Thematic Curriculum to the Master and Degree Programme of Information System

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***Abstract* —** There are three main statutory tasks for Finnish universities of applied sciences, these are: education, research and development, and regional development. An objective for Laurea University of Applied Sciences is to design, integrate and implement these three statutory tasks into everyday action using design research and action research. In the early phase of Integrative Action and "inter-operative learning", it soon became evident that the traditional curriculum process was not optimally supportive of the new operating model used between 2002 and 2004. The first objective was to design and implement the curriculum using Integrative Action which continuously integrates the three statutory tasks of the universities of the applied sciences. The result of the first phase of the designing and implementation work was a competence-based core curriculum developed from 2004-2006 and implemented from 2006-2008. This study addresses the second design research cycle for describing and designing as well as implementing a revised instance of a competence-based core curriculum, namely; the thematic curriculum for the Degree Programme of Business Information Technology (BIT) 2008-2009 and Master of Business Administration studies in 2010.

***Keywords* —** action research, design research, learning theory, methodology, networked expertise, quality management.

I. Introduction

THEMATIC as an adjective means having or relating to subjects or a particular subject and as a noun "*thematics*" is treated as a body of topics for study or discussion [40]. In this actualization the term "*thematic"* is related to the creativity and competences of the co-creation of innovations. Its aim is to join and compose the promising creations, artifacts or "objects of leading innovations" [35] to regional or societal innovation systems and value networks. Hence: a creation here means "anything created" that has been created by human beings [40]. Three examples of creations are: service, practices and events. The term (socio-technological) artifact means a creation that includes a technology such as animation, phone or information system etc.

In this study: the term "thematic" underlines: ability; interoperability; agility; trust; and value in regional collaboration (in the third task). In addition, thematic region, thematic living-labs, current research and development activities, thematic curriculum and thematic actualizations of study courses have the same scopes, corresponding interesting research areas and problems. This means that learning is related to a body of dynamic and agile scopes or themes for study that is important for a region, society and innovation system. The point of view is that interesting research areas, the theme of research agendas or the focus area of clusters within an innovation system interact with the generation of competences while an individual is studying. A thematic curriculum proposes and defines thematic competences.

A designed thematic curriculum is for students who are interested in the development and use of their own creativity and have the motivation to learn information systems, networks, security topics or information system related services in a collaborative and inter-operative way. It means learning through the applied methods generated for the three metaphors of learning [21] within the thematic network of living labs in learning environments.

The reasons for the research interest and themes for this study have developed because: We live in a world of globalization; work in global networks; conduct research and development requiring national and international innovation systems; have global and local needs for clusters; require entrepreneurship and globalization; develop agile objectives for international co-operation; use agents for representing and designing solutions in different cultures; and support transformations, creativity and innovations. In this context: the term "authentic" means that all transactions and implementations of learning situations are simultaneously connected to real development cases within the world of work and have a definite value (added value or lost value) [23].

In this study the research question is: What kind of competence-based core curriculum produces thematic competences and knowledge? What type of action bridges knowledge and competence in the study of thematic networks, thematic cities and living labs? What should competitive research, last mile research and living lab research be in the actualization of the thematic curriculum discussed? And what methods for evaluation and complexity management should be considered?

II. Formulation of Curriculum

A. Extensive Curriculum Reform

The development's objectives of the European Higher Education Area and research on curricula carried out by Finnish higher education institutions led to the adoption of a

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competence-based curriculum idea and model for 2003-2006.

The model's focus is on broader competences needed in the workplace of the future [12]. In the late 1990s, Laurea chose, as its strategic approach, the integration of education, research and development, and regional development as well as a concept of learning and knowledge in line with its strategic intent. This was recorded in Laurea's pedagogical strategy in 2002 and revised in 2007.

According to the strategy, learning at Laurea takes place through education, research and development. The principle of triple task integration, approved as Laurea's strategy, was turned into the idea of "learning in projects" in the 1990s. While implementing the pedagogical strategy, Laurea's practical developers refined this principle into the Learning by Developing (LbD) model [5] and [27] the base of theory is found in [7]. Learning by Developing combines two of the major orientations of universities of applied sciences: professional education (learning) and research-oriented higher education (developing) [5] and [12].

An extensive curriculum reform was concluded in 2006, which led to the creation and implementation of a shared competence-based core curriculum for Laurea from 2006-2008.

During the reform, a core curriculum model was created, which produces service innovations and competence, and safeguards and facilitates the fulfillment of strategies. All degree courses' curriculums were revised according to this jointly created model. The competence-based curriculum forms an innovative statement on Laurea's behalf, as well as a contribution to the metropolitan area's innovation environment and the development of the European Higher Education Area, in which it allows research and development to be integrated into education [12] and [5].

With the competence-based core curriculum, Laurea was defined as a university of applied sciences specializing in service innovations, whose specific task is to foster the competitiveness and regional development of the Helsinki area.

A significant crystallization for Laurea's pedagogical thinking was provided by the investigative and exploratory learning model proposed by [7] and [5]. This means learning is seen from three perspectives: knowledge acquisition that is also seen as the information gathering metaphor, the participation metaphor and the knowledge creation metaphor [21]. The exploratory and investigative learning approach has helped to create an understanding of a learner's thought and learning processes in R&D projects, and to create work methods and practices by which R&D skills can be developed in specially formed integrative learning environments and in integrative action [5] and [24].

The acquisition metaphor (1) of learning is a view of learning that emphasizes learning as a process of acquiring a desired piece of knowledge or knowledge structure. Knowledge is understood as belonging to an individual mind. The participation metaphor (2) of learning is a view of learning that emphasizes the process of participating in various social practices and shared, learning activities. The knowledge-creation metaphor (3) of learning is a view of learning that emphasizes learning as analogous to the processes of innovative inquiry in which an individual's initiative is embedded in productive social and institutional practices [8]. The focus is on the process of advancing knowledge, transforming social practices and developing expertise [21]. The perspectives are illustrated in Table 1.

