International Journal of Emerging Trends in Engineering Science &Technology(IJETEST)
ISSN: 2476-0862 Voumel. 1, Issue. 2

An Approach to Resilience and Learning: Accommodation of Unexpected Shifts

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Abstract— In this study, the term "resilience" is investigated towards knowledge, competence and capacity to build and improve critical infrastructure protection in energy, water & food systems that can absorb and accommodate future events and mechanisms in whatever unexpected frame and form them may take. The study is addressed to the investigation of the term "resilience" in viewpoints of knowledge-competence-capability co-creation and furthered recognition of characteristics of unawareness: as transition from the statements that "future events are expected" to that "they will be unexpected". The research methodology of study includes multiple case study analysis and resilience process design studies in the context of EU security research and development and Finnish energy, water & food systems and activities. Contribution of study is addressed to: characteristics of resilience, description of resilience aspects and elements of resilience in collective learning process which is interconnected to regional-national configuration and learning by expected-unexpected shifts in the critical systems, decision making, dynamics of social and ecological systems, resilience engineering and towards operative action competence achievements according to predict and prepare proactive settings and scenarios.

Keywords— action competence, adaption, continuity management, dynamic mechanisms, persistence, proactivity, resilience, robustness.

I. INTRODUCTION

The indent of this study is that energy, water & food systems have been recognized as a national critical mechanism in the #WINLandFI strategic research project and therefore, energy, water & food related information and services are investigated here as instances of critical infrastructure that should be protected by all types of threats, including such as security attacks, malfunctions, vulnerabilities and threats. An addressed challenge in this domain of study have lack of resilience understanding and adaptive learning paths as appropriate studies in comprehensive security oriented higher education, typically affecting losing of essential performance and functionality in dynamics of operative, social, ecological and economical systems, policy development and co-creative decision-making systems for collective policy development and in processes of learning for critical action competence development.

In the environment of study, the security paradigm of energy, water & food is understood as one of the most critical entities for the Finnish nation, decision making, operative systems and well-being of citizens. One fundamental element of this study is that energy, water & food security challenges have similarities with all critical information infrastructure protection subjects in EU and EC strategic research agenda, as approached in the pre-study article of author namely Mechanism of Critical and Resilient Digital Services for Design Theory [1].

Despite the term "resilience" appears in Finnish security strategy and policy documents, there is no single definition and common understanding yet to the term "resilience" that it's all appropriate dimensions would be directly applied to the energy, water & food system and aspects and dimensions of action competence [2], and purposes of regional-national resilience and learning paths [3], as in this context of study, the term "resilience" relates:

regional-national security, civil emergency management, dimensions of action competence, targets of activity, continuity management, critical infrastructure protection and crisis management observatory and response in domain of Finland and EU.

The overall research questions in the #WINLandFI resilience and learning theme are followed: How resilient current security-related systems and policy-making processes are to energy, water & food related threats in Finland? How do key stakeholders define resilience (in the energy, water & food sectors and as general view)? How can we improve resilience? Which are the key preparedness and safeguarding mechanisms in energy, water & food security in Finland and in EU?

In this study, the term "resilience" following with Latin world "resilier" is addressed to the study as ability to rebound, recover or jump back in the addressed critical fields of energy, water & food systems and national decision process models. Here, the term "resilience" can be address foremost to an ability of critical, institutional, organizational, hardware, software or operative service-systems to mitigate the severity and likelihood of failures or losses, to adapt to changing condition, and respond appropriately after the evidence of failure, fact finding, consideration of response, and scenario-based alignment and progress of action competencies. Confer related approaches such as Resilience Engineering [4] and viewpoints of robustness, persistence and resilience [5].

In the continuum of this study, the terms "integration", "integrative learning", and "integrative action theory" are addressed to "an interactive way of learning in where an individual learns along with a workplace, institution, school, and R&D -community, such as a national international research consortium as well as alongside a learning organization and across in a collective borders and disciplinary silos, as learning space that can be regional or individual-global oriented" [6].

