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Preparing Engineering Students for the Global Sourcing Environment

Social Video Learning with a Blended Learning Framework in German Soccer Trainer Education

Learning & Development in Times of Digital Transformation: Facilitating a Culture of Change and Innovation

Structural Relationship among Intellectual Capital Dimensions

The Importance of e-Learning as a Teaching and Learning Approach in Emerging Markets

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Preparing Engineering Students for the Global Sourcing Environment

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L. Manzione  
University of Hartford, West Hartford, CT, USA  
manzione@hartford.edu

A. Abu-aisheh  
University of Hartford, West Hartford, CT, USA  
abuaisheh@hartford.edu

N. Sumukadas  
University of Hartford, West Hartford, CT, USA  
sumukadas@hartford.edu

S. Congden  
University of Hartford, West Hartford, CT, USA  
congden@hartford.edu

Abstract—Globalization and rapid changes in modern product development and realization are creating gaps in engineering education systems around the world. The global economy has changed the way that engineering firms design, develop, and produce their products. Companies need to evaluate many options available worldwide, not just locally. The current trends are only likely to continue as the world economy becomes more competitive, interdependent, and characterized by global relationships among supply chain partners. This paper presents a plan for preparing engineering students for the new global sourcing environments and product realization processes. Infusions of supply chain management and project management skills into the curriculum are recommended, as well as use of university-industry partnerships, course portfolios, and study abroad programs.

Keywords—engineering education, global sourcing, supply chain management, project management.

1 Introduction

Engineering education today is facing an unprecedented array of challenges. Today’s continuously changing world with ever increasing globalization has upended the
environment in which engineers have traditionally operated. In the face of such upheaval, an important question to address is how engineering education programs need to respond to these sea changes. Universities are constantly playing the game of catch up. While scrambling to prepare engineering students for this new era of globalization, the speed of change in the global environment very quickly outpaces the snail’s pace of curricular reform.

The development of a pipeline of engineers with the necessary skills to operate in today’s environment cannot really occur without paying close attention to the needs of industry. A new generation of engineers will need skills in areas such as project management, supply chain management, technology evaluation, quality engineering and product testing, among others. Engineering students will become employees who will need to know how to operate in the world of multiple simultaneous product lines, global sourcing, and extensive customer and partner interfacing.

In this paper, we present a strategic plan for preparing engineering students for the new global sourcing environment. This plan includes: Supply Chain Management (SCM) training; Project Management (PM) training; university-industry partnerships; course portfolios; and study abroad.

2 The Global Sourcing Environment

“Thirty years ago, many large firms were vertically integrated, meaning they owned some of their suppliers and/or customers. Today, this practice is much less common” [1, pp. 5]. Indeed, in today’s world “the typical manufacturer spends more than 60 percent of its total income from sales on purchased services and materials” [2, pp. 362]. In some industries, this figure can be “as high as 80 percent or more” [3, pp. 1]. Not surprisingly, “integrating suppliers and customers … is critical in today’s increasingly competitive environment” [4, pp. 213]. Unfortunately, companies are finding that “knowing this and doing it are two different matters” [4, pp. 213]. Given such a complex context, it is easy to see why engineering students need training to meet the new demands of this changing environment.

In addition to increasing reliance on outside suppliers, companies are increasingly selecting these outside sources from around the world. The new global business realities have created a global sourcing environment where firms need to adopt global sourcing strategies [5]. Accelerating these global trends are improved transportation, cost effective global delivery services, broadband networks, and information links, all of which are continuously eroding the barriers of time and space.

Global sourcing has affected not just purchasing practices, but also the entire way that firms design, develop, and produce their products. For example, a shift in business model from purchasing raw materials to purchasing assembled components will have significant implications for the redesign of a company’s processes. While communications technologies and convergence in business practices facilitate global sourcing of materials and assembled components, they also permit simultaneous participation in technical or product development projects from personnel from around the world, both from within and from outside a company.
Several studies have commented on the impact of globalization on supply chains for high-tech production lines [6][7][8]. The new realities mandate that companies evaluate design, development, and realization options from across the world. A plethora of areas within the company are bound to be affected, such as facility location, capacity planning, global bills of materials, duties, and local content requirements, among others [9]. Even the new product development (NPD) process has changed. NPD collaboration nowadays often spans corporate, regional, and national boundaries. Boeing’s 7E7 program, for example, involved 30 companies and spanned 8 countries [10].

