The safety engineering of mass sports events – the model of emergency management of logistics processes with using of advanced technologies (Augmented Reality, GPS i ICT)

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***Abstract*—The organization of the mass sports event has to be supported by the tools and technologies related to the safety engineering. These include the ICT systems that enable the real-time upload the information necessary in making decisions. The picture of the augmented reality has to be 'superimposed' on the ICT systems. It generates the precognition and predicates of the events related to organizing of the mass sports event and its aspects of the logistics of the flows of materials, people, things, events, data and information. Monitoring the physical space's progress of organizing the mass sports event is supported by the GPS systems. In the case of the GPS, the operator has the ability to continuously monitoring the traffic in the organizational space, online collecting the information about the traffic and its supervision.**

Keywords—logistics processes, individual informatics solutions (IRI), augmentedreality, ICT, mass sports event

I. INTRODUCTION

The logistics processes require using systems related to safety engineering (tools and ICT) and detailed preparation. They also require anticipatingemergenciesrelated to the safety of activities, operations and processes.

Predicting the incidents affectingthe logistics processes is possible with using, among other things, ICT systems, that in real time, and in some cases predictively provide information that will enable toanticipating future events[Chomiak-Orsa I., 2014]. In addition, using augmented reality technology [Cieśliński, 2015], shows the predicted situations and provides the knowledge on how to react. Particular attention should also be paid to the special processes [Stadnicka D., 2014]. In this case, there should be adequate: preparing staff and technical resources as well as supervising the implementation. It requires usingthe appropriate working methods and systems supporting the work and enable not only to monitor, but also to oversight of critical processes in the logistics of organizing sports events.

To solve the mentioned problems can be useful the individual informatics solutions [Bernat P…, Streamlining… (in print)]that affect executing the order, using resources and assessing the costs. In the case of a transport company, it is proposed to apply: [Bernat P., Halikowska]

a) GPS system,
b) database system DBMS,
c) spreadsheet.

The logistics of the mass sports eventis primarily the identification, the anticipation and the ability to monitor the organization'sspace in the terms of geographical coverage. Thus, in a physical space, in which runs the organization of the event. The GPS system allows, among other things, locating the vehicle, monitoring the drivers' hours or consumpting the fuel [Bernat P…, Innowacje…, (in print)],

and locating the competitors or places of events related with emergencies (eg fainting player, car accident, etc.). The GPS system also provides protecting against theft. It provides the possibility of the effective supervision of executing process. It effects on the one hand on the safety of the athletes, employees of the logistical support, the driver and the cargo (‘moving event’), on the other hand,it significantly increases the probability of correct executing the process.

The database is primarily used to collect the necessary data concerning the resources that are available to the enterprise. It could be the information on the payer (the orders), the drivers, the vehicles or their condition. This knowledge contributes to proper usingthe available resources and therefore it increases the safety during preparing the order. Costing gives, in turn, the ability to the multi-criteria analysis of operating costs. Monitoring the operating costs allows for determining the level of order’s profitability, but also allows to explore, or to recognize and identify the impact of the individual cost’s components to the total cost.

Therefore, iteffectsthe financial safetyof the enterprise. Applicatingthe augmented reality to support executing the individual processes will be broadening the opportunities – above mentionted IRI - to ensure the safety.

II. THE LOGISTICS OF MASS SPORTS EVENTS

The logistics of the mass sports event [Witkowski K., 2015] is the diagnosis, the design, the execution of activities and processes related to moving the people, the things and the documents. Thus, the logistics of mass sports event is primarily seeking the answers to the question: how are executed and organized the processes and activities? It can be highlighted the processes related to the input logistics (doing the project and plan, the procurement, obtaining the consent), the logistics of organizing an event (launching the activities related to conducting a physical event) and the output logistics (organizing the transport equipment and the devices, the office supplies, the financial settlement, the final Report)[Krawczyk, 2005]. The Processes are a sequence of actions and activities transforming input resources into results at the output [Cieśliński, 2011]. In this meaning, the transformation processes can be discussed in the terms of things, objects, data, information, events.

III. THE SAFETY AND THE RELATED NOTIONS

The safety, in the traditional sense, refers to monitoring and reducing the risk of personnel casualties (injuries and deaths) to some acceptable level. [W. Blanchard, 2015]. The safety engineering deals with the design, construction, operation and liquidation of technical facilities to minimize the rational, and therefore healthy-mind way, the possibility and the size of their negative impact on the environment.[Pihowicz, W, 2008].

