Externally Funded Research and Development Projects in Perspective of Learning

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***Abstract*—The focus of this study is on stunted-centered learning activity which collaborates learning and research in an interoperative way and shares the regional-national research and development (R&D) capabilities, interests and agenda. The study is addressed to the cooperation model and factors of learning within R&D projects that develop academic knowledge, competences and regional—national capabilities for all participants by contributing authentic R&D scopes or problems in real-life situations. The study includes analysis of the research data regarding the R&D project, namely SATERISK (SATEllite positioning RISKs), which was initiated by two security management students at Laurea University of Applied Sciences and that has evolved into a substantial three-year R&D project between 2008 and 2011 and is funded by the Finnish Funding Agency for Technology and Innovations (TEKES).**

***Index Terms*—collaborative learning, collective learning, integrative action model, learning method**

I. INTRODUCTION

Learning in adult degree programme at Finnish university of applied sciences (UAS) takes place alongside the student's authentic work in a community of practice. A three-year period of work experience after the Bachelor degree is required before the Master's programme. Study units for the Master's programme can then be actualized so that students take a role as an expert in the community of research in which they have experience in the specific expertise domain they are studying.

R&D work with the generation of a new and novel way of learning and education at UAS is a multidimensional and challenging task. The challenges posed to development efforts of UAS have changed rapidly in the last ten years, and it has been tough for UAS to respond to these challenges. The Finnish Act (351/2003) sets three tasks for universities of applied sciences: 1) education, 2) research and development; and 3) regional development.

In actualization of these three tasks at Laurea, the term "learning" focuses on R&D and regional development. It means that students are participating in the actual R&D. The regional-national-international research agenda is used for the co-creation of learning scopes. Then, the learning transactions generates authentic results and impacts which aim at improving regional capabilities.

The focus of UAS is in achieving a role as trusted partner and cooperator in education, research, development and innovation (RDI) networks and combining knowledge from multiple sources and co-creating with other actors for contribution of novel and benefiting competences and capabilities, which are related to clusters, innovation system, industry and the region. In the middle of this, there are learning and cooperation activities with the R&D actors of regional network.

The start of the SATERISK project was a student-driven creation: two students were working as police officers during their studies when they realized that little was known and discussed about the risk of satellite-based positioning and tracking. Satellite-based tracking services are used to improve the security of property and personnel, but the new questions, such as "does tracking involve new risks" were also relevant for investigation. At first, the idea was developed in dialogue with lecturers and students; later on, the dialogue was expanded to include a more extensive network with other students, teachers, researchers, companies which participated as artifact and service developers and end-users, public end-users and publicly funded expert organizations for financing R&D.

The SATERISK has expanded into an academic multidisciplinary collaboration with the University of Lapland, ITMO in St. Petersburg, Russia and the BORDERS network, coordinated by the University of Arizona, USA. In addition, the collaboration was extended with four companies in the field of satellite tracking and government officials such as customs and police in Finland.

Learning in R&D as a collective learning method has its theoretical background in the Learning by Developing (LbD) approach, which is used as a pedagogical culture at Laurea. In this study, it is combined with the "Last mile in research" approach, developed by Prof. Jay F. Nunamaker, Jr. These two approaches support each other and authenticate the suitability of the R&D project for producing cooperative learning and the learning environment as a sustainable "R&D driver".

The research questions in this study are able to address the SATERISK data collection between 2008 and 2011, and the research interest is the understanding of the actualization and improvement of the learning structures within R&D.

The research questions in this study are: 1) How can the factors of learning and cooperation activities be understood in the R&D work at SATERISK? 2) What kind of main elements and factors can be identified in the performed R&D actualizations and learning in the SATERISK project?

As the SATERISK project is still ongoing, the final conclusion, evaluation, results and impacts cannot yet be made. However, the analysis presents the R&D cooperation model and the factors of learning within R&D in SATERISK that develops new regional capabilities and knowledge and competences for all participants.

II. THEORETICAL FRAMEWORK

A. *Learning by Developing(LbD)*

The Finnish UAS train professionals in response to labor market needs and conduct RDI activities which support learning and promote regional development [26]. Laurea UAS has been developing its unique pedagogical culture and learning model, Learning by Developing (LbD) since 2002 [18, 23, 36], and on this basis, Laurea UAS was nominated as a Center of Excellence in Education by the Finnish Higher Education Evaluation Council for 2005-2006 [41] and 2008-2009 [40]. Laurea UAS's student-centered R&D was nominated as a Center of Excellence in Education for 2010-2012 and was the only UAS to receive the nomination for the whole University [35].

LbD focuses the collective and authentic nature of learning where an individual learns with community learns and new competencies and capabilities are built by both individual and community work. Key dimensions in this model are: (1) research-oriented approach; (2) experimental nature; (3) authenticity; (4) creativity and partnership [18, 21]. The LbD model enables the binding and testing of different learning and R&D theories and a development of new theories as sound kernel theories [9] (testable theories or testable proposition as hypothesis) in different learning situations, domains and environments. In this article, the process of project SATERISK through the LbD model is analyzed. The dimensional LbD model is described in Fig. 1.

