World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:8, No:11, 2014

Requirements Engineering via Controlling Actors Definition for the Organizations of European Critical Infrastructure

Jiri F. Urbanek, Jiri Barta, Oldrich Svoboda, Jiri J. Urbanek

Abstract**—**The organizations of European and Czech critical infrastructure have specific position, mission, characteristics and behaviour in European Union and Czech state/business environments, regarding specific requirements for regional and global security environments. They must respect policy of national security and global rules, requirements and standards in all their inherent and outer processes of supply - customer chains and networks. A controlling is generalized capability to have control over situational policy. This paper aims and purposes are to introduce the controlling as quite new necessary process attribute providing for critical infrastructure is environment the capability and profit to achieve its commitment regarding to the effectiveness of the quality management system in meeting customer/ user requirements and also the continual improvement of critical infrastructure organization's processes overall performance and efficiency, as well as its societal security via continual planning improvement via DYVELOP modelling.

Keywords**—**Added Value, DYVELOP, Controlling, Environments, Process Approach.

I. Introduction

THE terminology, methodology and implementation of a DYVELOP© method [5], [6] are used for the modelling and evaluation of controlling processes in Small and Middle Enterprises (SMEs) [2]. They are surprisingly consonant to younger ISO 9001:2000. Above key words follow from their common sense: The organization promotes the adoption of a process approach when developing, implementing and improving the effectiveness of a quality management system, to enhance customer satisfaction by meeting customer requirements. For an organization to function effectively, it has to identify and manage numerous linked activities [3], [8]. An activity using resources, and managed in order to enable the transformation of inputs into outputs, can be considered as a process. Often the output from one process directly forms the input to the next. The application of a system of processes within an organization, together with the identification and interactions of these processes, and their management, can be referred to as the "process approach". Its advantage is the ongoing control that it provides over the relationships among the individual processes within the system of processes (PrS, see Figs. 3-5), as well as over their combinations and sophisticated interactions in the CASEs (see Figs. 5-8). When used within a quality management system, such an approach emphasizes the importance of understanding and meeting requirements; the need to consider processes in terms of added value; obtaining results of process performance & effectiveness; and continual improvement of processes, based on management´s responsibility in competitiveness environments [1]-[4].

DYVELOP (Dynamic Vector Logistics of Processes) is friendly computer assisted language for the analysis, evaluation, heuristics, modelling, simulation, scenarios and engineering of any entity´s relationships in a Blazon© on a scene (theatre). It has just a three fundamental entity´s kinds that differ in their sense, structure, character, behaviour and especially in their controlling actor's roles [5], [7]-[9]:

Environment (ENV©) is entity´s 1st kind, having a role of principal domain of any scene *without* controlling actor.

Process System (PrS©) is entity´s 2nd kind, having a role of a transformer of inputting things to outputting new-things and its *external* controlling actor operates from its defined ENV.

CASE© is entity´s 3rd kind, having a role of a complex situational set of process´s entities, requiring the purpose or action fruition in certain circumstances and conditions, according its *inherent* controlling actor, from of whose perspective it is initiated and composed.

DYVELOP method works with next special terms:

- Entity is it what exists, or what is possible to imagine even in human mind on any scene.
- Domains = real time, space and environments, are dominant entities absolutely independent on a controlling of human perception. Dominance is predominant aspect on the scene. Operation© represents the process chains / nets, running in dominant real time & environments, needing a work of the process factors (agents, actors, participants…). Scenario is formal record of the operations on scene & arena environments. Scene is exact specified framework of scenario entities.
- Libretto is one-sentence scenarios summary.
- Scenery represents instant perception of the scene and arena.

J. F. Urbanek is Professor at the Department of Civil Protection, University of Defence, Kounicova 65, 66210 Brno, Czech Republic (phone: +420603326355; e-mail: jiri.urbanek@ unob.cz).