According to the Simeon Institute, the emergency can be defined as ‘an extraordinary situation in which people are unable to meet their basic survival needs, or there are serious and immediate threats to the human life and well-being. An emergency situation may arise as a result of a disaster, a cumulative process of neglect or environmental degradation, or when a disaster threatens and emergency measures have to be taken to prevent or at least limit the effects of the eventual impact[W. Blanchard, 2015].

‘Disaster is a crisis situation that far exceeds the capabilities’. [Z. Husain, 2015] The disaster means ‘a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community’s or society’s ability to cope using its own resources. Though often caused by nature, disasters can have human origins. A disaster to be entered, for an example, into the EM-DAT database, at least one of the following criteria must be fulfilled: ten (10) or more people reported killed, hundred (100) or more people reported affected, declaration of a state of emergency, call for international assistance’ [IFRC, 2015; Abbott P. L., 2009; Casale R., 2004; Piepiora Z. 2012].

The emergency management is also called ‘the disaster management’ or ‘crisis management’. It can be defined as ‘the organization and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps’[EM-DAT, 2010; Ustawa 2007]

IV. THE EMERGENCY INORGANIZING THE MASS SPORTS EVENT

The following describes a case study on organizing the mass sports event which concerns ‘32. Wroclaw Marathon’[Own study on the basis of Jerzy Kosa’s doctoral work, promoter Kazimierz Witkowski, 2015, the University School of Physical Education in Wrocław]. The analysis of the emergency management system concerns identifying and anticipating all the possible interferences in executing the logistics processes. The emergency arises in any situation where the logistics process is disrupted. A model indicates the following critical points in the logistics process of the mass sports event.

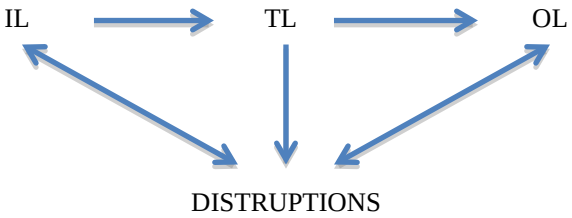

Figure 1. The model of the emergency in organizing the mass sports event
Source: own study.

The model of the emergency in organizing the mass sports event is presented in the figure 1. The feedback system in every situation during the logistical organization of the mass sports event is described in the model. It points to the need to identify and construction the procedures to enable rapid identifying and counteracting the emergency. The disturbances cause the emergency due to the fact that even the shortest break in executing process, generates in every phase,

damming of the problem, creating the emergency. Based on the up-to-date data from of organizing the mass sports event, indicated the critical points in each of the elements of the logistics process, namely the input logistics (IL), the transition logistics (TL) and the output logistics (OL).

The input logistics' processes– the planning phase, the emergencies:

1. Design and securing the route,
2. Medical and sanitary protection,
3. Alimentation of the athletes and visitors,
4. Obtaining the consent of the President of Wroclaw in Poland to use the roads in a special way and to organize a mass event,
5. Insurance of the event,
6. Touring the marathon route by the Technical Committee of the Head of Security routes with participating of the representatives of the police, the municipal police, the municipal transport company, the designer and the contractor of the security; verifying the design solutions used in reference to the up-to-date traffic on the roads of the city of Wroclaw, to assess the effectiveness of the design solutions for the safety of the athletes and the road users; writing-off a Memorandum of Understanding with the detour route,
7. Deploying and installing in the places indicated in the design of the road signs 'no parking B-36', along with 'arrays T-24' and the information about the date of their application until 06.06.2014;installatingthe information boards about the traffic difficulties and planned detours during pointed locations in the project across the terrain of the 'Big Island',
8. Providing the additional protection to the Olympic Stadium by the security company,
9. The duty of the plumber and make the necessary plumbing connections,
10. Closing the marathon route in accordance with a decision about using roads in a special way,
11. The health protection of the marathon provided by the massage therapists volunteer of the University School of Physical Education in Wrocław (50 massage therapists) at the start place, the marathon's route and the finish line,
12. The health protection of the marathon provided by the Emergency Service in Wroclaw
(6 ambulances) at the start, the marathon's route and the finish line,
13. Setting the column of cars 50 meters in front of the athletes at the start of the Olympic Stadium on the avenue toward the Różycki str. in order: the filter in pilot – the police patrol car, the pilot of the marathon, the co-pilot with the clock on the roof and the referee,
35. Addressing the invited VIP seats in the grandstand near the start place,
36. Setting the column of cars behind all the athletes set to take off, including the 'the end of the marathon' minibus, an ambulance.