TABLE I.
THREE PILLARS OF INTEGRATIVE ACTION IN LEARNING

Three Perspectives of Learning		
Knowledge Acquisition	***Participation***	***Knowledge Creation***
knowledge transfer	knowledge sharing	new knowledge creation
process within an individual's mind	social activities and practices as bases for interaction	new knowledge objects and activities are collaboratively created
based on constructivism	based on socio-constructivism	freedom of methods and support for creativity
process based	progressive	creative
instructive or co-instructive	co-operative inter-operative	co-constructive
Reactive	active	proactive
Processing Nature	Knowledge Sharing Community	Knowledge and Innovation Community

B. *Formulation of Curriculum models*

The consideration of curriculum is based on five higher education curriculum models, defined in [13] and illustrated in Table 2.

TABLE II.
FORMULATION OF CURRICULUM MODELS

Curriculum Models of Higher Education	
1	The study-unit-based curriculum, in which studies leading to a degree are listed by subject as courses. The internal classification of each subject area is used as the principle for grouping courses together.
2	The module model, in which study units are grouped into compulsory or optional modules. Each module forms a cohesive competence area, which must be completed as a whole.
3	The competence-based core curriculum, in which modules are not defined as single study units or competence areas, but as core competence modules consisting of various subjects and progression throughout the degree.
4	The project-based curriculum, in which generic competences are implemented into functional work entities - projects - for which students achieve concrete outcomes.
5	The block model, in which the studies for each semester form a fixed block of studies.

The outcome of the analysis of these models was the 3) competence-based core curriculum, which provides a solution to the practical integrative implementation [12]. The curriculum process was a challenge for Laurea as it was a dynamic and changeable process typical of an innovative

environment that could not be completely controlled, planned or formalized in advance of 2004-2006.

III. Environment Description

A. Laurea University of Applied Sciences

Laurea is the fourth largest university of applied sciences in Finland, and operates in the Greater Helsinki Region at seven units. Laurea employs approximately 500 personnel and has app. 8 000 students, of which app. 1 200 study in the adult education programmes. Laurea produces new competences in the field of service innovations and carries out professionally orientated education, regional development and R&D activities according to the LbD operational model.

The Integrative Action Model and Processes [5] and [25] are developed within the LbD culture and framework by using the Onion model's [5] actors and variables. The integrative work includes innovative and cyclic activities as well as linear development work. Dimensions of LbD [27] and principles are related and supported in the Integrative Action and Process Model [26].

B. Learning by Developing

Learning by Developing is a pedagogical and communal approach in which learning is linked to applied research and development projects and culture [5] and [27]. It refers to learning expertise arising from social interaction, knowledge and competence sharing, researching and problem solving regarding collective objects [5].

The model emphasizes cooperation and creating a "learning and developing" culture and makes it possible to include and use various scientific perspectives and methods of learning, researching and developing in operation and action.

The model represents a management and work philosophy and culture based on the production of shared competence and creativity. In the current developing culture there are genuine R&D tasks; there are no ready-made solutions.

The learning process starts by identifying the initial scope or strategic research object, analyzing and describing it, and selecting appropriate work methods. The model is not applicable for solving problems set in advance by someone else. Nor does it support the commissioned project principle, because the creative starting points are determined by the cooperating participants of the value network, often together with professional developers from research and development organizations. The creative objectives of the work are usually not possible to define clearly in advance, but are specified throughout the development process. The process requires critical thinking, strategies and skills for justifying solutions and evaluating evidence. Work consists of a continuously developing process, focusing on research, development and generating new competences [5] and [25].

LbD is illustrated as a dimensional model. The aim is to support the construction of creativity and innovations in which learning does not follow any fixed process model [4]. Instead the courses provide a supportive framework for students and bring out the dimensions of a programme in complementary ways. LbD also focuses on creating a learning culture, but not the formalized learning process [4].

The integrative dimensions of LbD and its three perspectives of learning are: knowledge acquisition, participation and knowledge creation. The derivative dimensions of learning are the individual's learning, the community's learning and building new know-how. The impacts of LbD are support for creativity, partnership in action, a basis in authenticity, the use of an experimental nature and research with international cooperation. The dimensions of LbD are illustrated in Fig. 1.

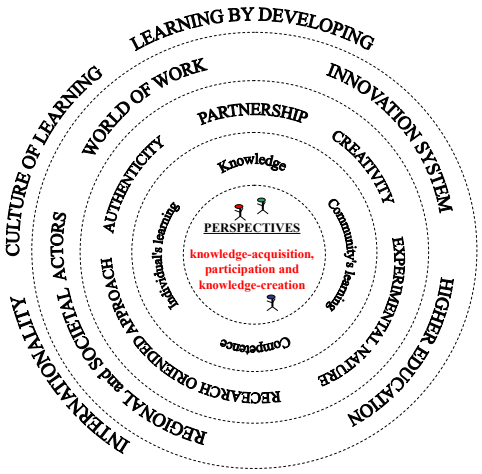

Fig. 1 The "dimensional model" supports the construction of creativity and innovations, where learning does not follow any fixed process model. However, the supportive framework of the courses brings out the dimensions in complementary ways. Thus the LbD model is a dimensional model of culture rather than a categorical one.

C. Onion model

The Onion - or cooperation model - is proposed in [5] for the integration of LbD and regional development work as well as international cooperation and globalization. The Onion model can be referred to as a first evolutional version (2002) of the Integrative Action and Process Model from the perspective of actors and variables.

Laurea's operations are steered by its strategic intent, which is to be a fully authorized and international university of applied sciences participating in innovation activities. In terms of regional and global development, "fully authorized" refers to the carrying out of applied research and development work serving regional development in accordance with the quality criteria set for the European Higher Education Area.