J. Barta works as a lecturer at The Department of Civil Protection of University of Defence and he is studying a doctorate at the University of Defence in Brno, Kounicova 65, 662 10 Brno, Czech Republic (e-mail: jiri.barta@unob.cz).

O. Svoboda and J. J. Urbanek are doctoral students at the University of Defense, Kounicova 65, 662 10 Brno, Czech Republic (e-mail: olda.svoboda@seznam.cz, jiri.urbanek2@unob.cz).

- Event is operational realization situation scenery. Disaster event is initial rise of crisis situation. Circumstance affects and guides event´s processes.
- Map is survey arrangement of entity´s portfolio.
- Blazon© is scenic meta-model, representing the entities´ roles, semantics and namely their *relationships* in pictographic mind maps, similar to relationship´s expressions in nobility blazonry.
- Interface is relative domain, symbolising (defined and demarcated) typological differences among entities.
- Situation is qualitative and quantitative manifestation of event scenery, influenced by the environments and circumstances.
- Controlling is generalized capability of complex governing of situation policy. The Policy is here goal-directed care for affairs of specific sphere.
- Controlling actor (alias CtrlingActor) [7] Controlling´s actor is an executor of controlling functions. If you are blazonry searching for real controlling actor, do you search symbol of a small "figurine" in the blazons!

The base of DYVELOP methodology consists in special very important possibility and ability - to express *Semantic Relationships* using Boolean algebra operators (not only some bindings, comparing to common modelling methods in flow-lines, pictures or charts – see Fig. 1).

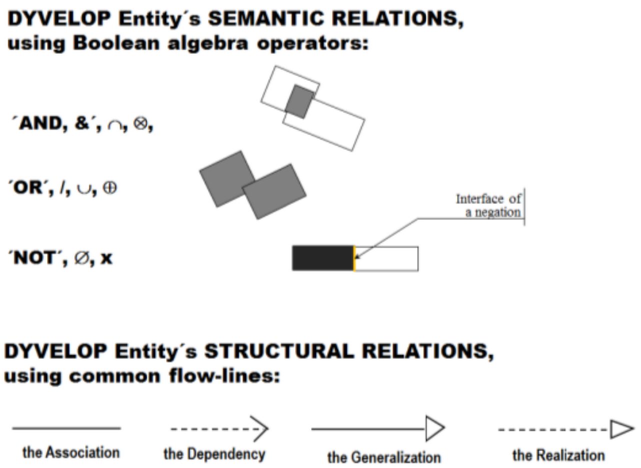

Fig. 1 Mapping of entity´s relationships

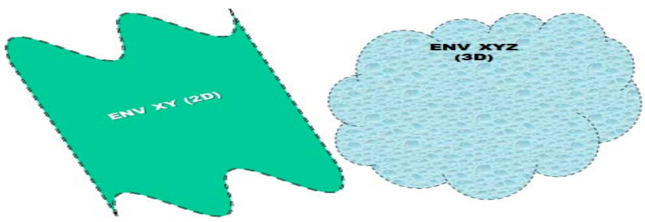

Fig. 2 Symbols for 2D or 3D modelled environments

II. DYVELOP Modelling

A. DYVELOP Kind, Existing without Any Controlling Actor

Environment (ENV©) is principal domain as DYVELOP kind, existing without any controlling actor at any natural or man-made process scene. The ENV totally lawful predestines any process running.

B. DYVELOP Kinds, Needing Controlling Actors

All Process Systems (PrSs) have sharp corners symbols, needing the controlling actors, operating *externally* from defined ENV. Next common PrS (blazonry tetragonal symbol at Fig. 3) has processor´s controlling actor = OPERATOR that has control/ regulation function from the ENV X, parameterized by real time (from top to bottom of page) and space (from left to right).