In Laurea's student-driven RDI model, "Student-centered Learning within R&D", students not only implement the authentic and "led" R&D projects, but also take a creative and active role and responsibility for the related preparation and applications [36]. Students will complete the majority of their studies in connection with real-life projects, producing new expert networks. The development projects are then genuinely rooted in communities of work and its development processes so its aim is to produce new practice and knowledge. The applied LbD model requires collaboration between lecturers, students and workplace experts in a collective process which bridges competences and the body of knowledge as proposed in [20]. Students work as equals growing up colleague with experts from the collaborating organization and the lecturers whose task and role is to be researchers, developers and pedagogues as insiders in the R&D process [36]. Structurally, this means that Laurea UAS does not have separate RDI units and that RDI activities are integrated in the learning. Since 2003, this selected management strategy is called to the integrative model at Laurea [18, 21].

B. *Last Mile in Research*

In the perspective of the integration of R&D and learning, the approach of last mile in research was introduced [15] to Laurea UAS by Jay F. Nunamaker, Jr.

He emphasizes that, "one should use academic insights to solve real problems for real people" and "the using of process as: 1) find people with a problem; 2) propose a new solution; 3) listen carefully to the reactions; and 4) devise an approach to solve their problem", and "there are prerequisites for an Information Systems (IS) solution which are: 1) the technical feasibility; 2) the operational feasibility; and 3) the economic feasibility" cf. [14, 16].

In Nunamaker's view, the IS research needs to be multi-disciplinary in nature [16] and carried out through field studies as the operational and economic feasibility can only be tested in the field [14, 16]. Nunamaker explained [15] that "often in the academia cases that ideas are generated for their own sake, and their implantation is considered less important or irrelevant." Nunamaker's 2010 model [16] is echoed in Fig. 2.

Nunamaker states, "however, it is impossible to know if an idea is feasible until it has been tested and implemented as taken to the last mile in research. The last mile is where the value to society is created; the last mile is where you make a lasting difference." A proof of concept and a proof of a value, they should strive a proof of use and add depth understanding for theory development [16].

Ref. [14] provides an integrative perspective under the label of a "systems development", a multimethodolical approach to IS research. It is approach that included the steps of: 1) theory building (conceptual frameworks, mathematical models, and methods); 2) systems development (product development, and technology transfer); 3) experimentation (computer simulation, field experiments, and laboratory experiments); and 4) observation (case studies, surveys, and field studies).

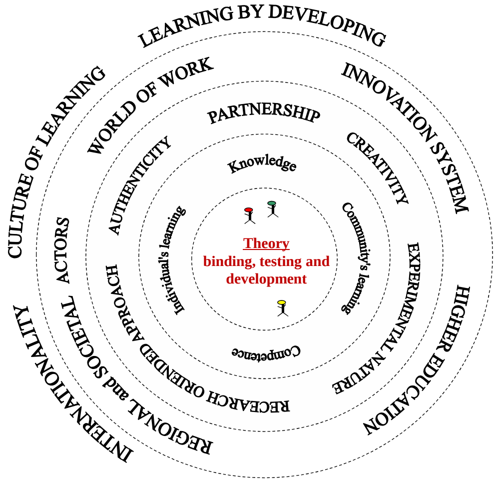

Figure 1. Dimensions of Learning by Developing

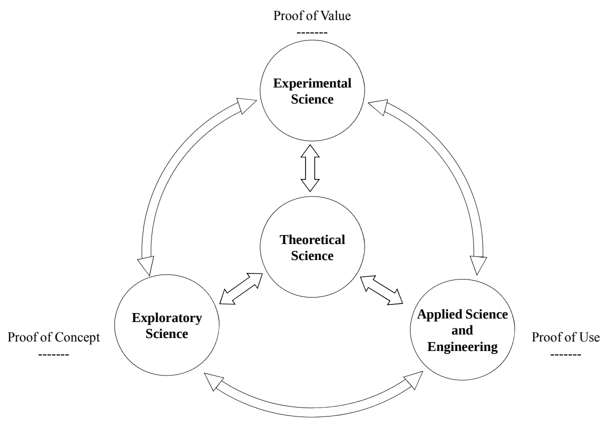

Figure 2. Multi-methodological R&D Model (Nunamaker, 2010)

III. RESEARCH FRAMEWORK

A. *Research Framework of Study*

The Action Research approach was selected as the research method in 2003 for transactions which are performed by the Finnish Higher Education Evaluation Council (FINHEEC); since then, it has been used in [18, 21, 39] so that five research cycles are completed between the years 2003 and 2010. The target of performed action research was on the actualization of practical action and research of organizational change, which includes design and development activities performed within five evaluation transactions by FINHEEC. In this analysis the data and results are related to the SATERISK project between 2008 and 2011. The data of the evaluations of the Center of Excellence in Education [35, 40, 41] is used as "towards future" of this study.