The elements of the transition logistics' processes –the organizing phase:

1. monitoring running the entire length of the route (the security, the communication with the institutions securing the marathon's route, verifying the state of all components on the marathon's route through the streets of Wroclaw,
2. serving meals and soft drinks for the athletes,
3. the physiotherapy for participants,
4. the acceptance of the deposits by marathoners after showing the starting number in the hall.

The elements of the output logistics' processes – the controlling phase:

1. Removing and collecting the hardware from the marathon's route and storing the equipment at the Olympic Stadium,
2. Dismantling and gathering sings from the marathon's route and storing them at the Olympic Stadium,
3. Collecting the fences and the toilet cubicles from the marathon's route,
4. Cleaning the marathon's route and collecting the garbage,
5. Removing all barriers, road signs after running the last competitor, after receiving the disposal of the Head of the police's security,
6. Loading and transporting all barriers and signs to the warehouses,
7. Supervising the café by two workers of the security personnel,
8. Removing all banners, advertisements and decorations,
9. Removing the Olympic Stadium sound system,
10. Dismantling own devices, transporting to the warehouses,
11. Tidying the Olympic Stadium and objects of the Wrocław University School of Physical Culture,
12. Dismantling and dropping-off the stages, platforms, stands and other equipment at the Olympic Stadium,
13. Loading and returning borrowed advertising banners of sponsors, organizing personnel and media sponsors,
14. Loading and returning rented other equipment,
15. Reimbursement of 13 vehicles assisting the marathon to the sponsor's living room.

All of the above identified critical points of the process require constant monitoring in the area of:

1. Fainting the athlete on the marathon's route,
2. The water main rupture along the marathon's route,
3. Collapsing the road along the marathon's route,
4. The entry of the vehicle on the marathon's road,
5. A bomb explosion on the marathon's route and places associated with the organized event,
6. Failing the power supply,
7. The food poisoning of the athletes and the marathon's service during the event,
8. The theft of the valuables (medals, trophies, awards, etc.) from the stock on the eve of the event,
9. Inadequate securing the marathon's route by the contractor of the order,
10. Lightning,
11. An anonymous telephone informing about the bomb threat on the marathon's route,
12. The failure of sound,
13. Delaying the start due to unforeseen circumstances,
14. Death of the athlete on the marathon's route.

V. THE ACTION MODEL OF THE SAFETY ENGINEERING IN EMERGENCIES RELATED TO THE ORGANIZATION OF MASS SPORTING EVENT

The following describes the basis of technologies useful in organizing the mass sports event from the perspective of 'the managed future events' [Cieśliński, 2015] which anticipating and preconizing can support the people coordinating the logistics process of the mass sports event in the decision making.

A. The information and communications technology as an instrument of the safety engineering

The information and communications technology (ICT or IT) caused rapid transformations in whole areas of life. ICT functions to unify and standardize the life. Nowadays, this notion concerns not only computers and telephones but also everything that is connected to the Internet and can transmit and process data[World Youth Report 2003. The global situation of young people, United Nations, p. 310].