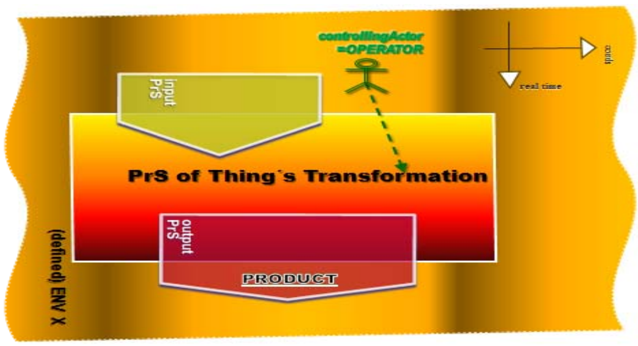

Fig. 3 A Blazon of the most common PrS "for thing´s transformation"

On next Fig. 4 the common PrS is added by others PrS´s symbols typology with their external controlling actors:

- MANAGEMENT PrS (triangular symbol) – capable to have control over own situational policy by own controlling actor = STAKEHOLDER.
- LOGISTICS PrS (pentagonal symbol) – flow productivity processor´s controlling actor = Ctrl INTERFACE, qualitative changing batches x/y = z/t, going from arrow source to tip target.
- EVENT PrS (hexagonal symbol) - hybridized manifestation of operational scene PrS realization, as well as situational symptom or occurrence *case* with controlling actor = LAWS of NATURE.
- OPERATION PrS (hepta/& moregonal symbol) – parameterized by real time, factors and environments, it is sophisticated multiprocessor with many controlling actors = Process´ MANAGERS.

Process Cell is the smallest PrS = (blazonry "puzzle" symbol at Fig. 5) has *Processor*´s characteristics, but "Whole Cell´s controlling Actor = *PROGRAMME*" is inherent part of process cell "body" that has the both the control/ regulation hybrid behaviour of next a CASE© as the attribute of Process Cell *Control Subsystem* (see Fig. 6). This hybrid behaviour makes automatic function of Process Cell as the smallest autonomous automat on defined ENV XY. But this automat needs two furthers subsystems: *material* and *information*, where the roles of these both subsystems´ controlling Actors take the both the Semiproduct and the Plan. An objective of Process Cell operation is producing of tangible *products* and/or intangible *services*. But here is unrequired co-product a *Waste* always.