It is within this global sourcing environment that engineering students must learn how to operate. These trends will only increase as the world economies become more interrelated, more competitive, and more interdependent. In such an environment, engineers must regularly prepare specifications and sources sought documents, communicate specifications to potential partners and suppliers, conduct technical evaluations on the multitude of global solutions available to them, assess capabilities of suppliers and partners, develop testing plans, as well as operate in different nations and cultures. To achieve that goal, their preparation should give them opportunities to master how to work in real life supply chain management.

3 Current Gaps In Engineering Education

We now proceed to examine engineering education programs in the context of the global environment described above. Taking a critical viewpoint, we notice that too many programs are not designed to provide students with the skills necessary to successfully operate in this new environment. Most significantly, students lack exposure to the skills necessary for operating within modern, global supply chains.

In addition to the above deficiency, we also notice some other important gaps. These gaps are also, in many respects, related to the global context. They include:

1. Inadequate emphasis on translating technical challenges to Requests for Proposals (RFPs) and Specifications.
2. Inadequate emphasis on technical evaluation of offered solutions.
3. Inadequate emphasis on business case vs. technical specification trade-offs.
4. Inadequate emphasis on systems engineering and industrial engineering.
6. Inadequate emphasis on Design for Manufacturing (DFM).
7. Inadequate emphasis on sustainable engineering solutions, and environmental impact of products, and processes to produce them.

To address such gaps in current engineering education programs, we propose a strategic plan that includes curriculum changes as well as teaching strategies. The changes are:

1. Training in Supply Chain Management (SCM) skills
2. Training in Project Management (PM) skills
3. University-Industry partnerships
4. Course portfolios
5. Study abroad

4 Supply Chain Management (SCM) Skills

As noted earlier, SCM has become an essential skill set for managers of global enterprises involved with the flow of goods and services towards fulfilling customers’ needs. SCM is the management of all activities involved in the sourcing of materials, the production of products, as well as the distribution of the products through wholesalers, distributors and retailers to the end user. It utilizes the methods of logistics and operations research to construct supply chains using holistic approaches that realize value at all nodes of the chain.

Robust supply chains allow businesses to deliver the most cost competitive and timely solutions to their customers by leveraging the capabilities of the multiple linkages in their supply chain. Many companies find that it is preferable to specialize in an area where they offer distinct advantages, while relying on supply chain partners for other specializations. By combining strengths, together they can create the best offer for the customer. Thus, in today’s highly competitive global business climate, dominated by multiple sourcing, effective and robust supply chains are essential for companies to leverage their supply chain partners to meet customers’ needs.

As companies are increasingly recognizing the need for SCM skills at all levels of the organization, engineering and business education programs across the nation are growing their offerings in SCM and the related discipline of logistics. While many different programs exist, with different flavors, we present an example that we have developed at our university. Working collaboratively, the engineering and business schools have developed a program in SCM that allows students to earn a post-graduate certificate or a concentration. This program is focused on developing a portfolio of SCM skills that are indispensable in the current complex business and engineering environment dominated by globalization and outsourcing.

The SCM program consists of four graduate courses (12 credit hours). Students enrolled in our M.Eng. program, as well as others with a prior undergraduate degree in engineering, can earn a post-graduate SCM certificate. Meanwhile, students enrolled in our MBA program can earn an SCM concentration within their MBA. As well, students already having an MBA from an accredited institution can complete a post-graduate SCM certificate.

Engineering and business students can enroll in the same courses, allowing them to learn with and from each other, and gain an interdisciplinary experience that promotes career readiness. Both engineering and business faculty teach courses to create a cross-functional learning environment. The program also includes a capstone course where students apply their skills to a process improvement project.

