hybrid projects of public security systems show their importance for project management theory. However, they do not provide an opportunity to qualitatively identify hybrid projects of public safety systems and their management processes, as the signs of identification of these projects, their components and impact on project management processes are not identified.

2. The nine outlined features of identification of hybrid projects of public security systems provided an opportunity to substantiate the components and their impact on the management processes of these projects. The proposed characteristics of HPs, which allow them to be identified, are the basis of their initiation and implementation of the management processes of these projects.

3. A well-founded hierarchical model of the structure of hybrid projects of public security systems provides for their consideration at three levels, which outline a purposeful and constantly managed interaction between individual processes and their elements. It is the properties of hybrid projects of public safety systems in terms of their purposefulness and manageability that significantly affect their value indicators and underlie the development of tools for determining the value indicators of these projects. Further research requires the development of tools to determine the value of hybrid projects of public safety systems.

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***Streszczenie.** W artyluke przedstawiono przeprowadzoną analizę prac naukowych określających metodyki, metody i modele zarządzania projektami rozwojowymi oraz funkcjonowania systemów bezpieczeństwa dotyczących wyodrębnionych branż i terytoriów, a także podejścia do realizacji projektów hybrydowych systemów bezpieczeństwa publicznego. Ustalono, że istnieje potrzeba prowadzenia badań nad rozwojem naukowej i metodologicznej identyfikacji projektów hybrydowych systemów bezpieczeństwa publicznego oraz procesów zarządzania nimi. Zarysowano dziewięć cech identyfikujących projekty hybrydowe bezpieczeństwa publicznego. Zaproponowane cechy identyfikujące projekty hybrydowe systemów bezpieczeństwa publicznego opierają się na ich inicjowaniu i realizacji procesów zarządzania. Uzasadniono hierarchiczny model struktury projektów hybrydowych systemów bezpieczeństwa publicznego. Przewiduje on rozpatrywanie projektów hybrydowych systemów bezpieczeństwa publicznego na trzech poziomach, które nakreślają celowe i stale zarządzane interakcje pomiędzy poszczególnymi procesami i ich elementami. Uzasadniono, że właściwości celowości i zarządzalności projektów hybrydowych systemów bezpieczeństwa publicznego istotnie wpływają na wskaźniki ich wartości i stanowią podstawę do opracowania narzędzi określania wartości tych projektów. Dalsze badania wymagają opracowania narzędzi do określania wartości projektów hybrydowych systemów bezpieczeństwa publicznego.*

***Zusammenfassung.** Der vorliegende Artikel stellt eine durchgeführte Analyse wissenschaftlicher Arbeiten dar, in denen Methodologien, Methoden und Modelle für die Verwaltung von Entwicklungsprojekten und das Funktionieren von Sicherheitssystemen in Bezug auf einzelne Branchen und Gebiete sowie Ansätze für die Umsetzung hybrider Projekte der öffentlichen Sicherheitssysteme definiert wurden. Dabei wurde festgestellt, dass es notwendig ist, Forschungen zur Entwicklung der wissenschaftlichen und methodischen Identifizierung von hybriden Projekten der öffentlichen Sicherheitssysteme und ihrer Verwaltungsprozesse durchzuführen. Demnächst wurden neun Merkmale zur Identifizierung hybrider Projekte der öffentlichen Sicherheit skizziert. Die vorgeschlagenen Merkmale zur Identifizierung hybrider Projekte öffentlicher Sicherheitssysteme basieren auf ihrer Initiierung und der Umsetzung von Managementprozessen. Das hierarchische Modell der Struktur von hybriden Projekten der öffentlichen Sicherheitssysteme wird begründet. Es sieht die Betrachtung hybrider Projekte öffentlicher Sicherheitssysteme auf drei Ebenen vor, die die zielgerichtete und kontinuierlich gesteuerte Interaktion zwischen einzelnen Prozessen und ihren Elementen umreißen. In dem Aufsatz wurde nachgewiesen, dass die Eigenschaften der Zweckmäßigkeit und der Steuerbarkeit hybrider Projekte öffentlicher Sicherheitssysteme die Indikatoren für ihren Wert wesentlich beeinflussen und der Entwicklung von Instrumenten zur Bestimmung des Wertes dieser Projekte zugrunde liegen. Weitere Forschung erfordert die Entwicklung von Instrumenten zur Bestimmung des Wertes von hybriden Projekten öffentlicher Sicherheitssysteme.*

Резюме. *В статье проведен анализ научных работ, содержащих методологию, методы и модели управления проектами развития и функционирования систем безопасности изолированных отраслей и территорий, а также подходов к реализации проектов гибридных систем общественной безопасности. Установлено, что существует необходимость проведения исследований по развитию научно-методической идентификации проектов гибридных систем общественной безопасности и процессов управления ими. Были выделены девять характеристик гибридных проектов в сфере общественной безопасности. Предлагаемые идентификационные характеристики проектов гибридных систем общественной безопасности основаны на их создании и внедрении процессов управления. Обосновывается иерархическая модель структуры проектов гибридных систем общественной безопасности. Она предусматривает рассмотрение проектов гибридных систем общественной безопасности на трех уровнях, которые определяют целенаправленное и постоянно управляемое взаимодействие между отдельными процессами и их компонентами. Обосновывается, что характеристики желательности и управляемости проектами гибридных систем общественной безопасности существенно влияют на показатели их ценности и служат основой для разработки инструментов определения ценности этих проектов. Дальнейшие исследования требуют разработки инструментов для определения значимости проектов гибридных систем общественной безопасности.*