Laurea is an operator in regional development, and the regional development task is linked to the whole education task. In terms of international relations, Laurea enriches its area of operation with international top-level expertise and promotes its internationalization. For learners, the Onion model means increased opportunities and the inclusion of increased international interaction in studies. Laurea's learners are equal participants in integrative learning environment

development groups, which also include lecturers, partners and researchers. Fig. 2 illustrates the Onion Model (2009):

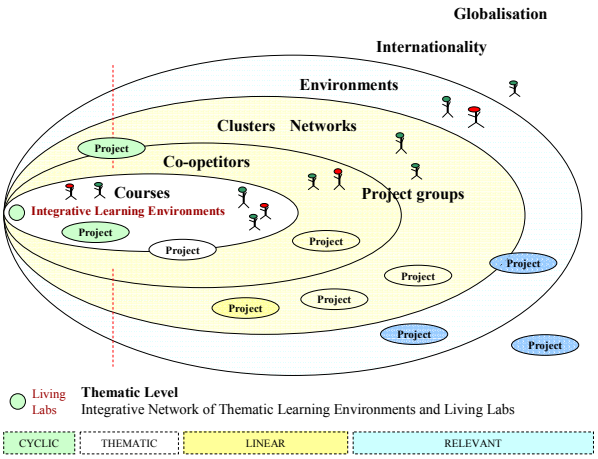

Fig. 2 the Onion model extends traditional and instructional learning to a culture of Learning by Developing. It is a construction of the paradigm shift from reactive education methods to a culture of proactive knowledge creation through research. Integrative Action links Living Labs and institutional integrative learning environments on a thematic level.

The four elements of Integrative Action (IA) are also presented in Fig.2, these elements are proposed in [24] and are: 1) Cyclic, which supports creativity and innovation. This element emphasizes the importance of creations: (anything created) e.g. the mental creation of an intangible idea; the physical creation of something tangible; a social creation, such as spirit or trust in the interaction of a value network. 2) Thematic, which is used to support the structure of the co-creation of lead innovation by using thematic scopes to integrate action and cooperation within thematic regions, thematic cities, thematic living labs, ongoing R&D, thematic curriculum, courses, and evaluations. 3) Linear, which supports the implementation of research, as well as development and action processes and work systems. 4) Relevant, which supports validity and scientific rigorousness, and ensures that the quality and action produced are relevant. This element includes a quality management system (QMS), which has quality measures and qualitative documents on actualizations. In the relevant element it is underlined that the QMS measures [38], [37] and [34] utility and liberates resources for cyclic-thematic-linear action but does not prevent LbD dimensions and the freedom of methods in innovations.

In the Onion model; the network of Integrative Action creates an enriching community of knowledge and practice. Innovative researchers emphasize the importance of people's spirit and flow in innovative work. Innovations arise from individuals and their interaction. An "enriching community" means the interactive relationships that link innovative individuals together and to their region. In terms of innovation, the applied Onion model's implementation strengthens the innovation capacity of its area of operation and creates favorable conditions for the birth of innovations.

D. Results and Impacts as Thematic Influence Onion

The quality process liberates "entity and utility" in IA, which means that quality is emphasized in results, impacts and "samples of evidence" but does not formalize innovations and inventions in advance or stop them from occurring. Quality in IA is then seen from the perspective of improvements and confirmation and occurs in the self governance of an institution. It exists as a systematic way to promote institutions as learning organizations through confirmation as well as through comparison leading to improvements in action and processes. If quality ensures that each linear task in the process and actualization succeeds first time, this assumption liberates resources for innovation activities. The benefits of affects and influences can be categorized into causal and mutual categories, similar to the Onion Model in [4], illustrated in Fig.3.

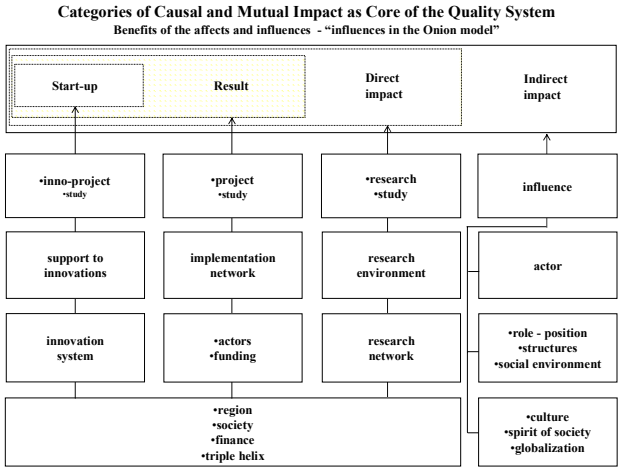

Fig. 3 shows that impacts and influences are causal and mutual. It also reveals that innovative results are possible to evaluate. It demonstrates that formalizing and generating ideas and innovations in advance (e.g. hi-tech innovations) require research, financial support and "thematic decisions" based on triple helix cooperation (industry-academia-government-services).

The influences occur as results, direct impacts or indirect impacts: all of which underline the importance of last mile research, living lab research and the research of impacts and influences in IA. The "impact onion" is seen as the core of the QMS, so the unit of quality and unit of analysis should be practical evidence, samples of evidence or evidence in quality management.

The most important result of quality management is that the personnel, participants and students in a learning organisation see the quality phases (plan-do-check/learn-act) as "liberating entities for linear activities" and are committed to using them. In other words, it is important that teachers and actors are committed to the process guidelines of measuring, analysis and developments as well as the monitoring of processes. And that those activities are based on strategies and produce impacts and results (evidence) that can be analyzed and

verified. It is also crucial that practices are able to use the data that is summarized into the quality system and that the data are meaningful to the development work, so as to ensure their influence and ensure that improvement can occur accordingly.

E. Thematic Nature of Integrative action

The integrative action process is a logic model of action and used in the best practices of exploratory, creative learning and LbD culture [25]. In this thematic curriculum the objective is to implement and integrate the three statutory tasks in the context of services, service design, security and information and communication technologies by allowing creativity and innovation in thematic networks: This means coaching activities and competences with participants (students, teachers, co-operators and manager) within innovation systems. The integrative action and process model is the creation of a linear development framework for cyclic innovation activities with a research and quality "evidence or sample of evidence" perspective; the model itself is a liberation and supporting process for innovative activities, rather than a process for automatic innovation generation.