All students need a prerequisite course in Engineering or Managerial Statistics. In addition, students must complete four required courses in Operations Management,
Supplementary Management or Supply Chain Engineering, Lean Six Sigma Principles, and a Process Improvement Application Project.

5 Project Management (PM) Skills

“Projects are common in everyday life as well as in business” [2, pp. 50]. This statement is especially true in an engineering context. The engineer is constantly in the middle of some project or the other, whether it be a technology innovation project, NPD project, process improvement project, lean project, six sigma project, or a simple kaizen event. Thus, it is not an understatement to say that PM skills are essential elements of an engineer’s toolkit. With the increasing demand in a world economy to combine different tools for implementing projects, there is a greater need today for skilled project managers to improve company performance.

Globalization means that “many projects now involve global teams whose members operate in different countries and different time zones, each bringing a unique set of talents to the project” [11, pp. 3]. “For example, Boeing created global supplier/strategic partner teams for their new 787 Dreamliner aircraft to co-design and produce various portions of the new plane: the vertical in Seattle, WA, the cockpit in Wichita, KS, the wings in Japan, and the center fuselage in Italy” [11, pp. 39].

Thus, PM skills are important for both business and engineering students. In order to satisfy student and employer demand for knowledge and skills related to PM, many business schools are offering graduate level courses, and even complete degree programs, in PM. Some schools started out by offering concentrations in PM, and then expanded to MS programs. As with SCM programs, many different flavors can be found.

Once again, we present an example that we have developed at our university. Our PM program offers content similar to others, but is designed to be multidisciplinary. As with our SCM program, both engineering and business students can enroll in the same courses. Both engineering and business faculty teach the courses in a cross-functional learning environment similar to business settings where projects are managed. In addition, we decided to align the course content closely with the Project Management Institute’s (PMI) certifications, namely Project Management Professional (PMP) and Certified Associate in Project Management (CAPM). Thus, students completing the program qualify to take either the PMP or CAPM exam, depending on their prior project work experience, and are encouraged to do so. PMI certification signifies that students have achieved a recognized standard of global best practices.

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All students need a prerequisite course in Engineering or Managerial Statistics. In addition, students will complete four required courses in Operations Management,

6 University-Industry Partnerships

An important element in preparing students for a dynamic and global environment is the building of partnerships between universities and industry. These can take several forms. At a basic level, industry experts can be brought into classrooms as guest speakers or students taken on field trips.

A higher level would be student internships. Student motivation can be heightened by experiencing “real world” work settings, especially if students can see the application and relevancy of what they have learned in the classroom. There are many other benefits to students (e.g., finding good employment), but we focus here on the benefits related to making them better prepared for an increasingly dynamic and global work environment. (For a more complete review of the benefits and costs of internships to relevant stakeholders, see [12]).

At the higher end of the university-industry partnership spectrum, schools must actively seek industry involvement in curriculum development. Employers are on the front lines of change. The surest way to keep educational outcomes current and in tune with rapidly evolving industry requirements is to regularly revamp course offerings based on input from industry experts. Interaction should happen on many levels: Deans with advisory boards, curriculum committees/taskforces with either ad hoc or standing industry panels, individual professors with companies to whom they consult or do projects with, internship coordinators with employers, and so on. Our project management and supply chain management concentrations discussed above were refined with feedback from industry personnel.

Using the input of industry experts together with internships can create a virtuous circle. Companies can guide the relevancy of curriculum choices, which then allows students to experience more linkages between course work and their internship experiences. Better prepared and motivated students, along with other benefits to employers such as the ability to trial potential hires, should stimulate more internship offerings. Better internships and eventual job offers should attract better quality students to a college of engineering, and so on. A key part of this is that more involvement by employers gives them a larger stake in student outcomes and hopefully motivates deeper reflection on their part about curriculum.