Design Science Research [11, 12, 19] is used for the integration of design and development activities for supporting and improving the everyday action and changes at Laurea. The outcomes, such as models, constructs, instantions and artifacts e.g. new strategies, measures, curriculums, services and models of processes, are influencing the learning activities. As well, the Design Science Research is used for improving the Quality System as Information System. The design science research is used in actualizations of bachelor and master study units, and it has effects on the data which is related to the Student-centered Learning within R&D since 2006 [35] and the SATERISK project. The Integrative R&D Framework is illustrated in Fig 3.

A case study research analysis in the SATERISK project brings an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research [3, 7, 33]. The case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships, but when the relevant behavior cannot be manipulated, and a case study is a strategy [8, 33] for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence and in a situation where especially a "how" and "why" questions are being posed [3, 7, 8, 33].

B. *Quality Assurance System and Data Collections*

The quality assurance system is used for data collection, monitoring and developing of operations in a systematic way at Laurea. The quality assurance system describes the operational starting points and processes. Using systematically collected data, the operation-related matters to be monitored and evaluated and the methods, procedures and tools are used in development activities.

Quality assurance is part of the continuous development of Laurea's operations and is linked to all Laurea's operations as different monitoring and development measures [39]. Therefore, it is part of the management, strategic work and internal result-oriented management of the organization. Everybody working and studying at Laurea, and the most important stakeholders, participate in quality improvement and are using the quality system, which at the same time produces data on it.

The quality assurance at Laurea consists of procedures, processes and systems used to guarantee and improve the quality of operations. Quality assurance is carried out using jointly-defined, operation-enhancing and appropriate procedures, methods and tools. In turn; the term quality at Laurea is understood as the suitability of procedures, processes and systems in relation to the strategic objectives. The achievement of the objectives is assessed through the evaluation areas specified in the Strategy Implementation Plan. The four steps of the applied quality assurance cycle are described in Fig.4.

There are two different dual interests behind the integration of quality assurance in the Integrative R&D Framework: 1) quality implementation and confirmation and 2) the development of operations and strategies and verification in which the focus is similar to but not the same as the dual imperatives of action research 3) research interest and 4) the problem solving interest as in [31]. Thus, it is understood in our R&D Framework that all of these four different perspectives complement each other.

As background, one of the most well-known and evergreen management models, the so called Deming or Shewhart cycle, or PDCA model (plan-do-check-act) or (plan-do-learn-act) [2, 30] is "light enough to use and meaningful for co-operative action" but nevertheless, it is useful and inter-operative in the context and views of quality and management that includes leadership and development, as in our context.

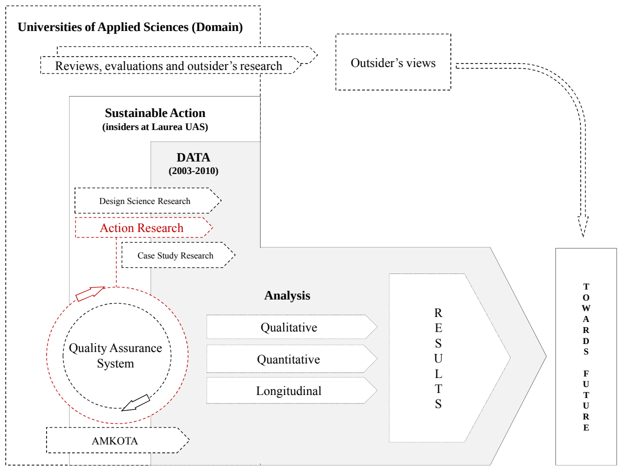

Figure 3. Integrative R&D Framework

Figure 4. Steps of Quality Assurance in Integrative R&D Framework

Shewhart described manufacture made according to statistical control as a three-step process of 1) specification; 2) production, and 3) inspection in [30]. Shewhart notes that this is specifically related to the scientific method of 1) hypothesis, 2) experiment, and 3) evaluation. Shewhart states in [30] that 1) hypothesis has similarities to specification; as it is the concept of using a statistical state to ascertain the limit to which one may hope to go in improving the uniformity of quality; 2) experimentation has similarities to production, which is seen as the operation or technique of obtaining uniformity; and 3) evaluation has similarities with inspection, which is seen as providing judgments. The PDCA model became well-known through Deming, although Deming called the model the Shewhart cycle, after its inventor and form. It is also called Deming's Wheel. Deming published the methodology in his book Out of Crisis [2]. For Deming, the PDCA model was a flow diagram for learning and for the improvement of a product and a process as explained in [2].

At Laurea, there are 500 faculties, 8000 students and about 70 cooperators which are all using Laurea's quality system for data collection, quality implementation and confirmation as well as development and verification purposes. The steps of quality assurance are actualized as:

Plan: Planning the activities i.e. what should be done and what results should be achieved and what is necessary to change in the actualization? This concerns the co-creative and participative nature of planning and the implementation of definitions into the design and optimization of the quality sigma.

Do: Doing the actualization and implementation according to the plan, actualizing and implementing interests, and co-operating and participating as well as generating new knowledge from the creation perspective of doing e.g. the learning process. The data collection process and implementation of measures are actualized.

Check: The checking of the activities and the results achieved, which involves development, the research interest, the knowledge creation interest (e.g. the reviewing of reports and updating of the syllabuses), the implementation of analysis, measurement and verification interventions in the quality sigma.