The integrative action model is used as a part of a larger innovation system and value network (network of research missions). In the thematic curriculum the integrative action is presented within the perspective of learning in a co-creative and thematic learning environment, that integrates a value/trust network, innovation systems, the goal of a mission and a global network together as a quartet in a research mission that is illustrated in Fig.4.

RESEARCH MISSION IN INTEGRATIVE ACTION

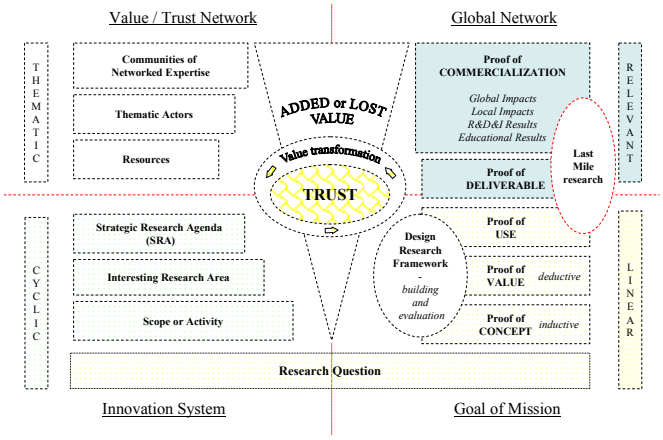

Fig. 4 in the Quartet for Missions (value-innovation system-goal-global impacts) in Integrative Action, the term value relates to being important or beneficial. It is actualized in the perspectives of added or lost value and both possibilities are present in a value network. LbD and Integrative Action places value networks in cyclic and thematic roles to promote student retention, engagement and achievement e.g. identity, trust; motivation; competence; equality; intensity of learning; and partnership.

In the Quartet for Missions, the nature of the Integrative Action process is clearly a proactive, active and reactive philosophy that is based on shared learning processes in the value networks of the innovation system. In addition, learning is based on services, innovations, design and development.

A participant's interests and motivation is based on value, trust and agility, the value gained from a network and the value given to a cooperative network. The importance of value transformations and support for agility are underlined in processes. Thus, competences are made more relevant to work; this positively influences students' employment and networking possibilities.

IV. THEMATIC COMPETENCES

A. Generation of Competences

The thematic competences structure of the thematic curriculum is based on the presented three statutory tasks. It covers: 1) general competences that fulfill the competence requirements of the labour markets, region and society (important in culture and globalization); 2) competences of development work and business within innovation system, clusters and workplaces; 3) scientific and theory based competences (needed in research for building-up, developing and improving of working life); and 4) competences of quality management and confirmation (able to recognize units of quality and improve utility). The aim of the programme is to provide and develop adult education in order to 5) maintain and improve workplace competences and build competences and methods for development in the world of work. The "competence generation machine" is presented in Fig. 5.

Generation of Thematic Competences

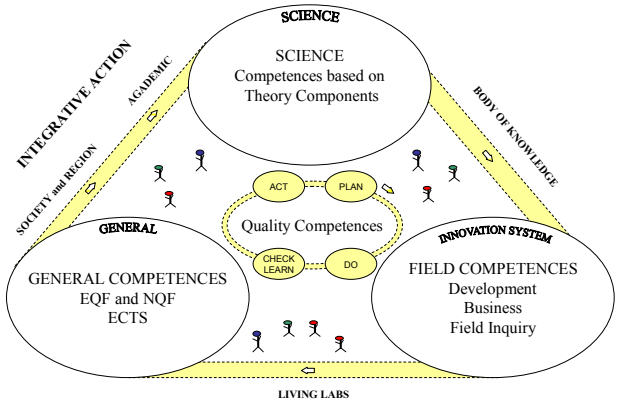

Fig. 5 thematic inter-operative learning builds and improves the competences of a learner by joining competences together in inter-operative learning. The perspectives of competence generation are generated by theory components, general competences, field competences produced in relevant quality practice (evidence).

In completing their tasks, universities of applied sciences collaborate with industries' representatives and employers particularly in their own region, and also with Finnish and foreign higher education institutions and other educational establishments. Research conducted by students, based on the demands for the development of the employment market and its needs in a region can be then used in the innovation eco system.

B. *Learning is Based on Research*

Education is based on research in a thematic curriculum [32]. The underlined research methods in the information systems field are design research [9], [10], [11], [16], [17] and [29] and action research [1], [2], [3], [14], [18] and [28] with a behavioral science framework [8] and [4]. This framework is extended and includes: Design science that produces the knowledge to implement an innovation [16] and [9]; case studies that are made to gain a detailed understanding of interesting scopes and innovations [31]; a proactive approach is used for influencing the future [30] and a service design is an activity aimed at materializing the non-material dimensions of services [15] and in information systems [39] and [11]. The validity, relevance and the rigorousness of research work are implemented in the linear and relevant elements of the integrative action process and our natural research scope also synergizes the behavioural, psychological, educational and sociological sciences [8] and [7].

In this thematic curriculum the two perspectives of research methods are emphasized for its competence base: design research and action research, these two perspectives complement the use of behavioral sciences at Laurea, explained in the general competences structure of Laurea [12] and [36].

Design research consists of activities concerned with the construction and evaluation of technology artifacts to meet organizational or thematic needs as well as the development of their associated theories. Behavioral sciences are concerned with theories that explain human or organizational behavior (evolutional methods), while design research is concerned with creating new and innovative artifacts [9]. Action research is sustainable and embedded into the action and learning culture [22] for producing knowledge in order to guide the practice of the modification of action [1], [2] and [23]. The scientific theory components [6] of competences are illustrated in Fig. 6.