This is not without costs. We believe at least a full time internship coordinator role should be done at the college level rather than relying on University-wide career placement services. Careful cultivation of quality internships specific to the needs of engineering students needs to take place. Much direct interaction of the engineering college with employers will be needed to provide the right internship learning experiences and to make sure feedback from the “real world” world is not lost. We believe that giving course credit for internships better communicates their importance to stakeholders. Project-based work formats as opposed to job-based work formats (see [12]) are preferable given the increasing importance of project management skills.
International engineering internships would be ideal in increasing a global perspective but would be difficult arrange on any large scale.

7 Course Portfolios

A course portfolio is a document prepared by a student that summarizes each chapter in the course. Preparing a course portfolio forces students to engage in deeper learning, as they have to understand the material thoroughly before they can rewrite it in their own words. A related benefit has to do with improving students’ technical writing skills.

Writing skills are essential in any engineering context since the consequences of miscommunication can be expensive. In a globally dispersed supply chain, these consequences can get magnified. Consider a simple example: A sends an email to a supplier, B; B doesn’t understand the email; but B is on a different time zone, so B cannot just pick up the phone to clarify the doubt; and so on. Given that a significant amount of engineering disciplinary knowledge cannot be communicated without strong technical writing, having excellent technical writers in the workplace is important for seamless collaboration.

A course portfolio also allows instructors to evaluate students’ understanding of course material. A helpful way to implement a course portfolio is to let students know that they can use only the course portfolio on the exam, and nothing else. To ensure that students differentiate between important topics and others, students can be asked to limit the length of each chapter portfolio.

8 Study Abroad

Several authors have written about the changing role of engineers in today’s evolving global environment [13][14][15]. This new role requires engineers to exhibit a greater appreciation of the tremendous variety of cultures, customs, and ways of operating that exist around the world. In contrast to universities in Europe, where many students not only gain fluency in multiple languages, but are also able to gain experiences in multiple nations and cultures, U.S. universities have been criticized for not preparing students with a global outlook. A great way to help engineering students think globally is to have them engage in study abroad experiences. No amount of reading about a distant place can substitute for the real thing.

To obtain a better understanding of the emerging global environment, it is important for students to develop an understanding of the world and the challenges faced by different regions, and the forces that hold them in balance. For example, technological challenges like climate change and sustainable energy sources can take on entirely different meanings in different contexts, with entirely different implications. Study abroad can provide students better insights into global marketplaces, economic trends, the availability and use of resources in different regions, and other factors that influence the success of technological ventures in different parts of the world. Stu-
dents also gain confidence and motivation to engage in further international undertakings.

While longer term study abroad programs (generally eight weeks or more) provide these benefits, it may not be practical for many students given time and/or financial constraints. Our strategy recommends the use of shorter-term programs. Short-term study abroad programs can increase participation and be done outside of the semester format. This is especially important for more structured programs like engineering [16]. While the benefits of longer-term study abroad are more accepted because of longer in-country experience, a study of 6,378 former study abroad participants found no significant difference in global engagement related to the duration of the programs; depth and intensity of the experience are what mattered most [17]. Short term programs often offer the advantage of being led by faculty from the home university, and can be controlled and structured to maximize student experiences during the time abroad, require ongoing reflection, and better integrate with student’s course work [16]. Short-term programs would also better allow students to have more than one study abroad experience, for example in both a developed and developing country.

We have had short-term study abroad programs in both developed and developing countries. One program sent engineering students to Germany to study how that country is using alternative and renewable energy. In a project led by our student chapter of Engineers Without Borders, students designed a solar-powered ground water pump system, and then traveled abroad to India to install it in a village. This program combined the benefits of study abroad and problem-based learning. Given limitations in what study abroad opportunities can be offered and/or sufficiency of students to make a particular trip viable, students are also encouraged to participate in study abroad opportunities in other schools such as the university’s school of business.