One macro-level doctrine of study is further the research dimensions including action competence dimensions [7], using of authentic real-world research process in higher education [3], and continuums related methodology which can be increasingly used for learning in higher education institutions. Then, the objectives of "integrative learning" can be "associated through various formal and informal structures, such as R&D networks and actors, especially in developing students and learners to specialize in their areas of novel expertise where applicable knowledge is produced and mobilized in the collective R&D-related learning processes", which can be related to the externally funded as national-international R&D projects and research alongside of regional-national-global consortium's targets, regional-national research agenda and national strategic research. For collective sharing and model co-creation: the development path-dependency of "integrative action" referrers such concepts as: learning by doing and inquiry [8]; adult learning [9]; instances of action related learning [3]; expansive learning [10]; and situated learning [11].

Different approaches for the term "resilience" have been included to the related critical environment and literature of study, involving followed common key subjects: avoidance, survival, recovery and adaption. Followed of these, it is noteworthy; that the terms "disruption", "disturbance" and "related threats" are imperative to be included to research as they clearly holds strong relations to the term "resilience" in the standpoints of critical action competence and context of human-system interactions.

The concept of "resilience'" related to critical systems is not grand new: it has relations and path-dependency within systems ecology in the 1970s, where it marked a move toward the balance-equilibrium models, cybernetics and complex systems theory [12]; engineering resilience associated with mathematic and ecosystem development [13]; the meaning of stability and complexity [14] and stability in model of ecosystems [15]; with an abstract variable, such as the time described in [16], it takes a system to return to a stable maximum or balanced as equilibrium position after a disturbance.

Similarities with an example in the view of market and economy: Reference [17] reasoned that…it was impossible for central planners to arrive at any of their goals by attempting to eliminate, influence or control prices for rational planning purposes…only the floating prices constituting the market, a radically decentralized computation and signalling system, are able to discover the relative value of things, to adjust,

evolve and incorporate information held by isolated and differentiated individuals… importantly, these adjustments are probably never "perfect" in the sense in which the economist conceives of them in equilibrium analysis [17] in [p. 523].

The "concept of resilience" has many recent and related aspects in the social sciences and being as the term of art in discussions of international finance and economic policy, corporate risk analysis, the psychology of trauma, policy-regulation development, the urban-regional-national planning, public health care and national security. The term "ecological resilience" is interpreted here as the ability of the ecosystem to regenerate after stress and overloading, meanwhile, "social resilience" is understood as the ability of communities to withstand external shocks to their social infrastructure [18] in [p.361]. Social resilience can be observed by examining positive and negative aspects of social exclusion, marginalization and social capital [18] in [p.352]. The social resilience is understood by relationships and the mutual trust of other peoples.

In the operative environment of this study, as well in security related higher education, research activities and achieved action competence and high-value impacts have become globally important for regions and societies, because requirement of new competence and competent networked experts to meet current and future challenges, such as unexpected shifts and resilience needs. However, this progress of a result and high-value impact in higher education integration is a complex and interaction based processes, not only within technology related resilience, but merged with the economic, legislative and social environment, where they are also influenced by government policy and programmes, financial instruments, externally funded research, laws and regulations, economic boundary conditions. In this study, the focus of higher education and energy, water & food research is addressed to progress of: knowledge, competence, capability and operative performance, dimensions of action competence in the perspective of accommodation of unexpected shifts and aspects of resilience.

In this study, the term "security related learning" addresses to interactions of learners, here such as researchers, decision-policy makers, teachers and students, to explore: environmental and national critical issues; related adaptive change; and our relationship with nature, to show how innovation, design and science can benefit us to solve challenges and find appropriate ways to communicate ideas, issues and implications differently in diverse disciplines and policy-decision systems. In this article, it is comprised and expected that term "security" discourses with "safety" aspects.

Comprised management assumption of study is that realization of regional-national development, R&D and its management functions are at least partially far from a linear-normative process and cannot be managed alone by one actor.