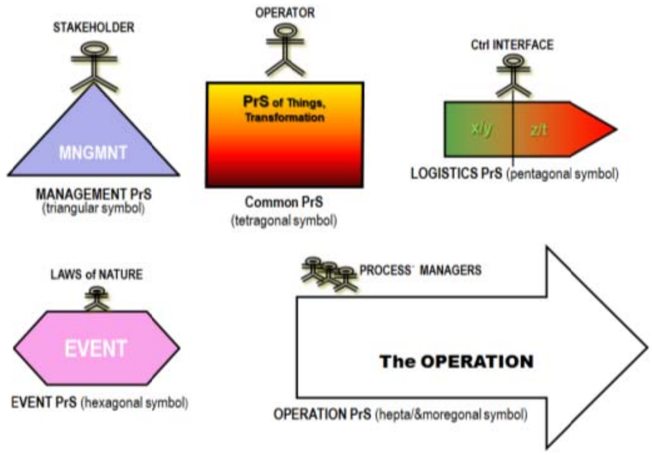

Fig. 4 A typology of five PrSs types with external controlling actors

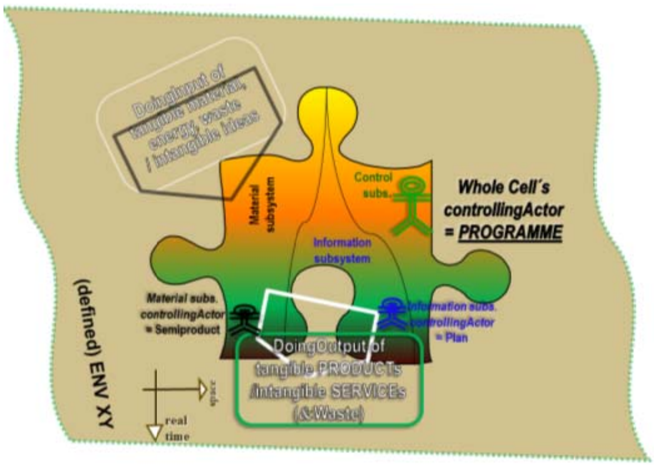

Fig. 5 The blazon of autonomous Process Cell

The *CASE*© represents new DYVELOP kind with its *inherent* controlling actor, from of whose perspective it is initiated and composed. So, all CASEs (symbols with rounded corners) need controlling actors, operating from the "bodies of CASEs". All Cases typology are together with Process Cell [7] shown at Fig. 6.

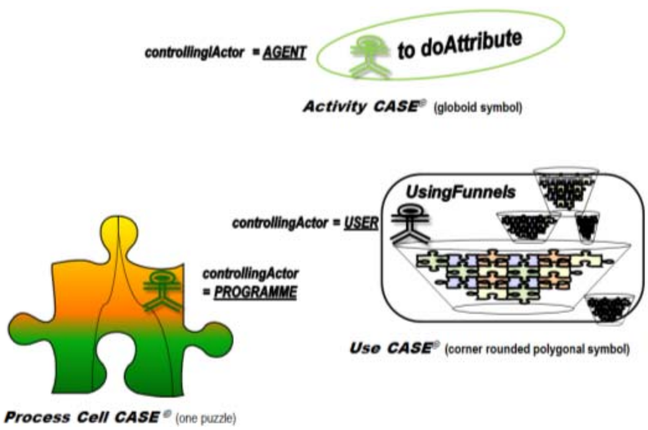

Fig. 6 A typology of three types of CASEs - inherent ctrlling actors

Use CASE© (corner rounded polygonal symbol) has Inscribed alphanumeric legend, which is *cursive typified gerundive form* as *verbal noun* ending in '-ing' (that has a function of a noun and at the same time shows certain verbal features). It can be ´camelLetter´ completed by process specification, expressing structural things always. CASE´s complex situational set of process´ entities, circumstances, conditions, environments and processors, where an output from the one often directly forms an input into another process, requiring the purpose fruition according its *inherent* controlling actor – the USER, from of whose perspective the Use CASE is initiated and composed.

Activity CASE© *(*globoid symbol) has inscribed legend, which is *cursive typified process verb* mostly as an infinitive with *´to´* preposition. It can be ´cameLetter´ completed by the attribute. It represents operational process´ function, aiming & specifying terminal or transit change of the thing, state, structure, behaviour, interaction, capability, service, relation, situation or attribute within real operation, requiring action fruition under its inherent controlling actor – the AGENT.

III. Added Value Controlling Model

The thesis „The controlling in European Critical Infrastructure Organization is also beyond numbers", will be tested. The controlling of critical infrastructure (CI) is Added Value (VA) is possible to model by DYVELOP method, starting at Fig. 7 which is blazonry operated a meta Processor (metaPrS) representative of CI model. This CI model has 3D (3D parameters are real time/space/information) ´funnel´ shape, aiming to PRODUCTs generation on defined ENV XYZ, operating on use case scene "Producing Value Added". The VA production is here abstractly indicated by means of thing´s transformation rate - ***τ*** *(tau),* which varies between ⟨0; π/2).