C. *Research-based Competences*

Research-based competences in the thematic curriculum:

- use scientific research (applied research) as a base for co-creative work and action, the two research methods emphasize design and action;

Theory Components of Information Systems Design Theory	Design Research Components for Competences	Action Research Components for Competences
Purpose and scope: This design component asks: what is the system for?	**Design as an artifact:** design research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.	Produces knowledge to guide the **practice of modifications of action**.
Constructs: a physical phenomena or abstract theoretical terms.	The object of the design research is to **develop technology-based solutions** for important and relevant business problems.	**The utility aspect of the future system**; modifies a given reality or develops a new system or action.
Principles of form and function: the principles that define the structure, organization, and functioning of the design product or design method.	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated **via well-executed evaluation plans**.	**Action taking and evaluation**.
Artifact mutability: the mutable nature of artifacts.	**Research Contributions:** Effective design research must provide clear and verifiable contributions in the areas of the design artifact, design foundations and/or design methodologies.	**The implications of the practice and the implications and contributions of the research** in collaboration with researchers and participants in the action system.
Testable propositions: if a system or method that follows certain principles is instantiated then it will work.	**Research Rigor:** design research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.	**Evaluation** of practical and epistemic utility. (scientific knowledge). Rigor and relevance.
Justificatory knowledge: this component provides the justificatory, explanatory knowledge that links goals,, processes, materials and the shape of the design .	**Design as a search process:** the search for an effective artifact requires utilizing the available means to reach desired ends while satisfying laws in the problem environment. Looked at from the perspective of the problem environment.	Action is the participatory perspective used here: The **researcher intervenes** in the problem setting.
Principles of implementation: the implementation in practice of an abstract, generic design method or development approach; the shape of the design and the organization of the design process(es) are the focus.	**Communication of Research:** Design research must be presented effectively both to technology-oriented as well as management-oriented audiences.	Knowledge is generated, used, tested and modified in the course of the action research project. Looked at from the knowledge sharing perspective.
Expository instantiation: whether an instantiation can be a component of a theory. Theory is an abstract expression of ideas about phenomena in the physical world.		

Fig. 6 the competences that are generated by the research component [6] are seen as extending structure to the ECTS competences [36]. In this curriculum the two perspectives of research methods are emphasized for competences: design and action research. These two perspectives complement behavioral sciences in which competences address the evolution type of development and research e.g. last mile research and living lab research: proof of concept; proof of value; proof of use; proof of deliverables and proof of commercialization.

- are able to build, evaluate and develop ICT intensive technology-based solutions (e.g. services, artifacts, constructs, intentions, methods, models etc.);
- analyze, evaluate, and develop action and operations in this framework;
- are able to collaborate and communicate both in technology and management oriented forums;
- utilize research documentation and information from the scientific communities, knowledge repositories and institutions that develop knowledge structures.

D. Development and Design Competences

The development and design competences address real scopes or issues (proof of idea and proof of value) as well as research questions or problems that should be conceptualized (proof of concept) and represented in the use of methods and techniques for solutions, which are then constructed. Solutions are built and tested using appropriate criteria and implemented in practice as work systems (proof of use) [20].

Developers typically use a phase model or evolutional model [11] to perform design and development work. In order to clarify models, examples of evolutional model should be prototyped or co-created and developed in a participatory way in a living lab and a example of a phase model should be a waterfall model or a rational unified model (RUP).

The proposition in IA is that design and development work in LbD is similar to learning. The objective of IA is that research, development and design are actualized so that integration works as an inter-operational spine for the research framework of participatory and co-creative research between universities of applied sciences, national clusters and innovation systems, illustrated in Fig. 7.

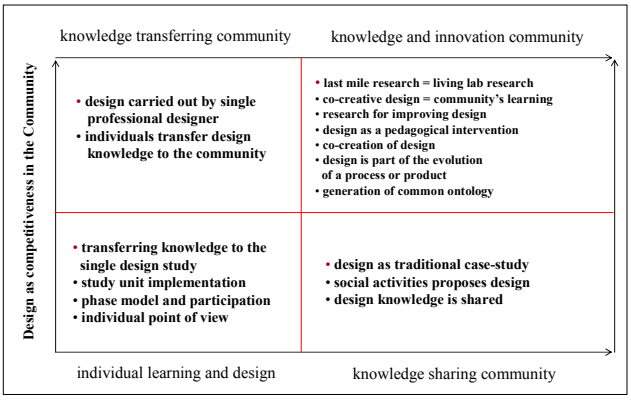

Fig. 7 design is part of LbD. The thematic nature of inter-operative learning and the authentic dimension of LbD transform design and development competences and direct them towards knowledge and innovation communities in which a community's learning includes co-creative socio-constructivism and evolutional development.

Design competences fall within the domain of LbD in a thematic curriculum. This underlines that design is a part or an extension of development work and both perspectives, design and developing, include learning. Some examples of learning-design are: learning by purpose of plan; proof of plan or concept, which demonstrate that the concept learnt is valuable; inter-operative learning by demonstrating, which shows that if design can be demonstrated and accepted in an organization then it can be learnt and it should be able to build and evaluate; learning by observing and participating shows that it is possible to see the competences as instances of socio-constructivism. A development and design competence in the BIT curriculum demonstrates that an individual:

- is able to work as co-creator, developer and designer within information system framework as a whole;
- is able to work on ICT development projects and in the different roles of projects;
- is able to implement and put technological and ICT related social and evolutionary systems into action;
- can work in the processes of information systems: e.g. production, deployment and research;
- is able to use and apply various ICT project planning and management methods;
- can design and utilize data management solutions with information technology;
- is able to specify, design and implement secure software systems, databases, and user interfaces;
- can identify and provide possible risks related to ICT projects;
- can work in a world of modifications and changing.

E. ICT Network's specified Competences

The competences used here show that an individual:

- is able to develop and maintain networked services;
- is able to design, develop and utilize main network components and solutions;
- can take data security issues into account in network and ICT infrastructures;
- is able to search for and utilize network solutions and components;
- can discuss key issues in the field with both technology- and management oriented audiences and perspectives;
- is able to communicate and document in an environment made up of networks.