Act: Acting rationally and systematically, taking into account the observations and results of the checking regarding the consequences and implications of the actualization for the next stage and the body of knowledge e.g. the binding of new theories (as center in Fig. 1.) and the writing of a draft for the next syllabuses. The Act responds to the question of management about the continuation of some activity or falsification as to forward future.

C. Follow-up and Evaluation Data

The follow-up and evaluation data describe Laurea's activities as a whole. The data is used in quality assurance, in evaluating and developing operations, in internal and external reports e.g. evaluations of centers of excellence and in support of the strategic, operative and pedagogic planning. In addition, the data is used when preparing for the agreement with the Ministry of Education and in the assessment of success made by the Ministry of Education. The follow-up and evaluation data is described in Table 1 and it is included to the quality assurance system as in Fig. 5 and it is used in the performed action research cycles [18, 21, 39] as presented in Fig.3.

TABLE I.
FOLLOW-UP AND EVALUATION DATA

Laurea's Follow-up and Evaluation Data between 2003 and 2010	
Category	***Data***
Applicant data	Applicants study places (youth) 2002- 2011 Comparison of applicants/study places (youth) 2002-2010
Student data	Number of students on 20th Sept., 2010 New students 2010 (21st of Sept., 2009 - 20th of Sept., 2010) New students/study places 2010 Number of students 2001-2010 Discontinuation rate 2005-2010
Degree data	Graduates 2003-2010 Length of study 2003-2010
R&D and publications	R&D activity 2003-2010 Publications 2006-2009
Studies in R&D	R&D credits 2006-2010
Theses	Theses (project-based) 2003-2010
Open UAS studies	Open University of Applied Sciences 2003-2009 Open University of Applied Sciences and cooperation in higher education 2010
Teaching in foreign language	Teaching in foreign language 2003-2009
Virtual studies	International student mobility 2003-2010 International staff mobility 2003-2010
International mobility	International student mobility 2003-2010 International staff mobility 2003-2010
Staff data	Number and education of staff 2010 Comparison of education 2009
Employment and placement	Employment and placement 2007

D. Data of R&D in AMKOTA

The statistics of the number of credits completed in R&D activities or projects by students in degree-awarding education are compiled for AMKOTA database as following: 1) credits included in thesis; 2) credits included in internship; and 3) credits included in other studies. The statistics of completed credits are compiled by calendar year and by field of education. Completed credits means credits that have been completed with a passing grade in the youth and adult education leading to a bachelor's degree and education leading to a master's degree.

Credits completed in R&D and development activity is defined by the Ministry of Education: Completed credits in R&D activity include all credits, which have been completed in such projects or assignments integrated in the student's curriculum that have been intended for research or developing of working life and that have been implemented by internal or external funding of a UAS.

According to the definition of Statistics Finland, research and development (R&D) means systematic activities directed towards acquiring more information and using information for finding new applications. The criterion is that the goal of the activity is something essentially new. Research and development activities include basic research, applied research and development work.

E. Analysis

This study includes both qualitative and quantitative data of the SATERISK which have been collected together at Laurea between 2008 and 2011, then this rounded up data collection was completed in May 2011.

The data is categorized as input for analysis. The SATERISK data is one view in Laurea's whole collection which includes qualitative (interpretative), quantitative (AMKOTA) and longitudinal (views of AMKOTA) data, between 2003 and 2011

The practical and theoretical contribution of the study were drawn from the data where the unit of analysis is a sample of evidence and the selection of data samples are related to Learning within R&D in the SATERISK project.

The qualitative data was analyzed in terms of systematic coding and categorization [1] of comments and statements given in the students' feedback and students' and participants' reports and reviews, in order to develop a synthesis which grasps this empirical evidence.

The scope of the analysis is in the collaborative change process of the learning method as in view of learning group, organization and regional actors and in integration of studies to: authentic R&D; participation and knowledge creation in education; and collaborative-collective learning activities with: regional actors; living labs; value networks; and regional-national R&D agenda. The focus of the analysis is in the cooperation model of the SATERISK project, which is integrated into the study units, as well as providing a description of the roles of different stakeholders when creating an environment for cooperation.

Student-centered Learning within R&D means integration of three statutory tasks in an inter-operative way of learning, and this development is in the middle of the analyzed change process at Laurea. Therefore, factors of learning and models of R&D integration are a main interest of this analysis of the SATERISK project. Thus, the analysis of study is an inductive, theory-building multiple analysis, and the proposed factors are used as theory components or factors of the integrative model in the inductive theory-building process towards the future activities as illustrated in Fig. 3.

The delimitation of qualitative research is that it applies to present the study, where the results lack statistical reliability, and they cannot be generalized without more deep quantitative analysis [27]. The used analysis method is based on [1,13].

IV. SATERISK

A. Brief

Satellite-based navigation and tracking has become a routine feature of modern society and everyday life, and their use is still growing, with the EU's new satellite system Galileo expected to be operational in 2013. Positioning, navigation and tracking are used to decrease risks especially in logistics and to optimize work flow. But it is questionable as to whether this is always the case in international legislation regarding tracking, or the lack of it- Are problems caused when tracking abroad? From a technical standpoint, is a tracking system likely to increase the security of a valuable consignment or would these merely provide an additional resource to potential thieves?