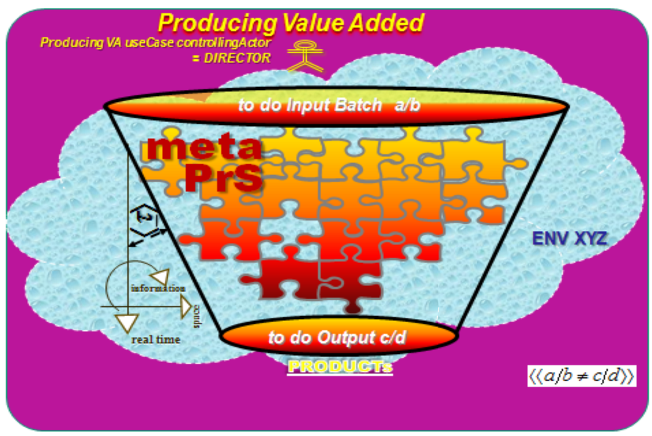

Fig. 7 The blazon of use case "Producing Value added" in 3D funnel (metaPrS), operating on 3D ENV XYZ – model of CI

The ***τ*** represents transformational processes of the thing´s productivity in the funnel between activity cases *"to do Input Batch",* having value ***a/b***, to the output with batch value ***c/d***, according inherent controlling actor a DIRECTOR. This scene produces the VA, proportionally to $\underline{\tau}$ size extent. If the $\tau \neq 0$, then this scene the batches have relation:

$$a/b \neq c/d \tag{1}$$

The DIRECTOR has a key user´s role in the need to consider processes in terms of added value, obtaining results of process performance & effectiveness and obtaining continual improvement of processes quality, based on objective measurement in local/ global CI environments [11].