II. METHODOLOGY

The data collection and analysis of this study is cumulative and systematically used for a qualitative and quantitative analysis, the setting makes as a continuum (a R&D path) of studies; followed (n) indicates as an instance of data collection used for this analysis between January 2010 and November 2016. The data collection is comprised according to the description by Finnish Academia Result Guidance including eighteen (n=18) cumulative categories: 1) scientific publication (n=42) according to publication forum classification; 2) number of open data collections (n=2) facilitated and licensed data collections (n=3) used; 3) collective creation of international publication (n=6) articles; 4) data of international researcher exchange; 5) integration of education (n=6) study units, related (n=3) thesis and related (n=3) dissertations; 6) data of externally funded (n=3) research projects in H2020 and data of new applications (n=3) for H2020 funding; 7) presentations and audiences with (n=6) stakeholders; 8) data of (n=4) workshops and (n=6) seminars, creation of (n=4) events for research and development; 9) participation to public audiences, such as in a parliament and participation to statements; 10) publication in (n=6) newspapers and general descriptions according to publication forum classification; 11) invited (n=3) presentations; 12) indicators of social media: Twitter, LinkedIn, Facebook and (n=3) homepages; 13) support of public events for international, national and regional audiences; and data of economic indicators, such as 14) investigations; 15)

patents; 16) licenses; 17) spin-offs; and 18) start-ups.

In this study, the multiple-case study approach was used; the method is explained in references that address "the case research strategy in studies of information systems" [19]; "building theories from case study research" [20]; "case studies and theory development in the social sciences" [21]; "qualitative data analysis" [22]; "real world research" [23]; and "case study research design and methods" [24]. Here, the multiple case study followed a replication logic, and the selected cases serve in a manner similar to multiple experiments, with similar results: a literal replication or contrasting results in a theoretical replication predicted explicitly at the outset of the investigation.In this study, the case study analysis brings an understanding of a complex issue and object and can extend experience or add strength to what is already known through previous research and reviewed literature. Here, case studies emphasize a detailed contextual analysis of a limited number of events or conditions and their relationships when the relevant behavior is not manipulated and the role of the researcher is that of an "objective outsider," as in [25] positioned.

Reference [24] noted that the simplest multiple-case design would involve the selection of two or more cases that arebelieved to be literal replications, while a more complicated multiple-case design would result from more and different -types of theoretical replications, such as middle range theories [21]. In this study, the end of data analysis was indi collection andcated by saturation, when no new information emerged for the research purpose [26].

This analysis involves data and research process followed: 1) the Academy of Finland Strategic Research Security Programme namely From Failand to Winland (#WINLandFI), including n=62 stakeholders; 2) European Commission Horizon 2020 funded R&D including n=3 projects, namely PERSEUS, ABC4EU and EU_CISE_2020; and 3) data of new applications n=2 for proposals to the Horizon 2020 Work Programme 2016–2017, namely MARISA and EPIC.

#WINLandFI: From Failand to Winland: The Academy of Finland Strategic Research Council funding from April 2016 to March 2019 as ongoing case. "This research project will take you from Failand (failed future Finland) to Winland, e.g., Finland where key security threats have been responded to with resilient policy-making. The starting point of research is the question: "What kinds of security risks and threats could paralyze Finland so fundamentally that our country becomes Failand? The proposal included arguments, that Failand becomes reality if two of the most fundamental elements of a functioning society fail: food security and energy security, which both are closely linked to water security. In addition, the proposal comprises that such failure is likely to result from the sum of three key components: long-term pressures + shocks & surprises + policy responses. Addressing such an equation, and guiding the way to Winland, requires a multidisciplinary team that works together in an inter- and transdisciplinary manner, involving the key stakeholders throughout the process. #WINLandFI consortium have paid focused attention to establish an integrative research and stakeholder process that will utilize a combination of scenario planning and decision analysis, supported by a series of co-creation workshops and other interaction methods. With the help of scenarios, #WINLandFI consortia will study how water, food & energy related pressures, shocks and surprises and policy responses affect Finland's overall-comprehensive security."

PERSEUS: "Protection of European Borders and Seas through the Intelligent Use of Surveillance is coordinated by INDRA Sistemas with n=29 partners. The timeframe of the PERSEUS research was between January 2011 and December 2014. In this study, the selection of PERSEUS as a case represents a program and research consortium that aims at the large-scale integration, validation, and demonstration of novel systems and symbolizes European research collaboration, providing a federative frame to join research and steering in areas of significant European interest. The focus of the PERSEUS investigation is consortium functions and research on international knowledge transition and path-dependency mechanisms, dissemination, and events."