An important aspect of providing maximum depth of experience during the trip is on-campus components before and after the experience. While also meeting course contact hour requirements, study beforehand can establish a base level of learning that heightens perceptions of international issues during the visit. Prior learning could take many forms depending the nature of the program, such as differences in business/infrastructure context, the design phase of a problem-based learning project, culture, history, and even basic language instruction. Post-trip components provide a chance for reflection, exchange of experiences, and project presentations. The Florida Institute of Technology even uses online synchronous and asynchronous meetings before and after to extend opportunities to more students, such as part-time students, students from satellite campuses, or even from other universities to attain sufficient numbers of students to run a particular study abroad course [18].

9 Conclusion

In many respects, the world today is indeed flat [13]. Skilled human talent is more globally mobile than ever before. Consider what happened during the global financial crisis when thousands of project management professionals in Hong Kong were displaced by lower wage talent from China [11][19]. “As a result, Hong Kong PMs are
finding that they need to increase their value to business in order to compete with the new arrivals from China” [19, pp. 43].

Extending this logic to engineering education, universities need to be constantly aware of global shifts in demand for skills. In an era when even highly skilled professionals find themselves expendable, what to talk of engineering graduates who lack the necessary skills?

Many US companies are already accustomed to hiring global talent. The term “outsourcing” has become a common buzzword, not just in the manufacturing sector, but in several diverse fields as well. In the software field, for example, technology companies cite a lack of skilled local software talent as they continue to petition the government to issue more visas. Meanwhile, local software professionals bemoan depressed wages. On a similar somber note, unless engineering students are adequately trained for a global environment, it is no stretch of the imagination that companies will seek talent elsewhere. It is crucial, therefore, that universities prepare their graduates to operate in this new global environment.

In this paper we presented a strategic plan that will help better prepare engineering students for the new global sourcing environment. As we have outlined, universities can implement curricular changes that include training in SCM and PM skills. We also recommend the adoption of learning strategies such as university-industry partnerships, course portfolios, and study abroad.

10 References

11 Authors

**Louis Manzione** is the Dean of the College of Engineering, Technology, and Architecture at the University of Hartford. He has a B.E. degree in Chemical Engineering from the Cooper Union, and a PhD in Chemical Engineering from Princeton University. Prior to coming to the University of Hartford, he was with Bell Labs Research in Murray Hill, New Jersey. He was the founding Executive Director of their new Bell Labs Ireland division near Dublin. His research activities have been in the areas of microelectronics and manufacturing. He has 17 US Patents, and a number of these have been commercialized into millions of AT&T and Alcatel-Lucent products. In Connecticut, he is the Chair of the Connecticut Engineering Deans Council, and he is Past-President of the Connecticut Academy of Science and Engineering (manzione@ hartford.edu).

**Akram Abu-Aisheh** is an Associate Professor of Electrical and Computer Engineering at the University of Hartford. Professor Abu-aisheh is a senior IEEE member, and he has ten years on industry experience in the area of fiber optic telecommunication systems and power electronics. Professor Abu-aisheh’s research interests include optical communications and power electronics. Professor Abu-aisheh has a M.S. and B.S. degrees in Electrical Engineering from the University of Florida and a Ph.D. in from the Florida Institute of Technology (abua isheh@hartford.edu).
N. Sumukadas is with Barney School of Business, University of Hartford, West Hartford, CT, USA (sumukadas@hartford.edu).

S. Congden is with Barney School of Business, University of Hartford, West Hartford, CT, USA (congden@hartford.edu).

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Social Video Learning with a Blended Learning Framework in German Soccer Trainer Education

Frank Vohle
Ghostthinker GmbH, Hamburg, Germany
vohle@ghostthinker.de

Abstract—This Case Study describes a Blended Learning Pilot Scheme with focus on Social Video Learning (SVL) in the context of education for popular sports trainers in the German Football Association. The didactic design provides information on target groups, learning targets and the structuring of the learning environment. Finally, the first evaluation results under the framework of a design-based research study show the positive assessments by students and trainers together with the potential for improvement in the redesign of the next development cycle.

Keywords—Social Video Learning, Blended Learning, Trainer Education, Football, Web 2.0, Video Collaboration, Video Annotation, Design-Based Research.