To answer these questions, the SATERISK research project was started in 2008. It aims at a situation where laws on positioning and tracking, and the financial risks posed by their usage, will not prevent the use of machine-to-machine (m2m) tracking across state and union borders. An essential part of the project is to study signal interference in the tracking, secure transmission and processing of positioning data, as well as to find ways to improve tracking devices and user habits in the future.

The project aims to bring new, international-level know-how to the European security field. The project will also create new methods and development paths for positioning and tracking systems. The widely used US-based Global Positioning System (GPS), a satellite-based positioning system, will soon get an EU counterpart and rival from the Galileo system. While most of the satellites are still on the ground, it is important that any problems and possibilities related to the new system can be charted. The project also aims to offer technological solutions and capabilities to issues that arise while the project is ongoing.

B. Initiation of the SATERISK Project

The SATERISK research project was developed in a student-centered LbD process [25, 35, 36] as being an authentic scope developed though creative partnership with different stakeholders. The whole project was ideated by two students who were working as police officers during their studies when they realized, through their own experience, that there was very little discussion about the risks involved in satellite-based positioning and tracking. "Satellite-based tracking services are used to improve the security of property and personnel. But does tracking involve new risks?" In the beginning, the students' level of familiarity with the system was such that one knew the tracking technique well and the other had extensive experience of using these systems, but neither knew the risks with regard to tracking.

After preliminary studies by students and personnel, the dialogue was taken further in discussion with companies and government officials. The students that initiated the project motivated other learning teams, shared knowledge and played an important insider role in building the project consortium, and at least one of them was present in each negotiation. Through planning and studies, the idea evolved into a large 3-year research project funded by the Finnish Funding Agency for Technology and Innovations (TEKES). The other funding partners included the University of Lapland, Finnish customs and industrial partners as described in Table 2.

C. Project Phase of SATERISK

After receiving funding, and once the project had begun, Laurea UAS recruited one of the initiator students as a temporary project manager who took a leave of absence from his work as a police officer in order to manage the project. Later on, the UAS recruited a professional in tracking to act as project manager of SATERISK and as a senior lecturer. At the same time, the steering group and the project group were formed. The project group comprised a scientific supervisor, who is one of the principal lecturers, researchers, senior lecturers and students working in sub-projects and tasks of SATERISK. The number

TABLE II.
PARTNERS AND BUDGET OF SATERISK

Partners and Funding of SATERISK		
Partner	***Funding***	***Percent***
Tekes – the Finnish Funding Agency for Technology and Innovation	337800 €	60 %
Laurea University of Applied Sciences	59600 €	11 %
University of Lapland	51600 €	9 %
Finnish Customs	30000 €	5 %
Finnish industrial partners	84000 €	15 %
Total	563000 €	100 %

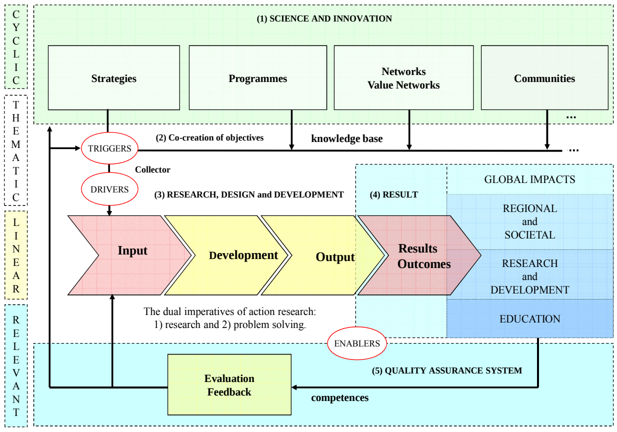

Figure 5. Learning with the R&D Process

of professionals in the project group has been growing as the project has gone further; e.g. a space expert from NASA was recruited to provide additional expertise in the project. In the steering group, the goals of the project were refined and its dissemination planned in the form of seminars, events and articles.

The web pages of the project (www.saterisk.fi) were created and final reports, articles and other project materials published there. A collaborative tool, SATERISK Wiki was been made available for different stakeholders.

V. RESEARCH FINDINGS

A. *The SCOPE*

The first finding of this study is the revised understanding of the term scope. The term "scope" is used as a mental or physical learning target or subject matter that something deals with as in [34] which the aim is first to support a student's imagination and creativity in learning transaction and it generates and maintains the motivation and spirit for learning in a "learning context". Second, it balances judgments and expectations of learning objectives, goals and targets in "balancing context" e.g. "tuning of cognitive load" [4]. Third, it addresses the idea that between two people there is always a third dimension, e.g. a model, artifact, tool, concept or mental or social thing with which they share knowledge, communicates, activates and motivates their own or the team's learning [10].