ABC4EU: "Automated Border Control Gates for Europe is European Union wide R&D project and involves a Consortium of 15 partners from 8 different countries (FP7-SECURITY-312797)

between 2014 and 2017. The purpose is to make border control more flexible by enhancing the workflow and harmonizing the functionalities of automated border control gates. Project started in January 2014 and will last for 42 months. The project is led by INDRA Sistemas S.A. from Spain. During the last years, many ABC Gates have been deployed in the main European airports, most of them as pilot projects intended to test their capability to improve the border crossing processes in aspects such as speed, security, automation, and false rejection reduction. In particular, harmonization would be required in areas as e-passports management, biometrics, gate design, human interface, parallel processes, signaling and interoperability."

EU_CISE_2020: "European Union's Information Sharing Environment addresses to steps forward along the accomplishment of the European roadmap for Common Information Sharing and Distributed Systems and Services Environment. The project attains the widest possible experimental environment of innovative and collaborative services and processes between European maritime institutions and takes as reference a broad spectrum of factors in the field of European Integrated Maritime Surveillance, arising from the European legal framework, as well as from studies, pilot and related R&D projects. Timeframe of EU_CISE_2020 is between 01/06/2014 and 01/06/2017."

MARISA: Maritime Integrated Surveillance Awareness as new H2020 application case includes followed as abstract: "Combating illegal immigration, and human smuggling, terrorism at sea, piracy, as well as arms and drug trafficking has become a high priority on Europe's security agenda. Securing the sea requires day-to-day collaboration activities between the numerous European actors of maritime surveillance, Member States' administrations and European agencies principally, and a significant number of initiatives are being taken at EU level to address this challenge. The large amount of 'raw data' available today, from different sources and in different formats, are not usable by the systems supporting maritime security since they are not accessible at the same time and, often, they are not interoperable. Therefore, the overarching goal of this project is to provide the security communities operating at sea with a data fusion toolkit, which provides a suite of methods, techniques and software modules to correlate and fuse various heterogeneous and homogeneous data and information from different sources, including Internet and social networks, with the aim to improve information exchange, situational awareness and decision-making and reaction capabilities. The proposed solution will provide mechanisms to get insights from any big data source, perform analysis of a variety of data based on geographical and spatial representation, use techniques to search for typical and new patterns that identify possible connections between events, explore predictive analysis models to represent the effect of relationships of observed object at sea. Enterprise and ad-hoc reporting and Maritime Services, within the CISE context, will be provided to support users and operational systems in their daily activities, as well as presentation tools for navigating and visualizing results of data fusion processing. The toolkit will be extensively tested by the involved practitioners (supported by the national industrial champions) to cope with specific user needs. Indeed the project will be driven by trials addressing cross country / cross domain applications as well as vertical testing to counter specific threats at regional and national levels."

EPIC: Emergency Response Planning Capabilities as new H2020 application case includes followed as description: "EPIC is a holistic EU emergency response solution aimed at achieving a more efficient civil protection capability through the use of a scenario building framework supported by an information and knowledge sharing platform of support services and tools. The EPIC solution brings together processes, technologies, best practice and a concept of operations (CONOPS) re-enforcing and further developing the existing Civil Protection (CP) ecosystem between first responders, industry, research and administration. Through this ecosystem using the EPIC solution, innovations, better services, and improved cooperation between Member States and international operators will positively influence the operational efficiency in every day CP missions across Europe. The EPIC solution is aimed at multiple categories of end-users ranging from the Civil Protection Mechanism (CPM), European Emergency Response Capacity (EERC), and the Emergency Response Coordination Centre (ERCC), through to national CP agencies and tactical and operational response teams."

III. Results and Discussion

The analysis of study addressed to the data of comprehensive security projects (n=3) and new applications (n=2) in H2020 and data collection of #WINLandFI strategic research project (n=62)

stakeholders from energy, water & food sectors of Finland. The focus of analysis was in aspects of resilience and learning in unexpected shifts.