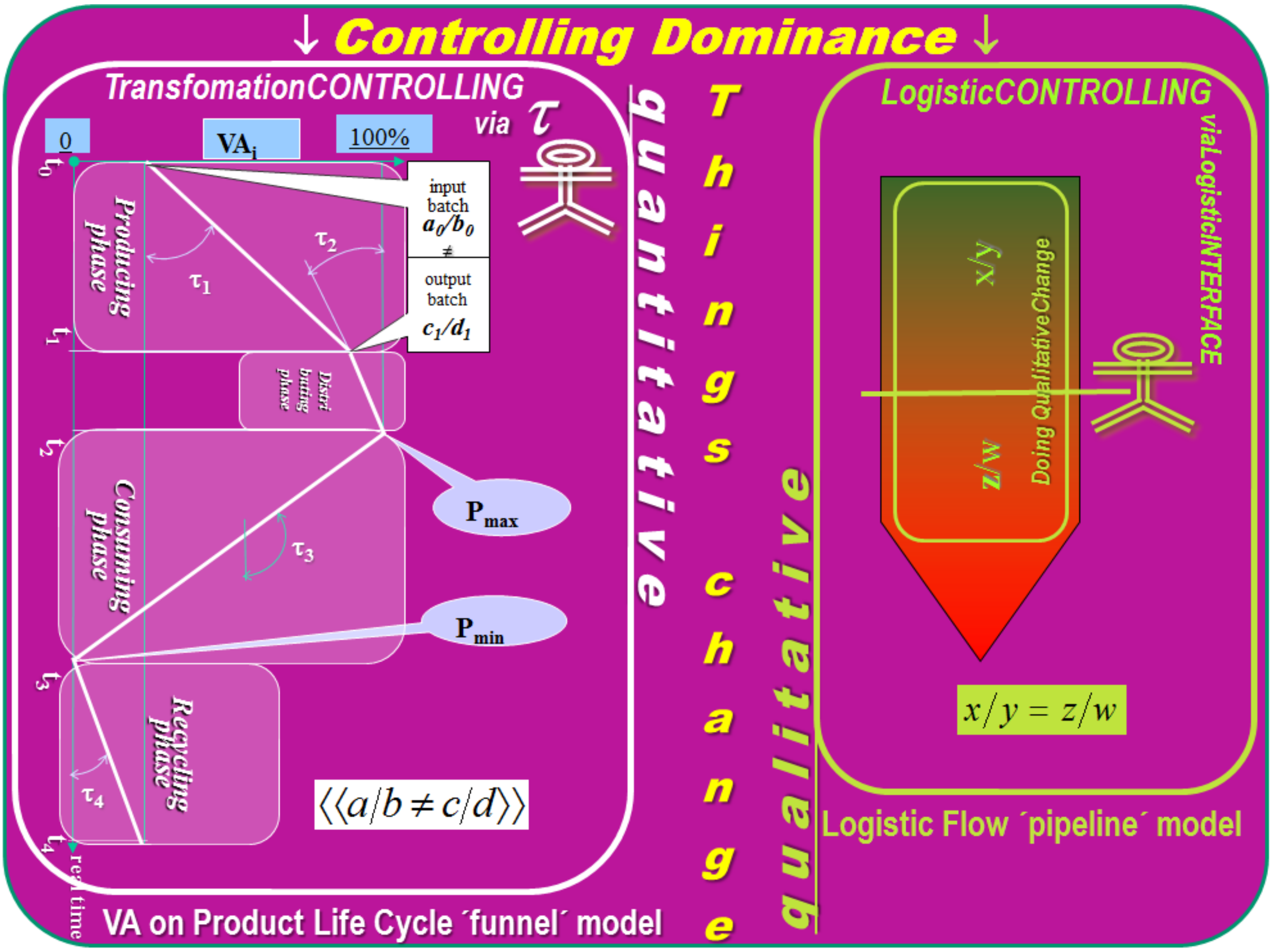

Fig. 8 The blazon of use case "Controlling Dominance of Things change quantitative / qualitative"

Above Fig. 8 needs a rolling out step by step in live power point presentation for full comprehension, which will be performed within WASET Conference. Here just in a static "picture" of the process scene must be rolled out by following verbal way for the reading of this blazon. Here, the process scene of the critical infrastructure is enacted at use case named "*Controlling Dominance*" where a "*Things change*" can be performed by two next librettos in critical infrastructure operation.

- A) "*Controlling Dominance of Things change quantitative*" (left side of the Fig. 8 named "VA on Product Life Cycle ´funnel´ model".
- B) "*Controlling Dominance of Things change qualitative*" (right side of the Fig. 8. named "Logistic Flow ´pipeline´ model".

In the A) libretto, the $\underline{\tau}$ angle (a figurine) is controlling actor, doing quantitative controlling dominance. Here, all processes are performed within use case "*TransfomationCONTROLLING via τ*", where graphic dependence of the <u>VA</u> on <u>real time</u> (going from top to bottom) is plotted in four phases (*Producing/ Distributing/ Consuming/ Recycling*) of any Product Life Cycle (PLC). In this graph, five time nodal points ($\mathbf{t_0; t_1; t_2; t_3; t_4}$) change mathematical curve trend, separating different angles ($\tau_i = \tau_1; \tau_2; \tau_3; \tau_4$) in each phase of the PLC. It express thing´s transformation rate, representing transformational processes productivity between *unequable* input/output batches of each phase (e.g. in "*Producing phase*" $a_0/b_0 \neq c_1/d_1$). The VA∈⟨0 ; 100%⟩ has dimensionless quantity, but on whole PLC is possible to find two monetary absolute quantitative values: $\mathbf{P_{max}}$ (product price of sold out to a consumer) and $\mathbf{P_{min}}$ (product price after its consumed by the consumer). For sustainable development of living environments in European Critical Infrastructure

Organization environments is necessary that PLCs continuity must be repeated without end, even in critical infrastructure is crisis situations and perils in whole scale from natural or man-made economic disturbance to liquidation [3], [4]. The continuity of never-ending cycling must be ensured via business crisis continuity [10] scenarios [7], bringing adequate level of societal security (ISO/DIS 22 301-303: 2012).