B. *Revised Integrative Process*

The four elements of Learning within the integrative R&D process are first specified by the author in 2008 [22]; these four elements are: 1) *cyclic*: which supports creativity, imagination and creations as innovations by all participants; the cyclic element emphasizes the importance of support to mental and physical creations by participants in the integrative learning within the R&D process, where it focuses on the freedom of the methods and philosophies used in learning and the design phase of the integrative R&D process; it supports agility and the continuation of new ideas which exist as agile, unpredictable and are independent of time or other variables; 2) *thematic*: which supports the co-creation of national-regional lead innovations, recognizing needs of regional capabilities and the scopes and structure of a body of knowledge; in SATERISK the co-creation and "collective and thematic sharing process" was created and led by students; 3) *linear*: which supports the implementation of linear research and development processes to study units; and 4) *relevance*: which supports reliability, validity and scientific rigorousness, as well as the quality and relevance of a task's execution, e.g. as implementation of the quality assurance system. Learning within the R&D Process is presented in Fig. 5.

Integrative Learning within the R&D Process is a developed application that is used to determine and put into practice imagination-creativity–creation supported learning, as a learning process of LbD culture. It integrates the three terms: 1) imagination (agile) 2) creativity (ability); and 3) scope (e.g. student's creations, led innovations or mental entities). Its target is the implementation and integration of the three statutory tasks in the context of services, service design, security and ICT.

The integrative R&D model itself is a liberation process for imagination-creative learning activities, rather than a process for the automatic or systematic generation of new innovation. The nature of an integrative process is to support, rather than manage, cyclic and thematic elements, and their objectives are in both linear and relevance elements. In this SATERISK project, the target is to develop the support construction for the birth of imagination-creativity-creation relations and artifacts, as well as inventions and then innovations, later in a regional context. The model includes and combines action, design science and case study research methods in a linear element and quality of research on a relevant element [19]. The Value Network Model [22] influences as the thematic collector.

In this study, the new proposition is three general categories of factors for the activities of Learning within the R&D process; these categories are: 1) triggers; 2) drivers; and 3) enablers. Thus, this proposition extends the integrative learning view from processes orientation to the orientation of general R&D activities and collective capabilities generation. These new categories of factors are added on Learning within the R&D process model as three "red ellipses" in Fig. 5.

Integrative Learning within the R&D Process is "a logic model of activities and learning" [19] and is used in the practices of exploratory and creative learning and LbD culture. An integrative model underlines coaching activities with participants (students, teachers, co-operators and manager) in co-operation within an innovation system.

Authenticity: As Freire; "authentic education is not carried on by "A" for "B" or by "A" about "B", but rather by "A" with "B" and this authenticity is mediated by the world which impresses and challenges both parties "A" and "B" as well as it is giving rise to views or opinions about it [6]." In this sense, the learning in this integrative model is understood as "A" with "B" within "C", where "C" describes the activities of the R&D&I community and R&D agenda.

Engeström states that innovative learning cycles do not follow any fixed order and the freedom of methods and creativity are emphasized in the innovation orientation [5]. Hence, the nature of the integrative process is bottom-up and supportive rather than top-down and managerial with its cyclical and thematic elements, and objective (statistic) and rigorous within its linear and relevance elements as [19] describes.

The Integrative Process combines proactive, active and reactive philosophy that is based on shared learning processes within value networks of the innovation system. In addition, learning is addressed on services, innovations, design and development (SID) as its homepages in Laurea SID describes (http://www.laureasid.com).

C. Dual Imperatives for Triggering

The first empirical perspective to discussion of triggers of learning within R&D is hypothesis or as testable proposition that the innovation center based objectives as: *led scopes; ready problem; evaluation results; or scopes of strategies etc*. are novel to triggers. This evidence of a hypothesis is based on the learning cases that create deeper and more relevant knowledge and competence for expertise communities than that of a workplace or a student's own theme or areas of interest [38]. This hypothesis is reasonable in many of our empirical situations because the innovation topics and research areas for innovation centers are deeply analyzed and verified, as well from a future-proactive perspective. In our situation, this factor, with led scope as a trigger of R&D activity, does not include any major contradiction with imagination-creativity support, as it is possible to keep the creative scopes and themes of the innovation center flexible, motivational and creative enough for students in the integrative learning within the R&D context.

The "led scopes" as a trigger of integrative R&D learning have resonance in literature, as in the theoretical views of: Sfard's two metaphors of learning 1) knowledge acquisition and 2) participation [28, 29] and the third metaphor of learning 3) knowledge creation by Paavola, Lipponen and Hakkarainen [17]; as well as Vygotsky's Zone of Proximal Development (ZPD) [32]; it is the theory related to gaps between the understanding of complexity of learning scopes. In SATERISK, this appears as a negotiated process between the student and learning groups and the other actor, where shared collective understanding was co-created. As well, this theory of Vygotsky's resonates in SATERISK, in arriving at a common understanding which influences the student, and can be internalized by the student. The ZPD referred to the distance between the independent abilities and with social support by another participant as the zone that it is then bypassed. Note that, these zones are mainly developed by students at Saterisk.