Study exposed that, energy, water & food critical systems in Finland are increasingly vulnerable to global threats, because Finland is one the most open societies in a word. Finland is continued and increasingly networked than ever before, then the action and systems are addressed by multiple new threats and malfunctions, including those posed by influences of over borders, e.g., terrorism, social exclusion, security of national energy, food & water supply relations and climate change as the sources of threats to Finnish comprehensive security.

In overall, study revealed that the resilience related design cycles and related learning in higher education (conclusion of design cycles is described in Fig.1) can be advanced by relevant elements in dynamics of social and ecological systems, such as: 1) user-citizen experience; 2) understanding of meaning by more systemic reasoning; 3) usability and modularity of artifacts; 4) willing to use methods and systems; 5) action competence; 6) co-creativity and trust building; 7) development of collective as well as co-creative policy development; and 8) sustainable high-value and high-quality higher education in critical systems domain.

According the data of study, user-centered (citizen-centred) aspects and user-system interactions are imperative for the success of the design and realization of decision systems, and thus living-based design is necessary to take more into account in the design research process models and development of resilience and accommodation of unexpected shifts, trust building in relations, communication, and management interactions regionally and over national borders and disciplinary silos (see the aspects of knowledge transitions in the part of scope-mind-action in Fig.1).

Study connected, that living in the domain of unexpected (as rest of live) is like a series of activities in where thinking, resilience and co-creativity can produce novel solutions for surviving and adaption. Then, related resilience design cycles and processes would be more transited into live and living-centered and addressed to rest of life and its unexpected dimensions, it is noteworthy, that thinking itself and co-creativity as nonlinear (cyclic) units in Fig.1 are an imperative entities in a resilience design cycles and process.

It is significant to integrate the user and citizen experience and design research, trust building, and co-creativity aspects into the decision-policy-making process as early and co-creative way as possible; it is also vital to train users and citizens for achievement of action competence to use the system, so that the system's design-development-dissemination continuums and resilience features can be realized in a novel and resilience alignment way as with effective high-value impacts as possible.

In this context, the description of the term "resilience" related understanding can be encompassed based on how much stress or force the energy, water & food activity or critical system can withstand without breaking or permanently altering its shape under stress, how much it can make "elastic curves" under stress and how fast it returns to its original as designed shape after the stress or force is relieved. Outcome curves and realizations are different that designed curves and specifications (see action-relevant-global aspects in Fig.1).

The study revealed that resilience in energy, water or food system or related action were addressed to a capability to resist and adapt according to external forces, shocks, and disturbances (trying to keep aspects of robustness) and it can quickly return to its normal or near (above or under) designed state (aspects of adaptiveness) and go on as designed (aspects of persistence and continuity management).

According this study, aspects of "robustness" and "resilience" are strong related properties in energy, water & food critical systems. Robutness represents here the degree to which a system or activities withstand without performance or activity level decreasing under designed level. This strains the term "unexpected" because "the concept of robustness" includes already preparation to withstand and against aspects of unexpected, such as in cluster configurations; achieved understanding in this study is that resilience is needed if robustness configuration is not robust enough, such as against regional-national disasters (see mind-action-relevant in Fig.1).

Study exposed that resilience in energy, water & food critical systems were practically addresses to

the capability and action competence learning to maintain subscribed functions, even in the event of a disruption and thus continue to operate within the parameters of what could be considered such as designed situation, normal functioning or operation as usual (see the "action competence scale" in Fig.1).

Analysis revealed also that the term "regional-national resilience" was understood here as according to capability that actors, stakeholders and citizen can withstand and recover from shocks, such as a deaths, loss of a job, natural disaster such as an earthquake or flood; including human, informational, technological, medical and material availability, recovery processes and location on demand if needed. In this view, three common founding was 1) the importance of the roles of cyber security; 2) aspects of higher education functions for sustain competence building and maintenance; and 3) avoiding the migration of talented peoples from Finland to more economically advanced, attractive and richer countries and regions.

Research data included resonance with aspects of the action competence (Fig.1) as followed threshold levels: 1) meaning of action design, reasoning of response, and co-creation of action competence for unexpected; 2) usability, the system and action design can be used and organized for unexpected; 3) preparation activity for unexpected, such as actors, users and citizen are willing to use the system, motivation and reasoning for action such as response, a sense and purpose of response and action are understood and committed; 4) coherence, management of activities, systems and interactions are ready for response; 5) competence is achieved, novel education and training for action as response and for using the system for unexpected; and 6) resilience settings for accommodation of unexpected shifts in action if robustness configurations are not robust enough.