1 Introduction

The pilot project is an in-service further training program for the B-License qualification (mid-level training). Two pilot groups were selected to put this into practice: In the Football and Light Athletics Association of Westphalia (FLVW), 23 trainers with an average age of 30 and in the Football Association for the federal state of Sachsen-Anhalt (FSA) 13 trainers with an average age of 26 received further educational training.

The aims of the pilot project can be summarized as follows: (1) Planning, implementation and evaluation of Blended Learning courses with the method focus on Social Video Learning, (2) focus on design and collaboration-oriented tasks in the online phases for the furtherance of trainer competence in technical-tactical perception and reflection.

2 Target Group and Aims

The pilot project is an in-service further training program for the B-License qualification (mid-level training). Two pilot groups were selected to put this into practice: In the Football and Light Athletics Association of Westphalia (FLVW), 23 trainers with an average age of 30 and in the Football Association for the federal state of
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### 3 Research Strategy

The pilot schemes initiated at the DFB are oriented to the scientific models of didactic development research and design-based research (Reinmann & Vohle, 2013). At the center is the development of teaching, learning and testing scenarios that are stable and useful in practice and which are realized through iterative phases of design, test, evaluation and redesign. Problem definition and step-by-step problem solution are undertaken together with the practitioners. At the same time both theory-based procedure and also theory-supporting work are demanded, whereby local design recommendations can be deduced. Fig. 1 (McKenny & Reeves, 2012, p.77) is the visual representation of how in iterative cycles an increasingly more mature intervention and deeper theoretical discoveries arise.

Against this background of (long-term) research strategy the initial cycle gave rise to the following media-didactic questions: (a) Is this new learning organization (Blended Learning) actively taken up and used by all those involved? (b) Is the method “Social Video Learning” classed as meaningful for the learning objectives to be attained?

![Fig. 1. Visual representation of how in iterative cycles deeper theoretical discoveries arise](http://www.i-jac.org)
4 Didactical Design

In the following part, because of similarity of structure between the two pilot projects, then only the didactic course design of FLVW is presented here in more detail.

**Blended Learning Framework:** The fundamental idea for the new study course design was based on retaining the previous scope of 120 learning units à 45 min. (presence), to be allocated to certain times and linked with additional online phases. This gave rise to a Blended Learning Structure with a typical interchange of online and presence phases stretching over 2 months, cf. Fig. 2.

**Online-Learning:** The online learning phases took place in the edubreak®SPORTCAMPUS (Fig. 3), a learning environment (LMS) with focus on “Social Video Learning” (SVL), developed especially for trainer education in sports (Vohle & Reinmann, 2014, Vohle & Reinmann, 2012).

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**Fig. 2.** Typical interchange of online and presence phases over two months

**Fig. 3.** edubreak®SPORTCAMPUS the webbased online learning environment
SVL is characterized by two technical-didactical innovations: The first of these is the possibility to comment on videos situation-targeted with text, drawings and symbols or annotations and secondly, by sharing and discussing these video commentaries with others (cf. Pea, Lindgren Rosen, 2008; Krammer & Reusser, 2005). In figure 4, the video player is seen as filtered with a video commentary and the overview of comments according to participant.

**Fig. 4.** The edubreak® player enables users to bring in written comments and drawings into the video.

**Content Design:** The learning aim in the online phases included “game reading”, which means recognizing the technical and tactical patterns in the game and also to verbalize with appropriate specialist terms. In support of this interpretation work, videos with football scenes are shown on the contents page.

**Interaction design:** Through observation tasks, trainers are required to incorporate video commentaries on tactics and techniques in-situ in the videos and to supplement the text comments with a drawing element. In addition the task also involved commenting on the previous video comments of other trainers in a critical and constructive manner.