F. Field acquired Competences

Field acquired competences show an individual:

- is able to apply knowledge and skills in an ICT framework for increasing and sharing competences;
- can work on ICT development projects and on the different roles of projects;
- is able to work in production processes (execution);
- can work in a responsible manner on ICT projects;
- can work in a systematic method and do project work;
- is able to use and apply various ICT project planning and management methods;
- can identify and provide possible risks related to ICT projects;

- can manage pressure and the workload of project work;
- is able to protect organizations from information risks and assess the effects of these risks on operations.

G. Business Competences

Business competence shows an individual:

- is able to deal with customers and utilize technology-based services in business;
- is able to participate in essential business processes and functions in a framework;
- understands applied information security as a co-creative part of an organization's strategy;
- is able to participate in the different role of ICT within an organization e.g. a supportive role in business processes and their development and a co-creation role in developing work;
- is able to develop business processes using ICT and recognize social perspectives;
- can understand the purpose of contracts, offers, licenses, and immaterial rights in the framework.

H. General Competences

The Finnish universities of applied sciences credits are transferred to the ECTS (European Credit Transfer System). The integration and harmonization of European higher education institutions has been steered by the process that was triggered by the Bologna Declaration in 1999 and which aims at making Europe a uniform, attractive and competitive higher education area by 2010. The final report of the transfer project [36] discusses and evaluates the rationale, practical measures and results of the project, as well as its future challenges. This curriculum implements the student-centric and competence-based principles of the ECTS system and the general competences of this thematic curriculum are presented in Appendix A and the actualization in Appendix B.

V. Conclusion

The tasks of the universities of applied sciences described in Finnish law include: further and higher education that corresponds to the demands of working life and its developmental needs [32]. Based on these tasks, universities of applied sciences link closely to working life and cooperate with regional actors.

First: the proposition in this study is that research is implemented to achieve the actualization of studies and the implementation of constructions, so research is done in the context of education and this process is called Integrative Action (IA)

Second: the proposition is that thematic activities are inter-operative and collaboratively interconnected with a region, innovation system and syllabuses and the implementation of their relationships. The base of their triangulation is demonstrated in the thematic curriculum, which was first applied to the Degree Programme in Business Information Technology (BIT) in October 2009 and available [33]. This will be furthered in the Master of Business Administration programme, to be actualized in January 2010.

Third: learning in this way requires the use of the three pillars of learning in which participation and knowledge creation are underlined. It is also recognized that scaffoldings for knowledge acquisition in LbD play a crucial role in interventions at the beginning of life-long professional growth.

Fourth: The research organization Laurea was appointed as a centre of excellence in regional development for 2003-2004 and 2006-2007, and as a centre of excellence in education for 2005-2006 and 2008-2009. Currently, there are more than 30 active collaborative projects that use the Integrative Action Model with research and education activities. The selected "samples of evidence" cases illustrate different types of actualization projects and demonstrations in the last part of this journal and more background on LbD for future reading is presented in [5], [23], [24], [25], [26] and [27].

VI. Challenges and Discussion

It is recognized that there are two challenging perspectives in inter-operative learning; the first scope is the evaluation of learning and the second challenge is complexity management in the context of LbD. In the challenge provided by complexity the perspective is placed between a cognitive load and natural information processing and asks the question; how is it possible to support individual and peer learning in interactions between complex information and the human cognitive system?

However in evaluation and complexity management there are some commonalities. Firstly, students usually know the actual learning and inter-operative situation better than their teacher. Secondly, peer evaluation maintains spirit and equality better than a teacher's evaluation can. Hence, peer reviews and subjectivity in evaluation and complexity management structures in learning-action are promising perspectives. The expected improvements are based on learning-action research and practices where complex settings are studied [22], [24] and theory in [19].

In this new trial, the observations, action point registers and formulations of explanations from different type of materials, literature and papers have been used as a base for evaluation and complexity management from a student-centric point of view. The units of self-evaluation and complexity management should be "practical evidence" or "samples of evidence"; a sample of evidence may also be research that does not need to find a solution (learning by failure) e.g. the "journey of research" is reflected upon and evaluated and advanced learning comes from that.

This background philosophy is based on positivism; the assumption holds that authentic knowledge is that which is based on actual sense experience within the dimensions of LbD. This knowledge construction process involves student, teacher, practitioners and expertise gained from working life; the students are often already experts in working life (at least the MA students are). They are all involved in the democratic

"learning-action process", bridging their own competences to produce new knowledge generation by learning from action.

In this new trial an action research is more than a traditional interpretative research in the sense that researcher (student and teacher) are directly involved in the research setting and in the experience itself. The student has a direct impact on the scope being studied and contributed to. The direct and indirect impacts are self-peer-triangulation-evaluated; thus the results and impacts are rigorously evaluated but not formalized in advance.

In this trial action, research is a systematic and inter-operative way to collect samples of evidence on which to base rigorous reflection by participators within an innovation system. Action research includes: research interest; design interest, problem solving interest e.g. problem positioning, problem correcting, building and evaluation and being motivated by a quest to improve and understand the world by changing it and learning how to improve it based on the effects and impacts of changes made in the performed intervention.

There are many views on learning-action research, but for discussion and comments an example of an inter-operative model is described in Fig.8.

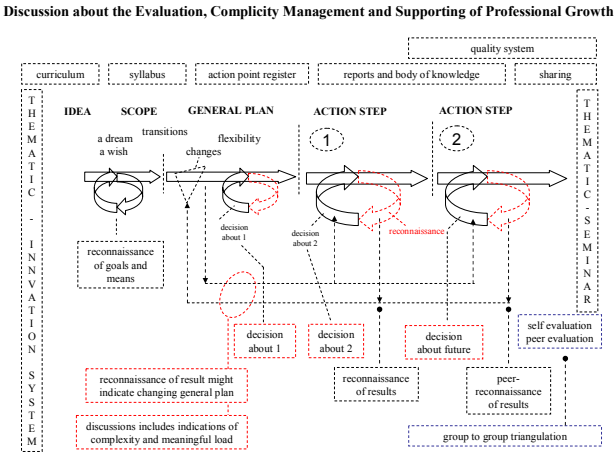

Fig. 8 describes one example of learning-action research in witch teacher participate to reconnaissance and decision meetings as well as to complexity managements but evaluation is done by students in using of: self evaluation, group evaluation (3-4 students per group) and groups to group triangulation and reflection.