In the views of comprehensive security of energy, water & food higher education, one advice for future is that creativity and innovative learning scopes would be more systematically designed and adopted for research, development and innovation activities in the context of current knowledge, competence, capability and performance as well as action competence settings (Fig.1). Hence, the creativity and innovation approach steers R&D process planning towards increasingly participatory, dynamic and creative forums of new competence production and, it will enhance learning and resilience usability and recognition (Fig.1).

One revised view of this study addresses to the improved understanding of the term "scope" (Fig.1) or "learning scope" which can be useful for resilience by "elastic nature" and for focusing on resilient learning paths and creativity, especially in perspective of students integration to R&D and learning by global-national unexpected shifts and targets. The integrative action and learning view involved followed: 1)the term "scope" was useful to a satisfaction, atmosphere, mutualtrust, confidence and "learning to like or dislike" in a learning space where a student takes "ascope" and ,makes his own personal activitycreation, improvements, and validation into the selected or shared learning target as "shared scope" and for learning of action competence; 2) a "scope" was not loaded by a teacher's knowledge in the beginning of studies, so scope-related knowledge can be composed openly by a student's viewpoints, interests, aspiration, and motivation, not only teacher's, problem-based or training viewpoints; 3) the term "learning scope" refers to a mental or resilient physical target or subject matter that something deals with in learning; creativity alignments and resilience; 4) the aim of using the "elastic scopes" in the beginning of R&D related learning process as frame to support a student's ning, and the imagination and creativity in lear assumption was that the understanding of resilience and"elastic scope" would generate and maintain themotivation and spirit for learning, balancing the judgments and potentials of objectives, goals, and targets; e.g., the tuning of a cognitive load in a lifetime of studies would be balanced by students and teachers interactions by "scopes"; 5) the "scope" addresses the idea that, between two people, thereis third dimension as a "scope", e.g., a ,oolmodel, artifact, t ,conceptor mental or social factorwith which students may share, transfer, adapt and build knowledge; it communicates, relates, activates, and motivates their personal or team learning spirit and confidence; and 6) the "scope" increases resilience, "everything does not go as designed" and elasticity in solution based learning approach, both can be advanced in the reactive and proactive sense.

Study revealed that partnership between higher education and energy, water & food stakeholders is based on mutual respect and trust, which is clearly as the base prerequisite for communities that work

creatively in order to achieve shared demanding goals, such as targets of work settings in research projects. In this sense, an "enriching research consortium" can rise up to innovation and creativity, which can increase in an atmosphere and spirit of freedom. Researchers and innovators should have the freedom to work creatively towards the vision, but, on the other hand, this freedom would be achieved through responsibility, activity, mutual trust, confidence and deliverables as results. The Unit of Analysis (UoA) can be such as "a sample of evidence" (action competence in Fig.1).

Social and cultural realities and cultural path-dependency have an impact on the communal creation of knowledge, and cooperation and interaction expertise are, therefore, highly imperative in the learning process (aspects of relevant-global in Fig.1). It can even be comprised that the individuals or one actor alone cannot by themselves even attain close to the deliverables and results which are achieved by a network-based community that works and learn collaboratively, and which establishes a common interest, objective, dignity and commitments.

IV. Conclusion

It can be concluded in this study, that the dynamics of technological, social and ecological systems have similarities in the domain of resilience design in energy, water or food systems. Here, diversity, modularity and harmonization contribute clearly the resilience of natural and constructed systems and resilience design itself. The future #WINLandFI research can be furthered with a flourishing community as realization which can be one prominent setting and form of life where people from different backgrounds and attitudes feel confidence and mutual respect. For example, decentralized group of houses or villages with its own water, energy & food sources may not be very efficient, but however, one noteworthy inference of study is that these regional configurations and path-dependences can be more resilient that centralized systems in critical and systemic viewpoints. Here, the term "flourishing" addresses to living within an optimal range of human functioning, one that connotes goodness, generativity, growth and resilience.