Then if $\tau \neq 0$ and $\mathbf{P_t}$ (a price in certain instant time) and $\mathbf{VA_t}$ as a value added in certain instant time are in the equations (2) and (3), where $\mathbf{VA_{TRANS}}$ and/ $\mathbf{VA_{LOGIS}}$ are produced values added from transformation / logistic processes respectively (see (5)),

$$VA_t = \frac{P_t}{P_{\max} - P_{\min}} * 100 \cdots [\%] \quad (2)$$

$$VA_t \cong VA_{TRANS} + VA_{LOGIS} \quad (3)$$

than we can deduce from the graph on the use case "*TransfomationCONTROLLING via* τ":

$$tg\ \tau_i = \frac{d\,VA_{TRANS}}{dt} = VA'_{TRANS} \quad (4)$$

i.e. that tangent of thing´s transformation rate (τ) is equal to a derivative of first order of value added according to time! The τ is controlling actor in this use case for critical infrastructure! [7], [8].

In the B) libretto, all processes are performed within use case "*LogisticCONTROLLING viaLogisticINTERFACE"*, performing qualitative controlling dominance. The controlling actor is a "*Logistic INTERFACE"* (horizontal line by a figurine, separating input ***x/y*** and output ***z/w*** batches in pentagonal arrow´s logistic PrS). It express thing´s qualitative change, representing logistic processes productivity between non-homogeneous, however quantitative identical values of input (source)/ output (target) batches. If $\tau = 0$ (see Fig. 7.), the $\mathbf{VA_{TRANS} = 0}$, then use case "*LogisticCONTROLLING viaLogisticINTERFACE"* (see Fig. 8 with arrow's inherent use case "*Doing QualitativeChange*"), then at arrow tip is for target produced just the $\mathbf{VA_{LOGIS}}$ in the equation

$$VA \cong VA_{LOGIS} \quad (5)$$

IV. Conclusions

A thesis „The Controlling in European Critical Infrastructure Organization is also beyond numbers", was confirmed in this paper. Here the controlling is taken as a generalized capability to have control over situational policy, where controlling actor is an executor of controlling functions as quite new necessary process attribute, providing for the critical infrastructure regional/ global environments the capability of fulfilment for specific Controlling Actor Requirements and Demands Engineering and profit to achieve its commitment, regarding to the effectiveness of the quality management system. The continual improvement of critical infrastructure is transformation and logistic processes overall performance and efficiency, as well as its continual planning improvement. They all are derived by the introducing of τ value as quite new and purposeful controlling actor, which is able to qualify the need to consider processes in terms of added value! (ISO 9001, 9004: 2000, 2008) It needs the continuity of never-ending product life cycles, being ensured via business crisis continuity scenarios, bringing adequate level of societal security.

Acknowledgment

The article has been written as part of the Ministry of Defence Czech Republic project, specific research project of University of Defence with acronym INTROP - Interoperability Workplaces to Support Teaching of Security Management in a Computer Network (SV12-FEM-K106-05-BAR) and project of the Technology Agency of the Czech Republic with acronym SIMEX - Research and development of simulation tools for training and cooperation actors in crisis management on subjects of critical infrastructure (TA04021582).