B. ICT in the sports application models of the e-AZS platform

The basis for designing information and communications systems is the process approach [Cieśliński, 2014]. Such systems are described using a variety of tools. One of them is the Business Process Model and Notation. It reduces the time needed to create and edit the process models, enables hierarchization of processes, and saves time by making it possible to reuse the defined sub-processes. Its fundamental disadvantage is the lack of description of processes in the form of a map that includes the organizational space and time. In short, it is necessary to build diagrams illustrating the flow of work, documents, information, data and knowledge as a spatiotemporal configuration [Cieśliński 2011]. The maps are also used to describe the value-added stream flow. One of the better functioning systems available on the market, capable of describing the spatiotemporal conditions of flows and indicating who is to do what and when, which is the best recommendation, is the iGrafx Professional for the Six Sigma program. The data, information and knowledge flow horizontally and across the organization, integrating the areas of previously poor cooperation. Preparing the enterprise, in advance, for the evolution towards the process orientation can improve the efficiency of the process implementation and functioning. The analysis of this aspect of the relations and dependencies should identify the areas that require changes in order to effectively use the modern ICT systems. Recent years have witnessed intense development of the information management support tools. Their implementation forces the organizations to become process-oriented as they seek the opportunities to effectively implement and improve the ICT systems, for example by creating and improving standards related to the process approach, that is the business process maturity model. The modern, advanced ICT systems supporting the business management processes are a factor that strongly modifies the behavior of people operating within the framework determined by the management systems. Implementations are accidental, performed without process and pre-implementation analyses, without applying the standard methodologies used firstly to assess the business process maturity and secondly to determine the environment in which a given enterprise functions. One could say that during the birth stage, the domain systems and MRP class systems can be implemented – the environment must be stable. During the growth stage it is possible to effectively plan and implement, without any great risk, the ERP class systems – the environment can be changeable. During the maturity phase it is possible to effectively and rationally plan the implementation of the BI class systems – the environment can be turbulent. In the table 1 is shown (through the use of vectors) the direction of increasing the risk resulting from the inability to prepare a rational process and pre-implementation project due to not knowing many variables covered by it.

These include the environmental conditions (the expectations of the clients, the legal requirements), stable or unstable functioning of the process teams, the stability and predictability of processes and predicting the results of their functioning. The co-dependencies described are presented in Table 1.

Table 1. The model of the selection of the management support system depending on the BPO phase and the type of environment

BPO phases /Type of environment	Stable	Changeable	Turbulent
Birth	Domain systems (module; F-K, production, sales, logistics, MRP, MRP II)	medium system implementation risk	high system implementation risk
Growth	medium system implementation risk ←	Integrated systems (e.g.: ERP, ERP II)	high system implementation risk →
Maturity	low system implementation risk	medium system implementation risk	Intelligent systems (e.g.: EIS – Executive Information Systems, DSS – Decision Support Systems, MIS – Management Information Systems, ICT

Source: own study, after: [Cieśliński 2011]

There are no universal ICT systems, just as there are no absolute and unchangeable business management ideas. This necessitates a response to changes not only within businesses, but also among the providers of the ICT systems, enforces cooperation between the designers and scientists working on recognizing the process approach in creating modern management systems (as in the case of cooperation with the US Department of Defense which has resulted in the creation of a model standardizing the operation of the software developers).The Capability Maturity Model and its further versions: the Capability Maturity Model Integration ver. 1.2 and the Personal CMMI, and supporting models: PSP – Personal Software Process, TSP – Team Software Process, TCD – Team Coaching Development, and others serve as a basis for such cooperation which results in spreading of this type of models to other sectors of the economics and also in sport[Cieśliński 2011].

C. Prototyping the dashboard simulator of the project manager organizing the mass sports event using the augmented reality technology

The augmented reality is a technology supporting the processes of monitoring the organization's space of the mass sporting events. It provides predicting the critical events occuring in the logistics processes of the mass sports event. According to Ronald Azumy [ISMAR, 2015] augmented

reality (AR) is defined as a system that fulfills the following three conditions:
- connects the real world with the computer-generated world,
- it is interactive in the real time,
- it allows the freedom of movements in three dimensions.

The augmented reality generates the virtual events on the events occurring in the real space. Therefore, it is pointed out that this type of imaging actually allows the prediction of the future events, particularly events that may cause the interference in organizing the logistics processes of the mass sports event and consequently may cause the emergency. The following describes the methodological assumptions of prototyping the dashboard of the manager of the organizational undertaking which is the mass sports event.

The dashboard manager – organizer of the mass sports event boils down to search for the answer to the question of how to effectively monitor the progress of mass sports event from the perspective of its security[1]?

The prototype of dashboard manager of organizing the mass sports event (the assumption):

1. Modeling a system for monitoring the logistics network of the mass sports event,
2. Controlling traffic in networks with regard to the problem of placing the objects of the intelligent control systems of the ISS,
3. Nonlinear diagnosis of the subtle interactions in monitoringthe organization of the mass sports event,
4. Developing the methodological formalism of mapping the organizational space of the mass sports event with the special emphasis on safety and behavior of its participants – the prospect of the security, including level of clarity and unambiguous interpretation of the data and information collected by the system.