VII. Samples of Evidence

SATERISK - Satellite tracking system, the idea to study risks related to satellites was created by students of Laurea University of Applied Sciences in 2008. Funding from TEKES (Finnish Funding Agency for Technology and Innovation) was secured on 14.11.2008 and allocated for the period 1.9.2008 to 31.8.2011. The goal of SATERISK is to study the risks connected to satellite tracking and to ascertain if the use of satellite tracking can generate further risks. The project analyzes risks using different approaches: legal, technical and mode of use. It will also study potential future requirements and risks.

RIESCA - Rescuing of Intelligence and Electronic Security Core Applications. There are a number of systems, such as transport and logistic, power and telecommunication, hydropower and nuclear power stations that are critical to the day-to-day functioning of any technologically advanced society such as Finland. When assessing possible risks, it is only seldom taken into account that power, hydropower and nuclear power plants are critically dependent on the reliability and security of information systems. In consequence, systems that are critical to the proper functioning of society may not work as well as they should. RIESCA aims to offer contributive and constructive solutions to this problem. The national project partners are: the University of Oulu, the University of Kuopio, and Laurea University of Applied Sciences. The international research partners are: Macquarie University, Sydney, Australia; the University of Arizona, USA; and the Software Competence Centre Hagenberg, Austria. The resources available also include individual students or larger student groups assigned to defined parts of the project. There are two notable advantages conferred by the use of students on the project, namely: confidential information management can be used and developed; and the students acquire more professional expertise that fits with the principles of Laurea's LbD development framework. The contributors to RIESCA are: TEKES, The Ministry of the Interior, Ministry of Defense, Civil Crisis Management Center, Finavia, EADS Secure Networks Ltd., Ixonos Ltd., Softera Ltd., Portalify Ltd., and Insta Ltd.

ORE - Open Rendering Environment. Rendering is the process of generating 3D images and movies on computers. The ORE project aims to bring the Berkeley Open Infrastructure for Network Computing based Big and Ugly Rendering Project distributed rendering service to Finland. This goal was realized by the opening of the "Renderfarm" service in June 2009. The Renderfarm service is the world's first publicly distributed rendering service advocating the use of Creative Commons licenses. The ORE project also aims to help companies and universities adopt the open source 3D modeling suite Blender into their everyday workflow. While creating new information about social behavior and distributed computing, Laurea and the project also function as a pilot project for TEKES as it researches the possibility of using Finnish universities of applied science as supporting structures for bringing new technologies into the reach of small and medium enterprises.

The ITEA2-DIYSE - Do It Yourself Smart Experiences (2009-2011) project will enable people to direct their everyday environment (and the objects, sensors, devices and media therein) into a highly personalized meaningful communication/interaction experience that can span the domains of home and city. The project aims to create a sustainable marketplace for user generated applications (components) for an Internet of Things world, in which non-technically skilled people can participate by using well-abstracted components, capabilities and devices. As such, it

goes beyond Web, mobile or multimedia applications. A Finnish consortium aims to develop and evaluate technologies that empower elderly and disabled people as well as young children to create interactive experiences like quizzes, collaborative school assignments or educational games.

ITEA2-GUARANTEE (2009-2012) - provides a technical solution for personal safety in the home environment. It introduces local and network supported decision making for safety applications on the basis of sensor input and with immediate response and feedback to the people concerned. Technology and services will be researched and developed that addresses the specific personal safety needs of individuals in residential environments.

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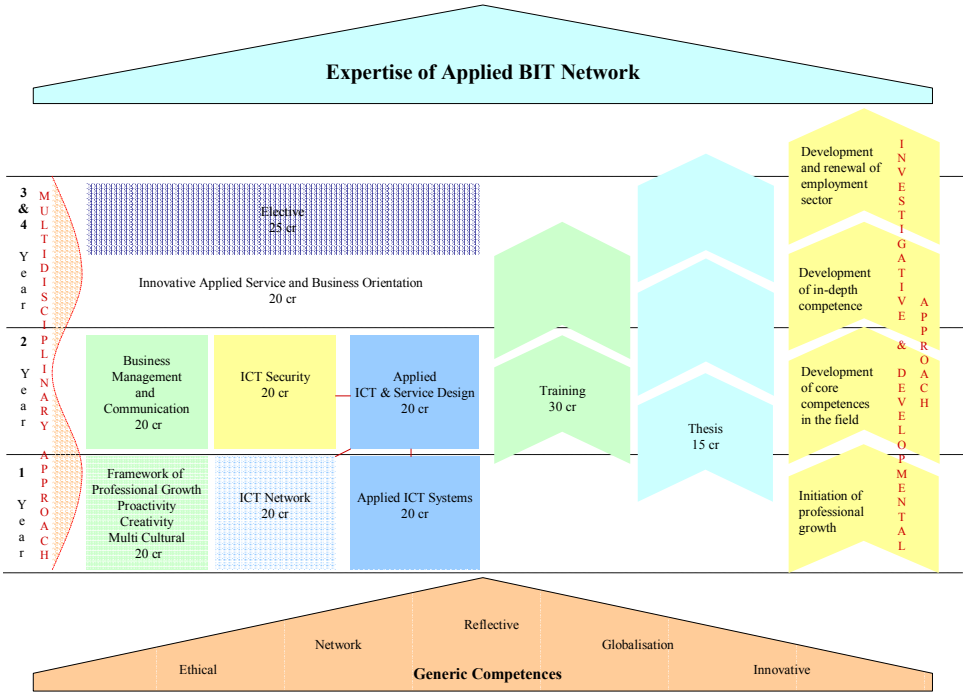
APPENDIX A:
THE APPLIED GENERAL ECTS COMPETENCES to the BIT Curriculum