Resilience, in this flourishing context, would include that a region, nation or community strives (scope-mind-action in Fig.1) for greater self-surviving in energy, water & food resources and other essential systems as a buffer and "enriching community" against more global sustainability related threats and disasters such as climate change, rising scarcity costs, and global strife. This view is based on saving and conservation rather than glory, credit and waste. The term "resilient human" was understood here related to ability of emotions regulation, and that human are capable of seeing failure as a form of useful feedback (knowledge transitions and action competence in Fig.1). After a misfortune, these "resilient people" are able to change course (scope and mind in Fig.1) and go on (action in Fig.1) more sustainable manner which is described as the term "relevant" (in Fig.1).

Then the methodological contribution of study can be remarked and discussed for the resilience and "elastic nature" design and for future studies in the #WINLandFI. How can we improve resilience? Which are the key preparedness and safeguarding mechanisms in energy, water & food security in Finland and in EU? The proposal for design-realization cycles and process of action competence generation and accommodation of unexpected shifts is concluded to Fig.1.

Fig.1 describes knowledge transitions, co-creative process and management functions for design-realization process of action competence generation and accommodation of unexpected shifts. Here, the term "scope" is addressed for target recognition, such as: thinking, ideas, issues, and task orientation. The term "mind" includes aspects of perceptions as judgements, strategies and mechanisms, such as management in the way of pedagogic leader, R&D consortiums leaders, regional planning groups and co-creative designing. The term "action", related to such as led action, activities of strategy for cascading effects prevention and alignment of robustness and resilience aspect, response activities according to concept of operation and led R&D activities. The term "relevant" is related to outcomes, such as practical results, response activities, new services, realized method, artifacts as well as emergent innovations, collaborative capability, action competencies, and new or improved knowledge; then, proofing events and feedback can make continuums for knowledge transition process in forms of preventative knowledge and its dissemination.

The effects of these knowledge transitions (in Fig.1), such as new or improved artifacts, new

ISSN: 2476-0862 **Voumel. 1, Issue. 2**

knowledge or method, can be proved inside action competence training or in living labs (transition to live) in regional-national-international context (as globalization in Fig.1); this can also be formed as targets in the direction of global forum for learning by protecting and preventing upcoming as glocalization-based crisis. Here, regardless global distribution aims of artifacts and knowledge dissemination the path-dependency and cultural-dependency connections are increasing towards globalization which relative straight implicates needs of an additional research and recognition of system's and cultural transformations as well as common information sharing and crisis management observatory networks. The term "glocalization" addresses here to the approach of "think globally act locally", such as understanding of emergent shared scopes of comprehensive security themes around the world.

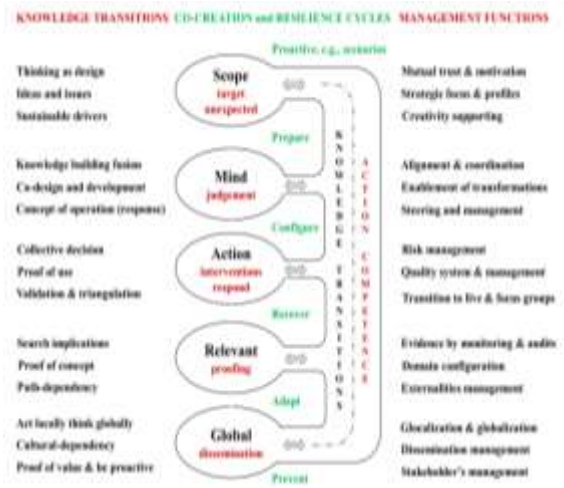

Fig. 1 Co-creation cycles and process of resilience with knowledge transitions and management-leadership functions

The described management functions (in Fig.1) can be useful for qualitative and structural change in action competence viewpoints: 1) mind sets; 2) interactions; 3) activities; and 4) knowledge structures. In light of the knowledge transitions, it would be stated that a type of shared knowledge, action and activity changes between described management functions (in Fig.1) which are acting as initiators and perquisites for achievement of larger collective integration and towards interest of global crisis management community.