The result of the mentioned assumptions should be:

1. The prototype of the dashboard manager of organizing the mass sports event,
2. Developing of the functional simulators to monitor of organizing the mass sports event,
3. Developing a model controlling the intelligent network of the organizational space of the mass sports event,
4. Developing a system of indicators to monitor the level of communication skills and uniqueness of perception the data and information from the perspective of security of organizing the mass sports event,
5. Mapping the processes and procedures for monitoring the behavior of participants of the event and its 'imaging' using the augmented reality's technology and 3D AR.

D. The GPS system

In the case of the GPS system, it was conducted the analysis for the selected route, and it included: the fuel consumption and the expenditures ensuring the communications between the transport managers and the drivers. The fuel consumption has been studied for one vehicle to the route chosen in the fourth quarter periods of 2012 and 2013. [Bernat P., 2015].

The execution's benefits may include routing, controlling the unauthorized passes or locating the vehicles. Using the GPS system, with the disposal preview current locationof the vehicle, it can checked and calculated a route and provided the appropriate instructions to the driver. As a result, the response time to the situation, eg. on the road is reduced.

The GPS system allows to calculate the length of the route and the travel time. It allows the driver to move in accordance with the schedule and to exhibit the greater attention to the operated vehicle and the transport process itself. The GPS system records every deviation. It is the way to eliminate the unauthorized mileages that have an impact on business costs.

The GPS system is also useful in case of the communication problems such as the communication with the driver. After the statement of the total costs maintaining the communications before and after the implementation of a GPS system in executing the international orders in the aforementioned period of time savings amounted to 1230 Polish zloty.

Supplementing the mentioned possibilities with the augment reality's technology would allow to visualize the destination, the route or the sequence of executing procedure (transporting, operating the vehicle) or the compliance of the documentary. Thus, in the daily work, and especially in the emergencies, it would be a support to the drivers in their daily work.

E. The benefits of IRI

The scope of the IRI's support should be based on the identified needs, and the full version for a transport company may include: [Bernat P., Halikowska]

a) managing the order,
b) managing the resources,
c) managing the costs.

The benefit analysis was carried out in the enterprise with the previously adopted the division of IRI. The advantages (benefits, strengths) were identified both the execution's and cost's side.

F. The DBMS system

In the basic version, the enterprise can use the functionality of the DBMS system for collecting the data on

[1] It is worth to notice that the assumptions are taken from the poject ‚Dashboard Manager of the Road' which was initiated by Wojciech Cieśliński, and eventually created a research consortium, which included; Wrocław University of Economics (primary investigator: M. Owoc; co-investigators: Jerzy Korczak, Helena Dudycz, Miroslaw Dyczkowski,), the University School of Physical Education in Wrocław (Wojciech Cieśliński, Edyta Sczuka), Wrocław University of Technology (Janusz Sobecki, Dariusz Gąsior, Marek Zuk) and the State Higher Vocational School Nysa (Wojciech Cieśliński). The project was submitted to the Polish National Research and Development Centre in 2015 (the project has not been approved for funding, but received a good substantive assessment).

the technical measures, their state or status. It allows for the efficient management of the available resources. With the automatic reminders of the upcoming inspections, the repairs or the approvals, it can be avoided the problem of availability's lack.

The entire system can also gather information about the drivers, but the most important benefit is the ability to collect information about orders that can manage the relationships with the customers.

However, even such undoubted benefits of the entire DBMS does not always induce the enterprise to implement full functionality.

VI. Conclusion

The organization of the mass sports event has to be supported by the tools and technologies related to the safety engineering. These include the ICT systems that enable the real-time upload the information necessary in making decisions. The picture of the augmented reality has to be 'superimposed' on the ICT systems. It generates the precognition and predicates of the events related to organizing of the mass sports event and its aspects of the logistics of the flows of materials, people, things, events, data and information. Monitoring the physical space's progress of organizing the mass sports event is supported by the GPS systems. In the case of the GPS, the operator has the ability to continuously monitoring the traffic in the organizational space, online collecting the information about the traffic and its supervision.

Finally, it points out the necessity of building the 'dashboard manager' – the organizer of the mass sports event using of the ISS, ICT and AR which will increase the sensitivity of the entire organization and will enable the prediction of the disturbances and the rapid response.

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