References

[1] Barta, J., Sadovska, V., Srnik, A., Urbanek, J. F. Protection of Information and Communication Systems. Environmental Software Systems. Fostering Information Sharing, 2013, vol. 2013, no. 413, p. 302-310. ISSN 1868-4238.
[2] Kral, D., Urbanek, J. F. Enterprise Crisis Continuity Scenarios on the Competitive Environments, *In Enterprise and the Competitive Environment 2014 Conference*, ECE 2014, Mendel University Press, Brno 2014, ISBN 978-80-87106-74-7.
[3] Ludik, T., Barta, J., Navratil, J. Design Patterns for Emergency Management Processes. In International conference *World Academy of Science, Engineering and Technology*, 2013, vol. 2013, no. 84, p. 515-522. ISSN 2010-3778.
[4] Rehak D, Grasseova M. *The ways of assessing the security of organization information systems through SWOT analysis*, pp. 162-184. DOI: 10.4018/978-1-61350-311-9.ch007. In ALSHAWI, Mustafa, ARIF, Mohammed (eds.). *Cases on E-Readiness and Information Systems Management in Organizations: Tools for Maximizing Strategic Alignment*. 1st edition. Hershey, PA, USA: IGI Global, 2011. 318 p. ISBN 978-1-61350-311-9. DOI: 10.4018/978-1-61350-311-9
[5] Urbánek, J. F. *Dynamic Vector Logistics of Processes*. In Philadelphia State University, 1999, ISSN 1091-8043.
[6] Urbanek, J. F., Balaz, T., Barta, J., Prucha, J. Technology of Computer-Aided Adaptive Camouflage. In: WSEAS International Conference on Computers and Computing (ICCC´11). Lanzarote: neuveden, 2011, p. 81-87. ISSN 2223-2753. ISBN 978-1-61804-000-8.
[7] Urbanek, J. F. et al. *Crisis Scenarios*. Brno: University of Defence, Monika Promotion Ltd. 2013, ISBN 978-80-7231-934-3.
[8] Yourdon, E. *Modern structured analysis*. Englewood Cliffs: Prentice-Hall, 1989.
[9] Zeigler, B., Praehofer, H., Kim, T. G. *Theory of modeling and simulation: Integrating discrete event and continuous complex dynamic systems*. Vyd. 2. San Diego: Academic Press, 2000, 510 s. ISBN 0-12-778455-1
[10] ISO/DIS 22 301-303: 2012; BS 7799-3:2006
[11] ISO 9001, 9004: 2000, 2008

Prof. Jiri F. Urbanek, Ph.D. was graduated 1972 at Brno University of Technology, Faculty of Mechanical Engineering. 14 years he operated in Czech industrial and mining enterprises, including technical help for mining rescue services. Parallel he was graduated Ph.D. with thesis Mathematical

Methods in Industrial Processes. Then he gave the lectures on technological, managerial and military universities in the branches Automation, Management, Logistics and Non-conventional Technologies. On Brno University of Technology he habilitated in branch Mechanical Technology and later in branch Management and Battle Employment of Ground Forces in Vyškov Military University.

Now, he gives professor's lectures at University of Defence, Faculty of Economics and Management in Brno, Czech Republic. His research branches are Safety, Civil Protection, Interoperability, Security Management, Crisis Scenarios and Civil Emergency Planning. He is European Commission expert for Security Research and for the Development of Small and Middle Enterprises. He solves many national and international research and development projects. He is author of 285 articles, 7 books and 8 patents. 4 papers were published via WASET publishing.

Jiri Barta was born 16th June 1977 in Vyskov, Czech Republic. He was graduated 2001 at Military University of Ground Forces in Vyskov, Faculty of Military Leadership. From 2003 to 2004 he worked as a lecturer at the Civil Protection Department of Military University of Ground Forces in Vyskov. He gave the lectures on Crisis Scenarios, Civil Emergency Planning and Information Systems for Crisis Management. Parallel he 11 years operated in the private sector in the field of insurance and family finances.

Since 2004 he gives lectures at Department of Emergency Management University of Defence in Brno, Czech Republic. His research branches are Safety, Civil Protection, Interoperability, Security Management, Crisis Scenarios and Civil Emergency Planning. He solves many national research and development projects. He is the author of more than 50 scientific articles, 2 patents and co-author of two monographs collective expertise.

Oldrich Svoboda was graduated from the STING Academy in Brno in 2013. Now he is studying at the University of Defence in Brno. He study the field of protection of the population at the Faculty of Military Leadership. His dissertation is focused on the implementation of societal standards in the business continuity management. His supervisor is a university professor Jiří F. Urbánek.

Jiri J. Urbanek was graduated from the Tomas Bata University in Zlín in 2013. Now he is studying at the University of Defence in Brno. He is study the field of civil protection at the Faculty of Military Leadership. His Doctor´s Thesis is focused on the implementation of standards in the business continuity management. His supervisor is a university professor Jiří F. Urbánek.