The second hypothesis takes place in this SATERISK project. The integrative R&D learning model and LbD was implemented to enable knowledge creation and globalization of transformations. The idea, foundation, focus, themes, topics and spirit of SATERISK were elaborated by students, so SATERISK is purely a student scope and creation. This proposes that student-driven creations and designs as new scopes would also lead to the thematic collector of an innovation system and the entities in the innovation agenda may be triggered as co-creative creations of students.

Ref. [10] produces advanced judgments for this perspective of creativity in learning as they focus on students' own creations, designs and promote the use of scaffolding structures in learning.

Our solution in SATERISK is that co-instructive, co-operative and co-constructive creativity is supported in the LbD culture and Learning within R&D, as we also accept Ellen's and Clark's assumption [4] that "less is more in handling complexity" in R&D-based learning, especially with new scopes as complexity management process of learning integration. Thus, one dominant need is for linear instructional environments, [10] e.g. scaffoldings and co-instructions that reduce the amount of irrelevant cognitive load to a minimum through an increased awareness as knowledge of the individual and cultural factors that influence cognitive processing. As in [4], that theory and research into the relationship between controlled (linear) processes in learning may clearly advance our capacity to handle complexity as these activities combined in Fig.5.

D. Sustainable Driver Model and Roles of Insiders

The scope of SATERISK addresses the risks of satellite-based positioning and tracking, which was the authentic starting point for the two police officers in security management studies. As the adult students fetch and share real scopes or problems and R&D questions from their own experience and working life, the personnel of Laurea UAS and learning environments play an important role as a facilitator by taking the questions and ideas further. In this practice, the principal lecturer, or the senior lecturer, acts as an intermediary between different stakeholders in order to promote student-driven R&D work and as *actors of driver*, the faculties, e.g. teachers, management and trainers, are sustainably co-operating with different networks, different projects and students.

The role of the student at the initiation phase of the project was related to the idea creation phase, where the adult students bring authentic challenges from their working life into a collective discussion. At the preparatory phase, the students work in a team, conduct applied research in different study units, and write their report and thesis on the project. The research methods were used in different studies, such as design science research, case studies and action research as described earlier in [19].

Internships are done on the project by both Laurea's own students and international students. The internship has been highly valued among the students, and there is competition for the internship positions. Students work in different study units in order to generate background information for the funding application. Both of the police officers that initiated the idea wrote their thesis on the subject, and one of the theses was used as the basis for the application.

The following integrative driver model, which is first described in SATERISK reference [25] is presented and updated to Fig. 6. It is an elementary part of the Integrative Learning within the R&D process as presented earlier in collector of Fig. 3.

Lecturers or researchers participate in the SATERISK project by guiding and coaching the development process in different study units and theses. Even if the lecturer is not familiar with the subject in question, guiding is possible in the R&D process through general research guidelines. In the SATERISK, the expertise guidance is done by the project manager or researchers, and researchers can also participate in knowledge creation by co-supervising the students in the thesis and study-unit work.

The scientific supervisor of the project is responsible for the quality of the research and ensuring that the research questions are answered. In the SATERISK project, the scientific supervisor is a principal lecturer at Laurea UAS who has supervised various Master's theses and has been a co-writer of conference papers. The role of companies and government officials was addressed to the creation and setting of partnerships and goals for the project within collaboration, with all partners.

Besides these activities, the bottom-up and vision-based management was the force of a sustainable driver and as well as enabler to agile scopes in learning processes, so that the ecosystems of different stakeholders can come up with new creative ideas. The management's statement of direction was "freedom within R&D framework".

E. *Factors of Quality in Learning by Saterisk*

The following factors which increase quality in learning within R&D were drawn from the SATERISK data of the actualized study units. The empirical findings as factors which influences in the LbD learning processes are drawn in Table 3.

F. *Enablers*

The role of the quality assurance system is understood as an enabler of activities at Laurea: it involves gathering feedback of all results; organizing, conducting and utilizing feedback data for varying decisions.

The student feedback system produces systematic and comparable data for the use in quality assurance, operational development, and strategic, operational and pedagogical planning. The feedback system includes themes for students to evaluate their progress into developers and to provide feedback on learning as part of the R&D activities. Study unit feedback is collected by teams of lecturers as soon as it is complete and utilized in the self-evaluation of teaching and its reviews with students. Responses of comprehensive initial and graduation questionnaires are examined jointly, analyzed, and utilized in development work regularly at development seminars at least once a year. The Pedagogy Team gathers the development challenges that apply to Laurea as a whole, conducts development work and monitors the effectiveness annually. At Laurea, an alumni questionnaire is conducted every second year for those who have graduated three years earlier. Systematic feedback data is also collected from the employment sector in connection with work placements of students.