It is noteworthy, that managerial functions can be addressed towards the repositioning of knowledge production and development of action competence and artifacts through the creation of study units within integration of regional-national development, R&D and knowledge transitions. The change in integration of study units was taking place due to: 1) cooperation in value networks; 2) "co-created" or "emergent" innovations; 3) offerings of lead innovations; and 4) especially the integration of regional-national development that has a high-value impact on social and global improvements and knowledge diffusion.

In perspective of realization of comprehensive security related study units in higher education: the focus was in: 1) implementation of new forms of study units; 2) realization of models and relations of integration of R&D and higher education functions; and 3) facilitation of new methods of R&D collaboration, which were created to supply for creations of "emergent" innovations in services, safety, technology, economy and society.

The latest remark of study is that the new undertakings and events were more service related, such as artifact-based and living-based services than linear manufacturing based, and value "co-design" and "co-creation" would be based more on new knowledge and attractive professional growth. This relatively new perspective regarding the emerging "knowledge economy" refers to a focus on interactions between individuals as units of analysis (UoA) in future research. In this case, not only are institutions, countries, regions, companies and universities adopting a global perspective, but also individuals and especially students in higher education.

Currently in the #WINLandFI and MARISA, there are ongoing discussions related followed: resilience and stability of ecological systems [12]; community and mechanism of critical and resilient digital services [1]; resilience in globalization and transitional pathways [27]; genealogies of resilience [28]; from systems ecology to the political economy of crisis adaptation and management; resilient systems [16]; and resilience engineering [4]. In this study, the term "resilience" was investigated towards knowledge, competence and capacity to build and improve critical infrastructure

protection in energy, water & food systems that can absorb and accommodate future events and mechanisms in whatever unexpected frame and form them may take. The study was addressed to the investigation of the term "resilience" in viewpoints of knowledge-competence-capability co-creation and furthered recognition of characteristics of unawareness: as transition from the statements that "future events are expected" to that "they will be unexpected". Contribution of study focused to understanding of the term "resilience", description of resilience aspects and factors of resilience and description of dimensions of the resilience cycle in Finnish energy, water & food systems and activities as described in Fig.1.

Based on this study, as continuum, a plan of future studies is addressed to development of resilience metric, resilience index and resilience readiness levels for interconnections and management of accommodation of the expected-unexpected shift in the critical systems, decision making, dynamics of social and ecological systems, resilience engineering and operative performance viewpoints according to predict and prepare the future of the energy, water & food systems and mutual communication and relations in Finland and EU.

Study implicated that a holistic and multi-disciplinary systems thinking can be focused to analyse and manage the causal complexity and sustainability of the world in where we live. An ecosocial approach to well-being addresses on post-material values as they are more loosely coupled with resource consumption and can promote psychological well-being and nurturing social harmony and cohesion [29].

In addition, despite continual progress in the systemic risk management of cyber domain, it is clear that anticipation and prevention of all possible type of attacks and malfunctions are not achievable for current or future cyber infrastructures. The future research plan addresses also to the investigation of a cyber security paradigm, adaptive systems and sense of resilience in a domain of energy food and water related critical information infrastructures and mechanisms.

One indent of future continuum of #WINLandFI is to investigate the aspects of interactions of policy development, administrative operability and resilience in the institutional comprehensive security environment which is related to a progress of comprehensive security for collective policy development and national governance-decision system. This focus is on the interactions, resilience, manners of learning, progress of security environment, and novel analysis of emerging security and safety threats.

In the view of dissemination of results and external validity: the terms "resilience", "continuity", "risk management" and "live-centered" has recently been taken up increasingly in discourses of financial, urban, regional security, critical systems and information systems as to a general agreement about the necessity of adaptation through unexpected crisis, accommodation of unexpected shifts, realization of resilience and crisis management observatory and response in EU.

ACKNOWLEDGEMENTS

#WINLandFI project is funded by the Strategic Research Council (SRC) at the Academy of Finland (AKA/5/02.04.10/2015). ABC4EU (Project ID: 312797) and EU_CISE_2020 (Project ID: 608385) are funded under the FP7-SECURITY PROGRAMME. The completed PERSEUS project (GA 287600) was funded under the 7th Framework Programme of the European Commission.

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