COMPETENCE	DESCRIPTION OF THE COMPETENCE, FIRST-CYCLE GRADUATE	DESCRIPTION OF THE COMPETENCE, SECOND-CYCLE GRADUATE
LEARNING COMPETENCE	▪ is able to self-evaluate their own competences and define his/her development and learning needs ▪ recognizes their own learning style orientation and is able to conduct studies independently and develop learning strategies ▪ is capable of collaborative learning and sharing knowledge in teams and working communities ▪ is able to operate in changing environments and to recognize and utilize available learning opportunities ▪ is able to plan, organize and develop their own actions	▪ is able to self-evaluate their own competences and expertise in a versatile and systematic way and define their development and learning needs ▪ is equipped for life-long learning and understands and can self-directs their learning process ▪ is able to study together and share their learning and expertise in different expert teams and networks ▪ is able to work on their own initiative and anticipate changes and needs for change ▪ is able to plan, organize and develop their own actions
ETHICAL COMPETENCE	▪ is able to apply the value systems and ethical principles of the subject field in their conduct and tasks ▪ takes responsibility for their own actions and work according to the jointly agreed principles and measures ▪ Is able to apply the principles of sustainable development to their actions ▪ is able to take other people into account in their actions	▪ is able to apply tasks as an expert and as a developer in their working life ▪ takes responsibility for their own actions and work ▪ is able to apply the principles of sustainable development in their actions and knows the social responsibility of the organization(s) belonged to. ▪ is able to cater for others in their own actions and make decisions that take into account individuals, their community and wider society
COMMUNICATIVE AND SOCIAL COMPETENCE	▪ is capable of listening to others and communicating through writing, speech and the ability to use visually different communicative styles ▪ is able to function in the communicative and interactive situations typical of the field ▪ understands the principles of group and teamwork and is able to work together with others in multidisciplinary teams ▪ is able to utilize information and communications technology at work	▪ is able to listen to others and communicate in writing, speech and visually with different target groups ▪ is able to manage in different communicative and interactive situations and to organize and create professional networks ▪ understands the principles of group and team work and is capable of working together in multidisciplinary teams also as a team-leader ▪ is able to utilise information and communications technology at one's work
DEVELOPMENT COMPETENCE	▪ is able to retrieve and analyze information in their subject field, to critically evaluate it and to perceive entities in a holistic way ▪ knows the basic principles and methods of research and development work and is able to conduct small-scale research and development projects applying the existing knowledge of the field ▪ knows the principles of project work and is able to work in projects ▪ adopts an initiative and proactive approach to work and is capable of problem solving and decision making in their work ▪ understands the principles of profitable and customer-focused operations and possesses entrepreneurial skills	▪ is able to retrieve and analyze information in their own subject and connected fields and to critically evaluate and holistically perceive it as well as generate new knowledge ▪ can master the required methods of research and development work and is able to independently carry out R&D projects knows the intricacies of project work and is able to work in projects and manage them ▪ works proactively on their own initiative and is able to start and implement change processes ▪ is capable of creative and innovative problem solving and decision making at work ▪ is able to start profitable and customer-focused development projects ▪ is able to guide and mentor others
ORGANISATIONAL AND SOCIETAL COMPETENCE	▪ knows the socio-economic interdependence of the organizations in their subject field ▪ knows the possibilities for influencing society through developments in their field ▪ knows the basic principles of organizational management and leadership and has the ability to supervise tasks ▪ knows the methods needed in their working life and is able to operate in work communities ▪ is able to plan and organize activities	▪ knows the socio-economic interdependence of the organizations in their subject field ▪ knows and is able to utilize the possibilities to influence society ▪ knows their organization and its work culture(s) and is able to participate in intra-organizational and inter-organizational coordination, development and management ▪ is able to evaluate the operations of a work community and to plan, organize and develop activities in changing situations within their working life ▪ is able to perceive holistically wide entities and cause and effect relationships as well as operate in demanding situations that require versatile competences
INTERNATIONALISATION COMPETENCES	▪ possesses spoken and written communicative competence at least in one foreign language necessary for their work and for professional development ▪ understands cultural differences and is able to work together with people from different cultural backgrounds ▪ is able to use international sources of information of his/her own field ▪ understands the effects and opportunities of internationalization in their field of study	▪ possesses writing and speaking communicative competences in one or two foreign languages necessary for their work and for professional development ▪ understands cultural differences and is able to operate in diverse international environments ▪ is able to apply international knowledge and competences within their own field ▪ possesses an overview of the position and importance of the profession in its international environment

APPENDIX B:
ACTUALIZATION OF THE BUSINESS INFORMATION TECHNOLOGY (BIT) CURRICULUM



At the initial stage of their studies, students learn to use learning tools and to apply them, particularly in the context of LbD. Other skills are related to, for example, project work and an investigative approach. At the same time, students start to become familiar with the substance of business information technology, seeing the significance of the field in the social context. In addition to specialist competence in business information technology, students develop skills in business and leadership. These competences are linked to the sector's operating environment and are studied from the first year.

In their second year, students develop their expertise in the field. They build the foundations of their ability to work in various operating environments of the sector. This is supported by job placements, whose content can be chosen by the students themselves. The distribution of job placements over the degree programme is set in each student's personal study plan. The first placement is carried out towards the beginning of the degree, and is used to build a bridge to the employment sector. The second placement, towards the end of the studies, deepens the students' practical competence and helps them to become profiled as developers of the field.

Third-year students continue to develop their expertise in business information technology. The objective of the themes in the third year is to help students apply what they have learnt and grow into developers of their field. The thesis works towards these same aims, giving students opportunities for refining their career paths. Competence and expertise increase and deepen throughout the studies through optional and specialisation studies.