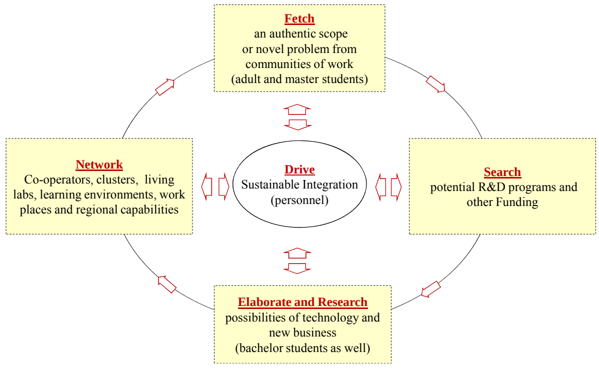

Figure 6. Empirical Model of Sustainable Driver to R&D integration in the SATERISK project

TABLE III.
FACTORS OF LEARNING BY SATERISK

Influencing Factors in Learning (SATERISK Data)	
Factor	***Influence in the LbD Learning Process***
Scope	Support for novel scopes and students' triggering in the LbD process. Teacher is setting as strategy for learning and then students, using expertise, conduct and further the learning scopes into questions, problems and new creations.
Authentic	Authentic development of new and novel capabilities to all participants; it produces practical and epistemological utility for all participants "A" with "B" within "C".
Learning group	Working in learning groups of 2-3 students. Each group reflects and evaluates each other. Self and group -based assessment over the whole learning process. Knowledge and practice sharing.
Role of Teaching	Teacher's task was in facilitation and guidance; e.g. work of groups; guiding of understanding of methods and analyses; development of scopes; the role of R&D quality in assessment as review process; feedback reviews; and delivery of sample of evidences.
Sharing	Group-to-group knowledge sharing as main learning transaction. Latest knowledge and reference searching process was facilitated by librarian and teachers. Putting efforts into producing of research papers and participation in international transactions.
Modularity	In the linear stage of integrative learning view, students learn with one concrete task at a time, knowing that their work is meaningful and an elementary part of something bigger – not just a meaningful exercise.
Theory binding	Binding of theories and practice in the Learning within R&D process.
Cognitive load	Balancing of cognitive load in developing of scopes and learning transactions. "less is more in handling complexity in learning".
Assessment	Assessment as sample of evidence and part of lifelong learning. Reviews with quality perspective of R&D. The results were evaluated and reviewed but not formalized in advance. Give space for learning in assessment. Recognition of the Zone of Proximal Development by students, teachers and partners (student-centered view).
Spirit of learning	Willing to learn; keep motivation and trust; focus is in future capabilities and possibilities; the group atmosphere was recognized in guiding.

Furthermore, some general factors which are recognized as enablers in Saterisk: economic situation and balance; actualization plan of strategies and working time of faculties; liberating activities and resources; syllabus and curriculum; projects; links and pipelines; living labs; regional capabilities; innovation system; and collective learning culture and organizational learning.

VI. CONCLUSION

The actualization of learning in SATERISK has been created in collaborative R&D teams (2-3 members) and has resulted in several different contributions to learning within the R&D concept: First: the revised understanding of the term scope in learning is proposed; Second: the three general categories of factors for the activities of Learning within the R&D process are produced, which are: 1) triggers; 2) drivers; and 3) enablers; Third: the sustainable driver model, which is generated in the Saterisk project [25] is added to the thematic element of Integrative R&D Process; Fourth: influencing factors in learning processes of the SATERISK project are stated; and Fifth: description of the roles of insiders are produced.

Besides the total of hundreds of credits obtained in the SATERISK project, hundreds of credits in Bachelor programmes, 165 credits in Master programmes, and 70 credits in Specialization studies have been achieved. The academic results so far (by May 2011) consist of: 2 journal papers, 8 Conference papers, 5 Master's theses and 3 Bachelor's theses.

The dissemination of the results of the project continues, and through publications, the knowledge can be more widely distributed. As for the towards future activities, there are also four major spin-offs of SATERISK which include AIRBEAM FP7 (14 M€, starting March 2011, coordinated by EADS Innovation Works), PERSEUS FP7 (40 M€, starting Dec 2010, coordinated by INDRA and Cassidian), AIR-I (a new innovative SME) and ENPI CBC (European Neighborhood and Partnership Instrument, cross-border cooperation) projects.

As for results in the way of learning, the ICT students started to study new tracking technologies, security management students tracking services in the security field and business students' models of new and novel business in the domains of satellites.

As for the methods, multidisciplinary studies were realized in dialogue with students and teachers [37]. The two students that originated the idea continued their studies within the development of the idea in their thesis that served as a basis for the funding application.

As for new roles, the project manager plays an important role in coordinating the project. Her main task is project management in general and integrating the scopes of the project into study units so that new knowledge and competencies can be created in partnership with multidisciplinary student groups, lecturers and partner companies in accordance with the LbD methodology. The integration of scopes is done in two ways: firstly, research needs are planned and secondly, new innovation ideas and solutions are gathered from the stakeholders. The scientific supervisor, together with the project manager, made sure that the target was clear and that the scientific quality of the dissemination of the result is of high quality. The planned activities of the project varied depending on the phase and active sub-projects.

Besides that view, the bottom-up approach of management is important so that the ecosystem of different stakeholders can come up with new ideas. The SATERISK project has been included in different information systems and security management study units in a multidisciplinary way e.g. in some study units, such as "Developing Service Innovations", the SATERISK has been one of the ten current R&D projects with such as described in [24] and which was offered to students at the start of the course and described in syllabuses.

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