**Supervision design:** The didactic design of the course was under the motto: High level management economy! Against the background of this objective the supervision was restricted to motivating and constructive News together with the introduction of expert commentaries (comments by Masters) as an effective form of feedback. The aim was to support the participants to compare their own reflection abilities with expert know-how (self-evaluation).
5 Empirical Results

In respect of the current pilot projects at the DFB it can be ascertained that a first cycle is run according to DBR (cf. Paragraph III), in other words, (a) the field was analyzed and explored in cooperation with Practitioners, (b) on a theoretical learning basis (Competence Orientation, Cognitive Tools, Video Reflection) whereby a learning environment with specific tasks for Social Video Learning was drawn up, (c) the Pilot project was carried out and (d) experiences were systematically collated and background aims evaluated. Under this framework of research strategy the following evaluation results can be classified at the same time understood as a “moment record” for the purposes of redesign of learning systems together with content, interaction and supervision design.

Examination design: The Pilot was evaluated in form and sum. In respect of form evaluation, field notes were introduced whereby the Author telephoned every week with the Course Supervisor in order to document problems, to discuss possible solution options and “just in time” implementation. The summarized evaluation comprised an online questionnaire (anonymous) for those taking part with questions about the acceptance of Blended Learning and the use of Social Video Learning. A follow-on on-line discussion (open) amongst the participants questioned the uses of the Sport Campus and Social Video Learning for the examination passed.

Result 1: The Online Questionnaire showed the following results (4-point scale, here positive and negative responses possible).

<table>
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<td>Could such a training concept, as you have now learnt it (Mixture of presence phases and online phases) accord with your personal Time Management?</td>
<td>22 Yes, 1 No</td>
</tr>
<tr>
<td>How do you evaluate usability in the Sport Campus?</td>
<td>23 good, 0 bad</td>
</tr>
<tr>
<td>How do you assess comprehension level for tasks in the learning environment?</td>
<td>21 good, 2 bad</td>
</tr>
<tr>
<td>Situation-related video commentaries enable the participants to deal more intensively with the video and observation tasks. Do you agree with this statement?</td>
<td>23 yes</td>
</tr>
<tr>
<td>An own perspective of the video content is expanded in that all video comments are seen after the deadline and then still possible. Do you agree with this statement?</td>
<td>20 yes, 3 no</td>
</tr>
<tr>
<td>The Sport Campus (platform) with focus on video work was developed for Blended Learning formats in Trainer Education. Has the Sport Campus fulfilled expectations?</td>
<td>23 yes</td>
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Result 2: In the open online discussion after the final examination the following questions were asked: Did you have the feeling that the Sport Campus (with didactics) had prepared you for your examination? What could we do better in future to improve similar training courses? Six course students took part in this open survey. Three persons classed the course as extremely helpful for the preparation for the oral examination, as “specialist terms are used more precisely by video analysis and interchange with other participants and with the lecturer was possible”. As well as this positive evaluation, those taking part also mentioned suggestions for improvement: The video commentary should be viewed only after expiry of the deadline. Time Management of
the Blended Learning phases was rather inconvenient for those people with jobs as too much had to be processed in too short a time (mostly in the evenings or weekends). The introduction of a grading system should be considered in order to provide a “reward” for services rendered. For the video players the “football-related” drawing tools (e.g. pathways as serpentine lines) should be fine-tuned.

**Result 3:** Apart from the assessments by participants, this Pilot Project also collated observations and assessments by the lecturer in telephone calls and online meetings. For example, at the beginning of the first “presence phase” the speaker establishes that the “group atmosphere is exceptionally good”, as it can be assumed that the participants already know one another before the online phase. He observes that through the writing down of the tasks involved one then has the sensibility for precise instruction, as by means of the video commentaries, it is quickly established whether the core of a set task is understood or not. In the “presence phases” there is a greater “openness for critical dialogue” because the persons taking part see the difference between their layman’s perspective (their video commentaries) and the comments of experts. In the end the lecturer assessed the effort-benefit ratio as “good” as with a relatively low level of supervision, “specific points of view” of the participants could be approached which as a rule are not made explicit by those taking part. Social Video Learning thus generates a totally new type of benefit.

6 **Conclusion**

When the results of the pilot project in Westphalia are summarized and supplemented with the very similar assessments of colleagues in Saxony-Anhalt then it is ascertained that the planning and implementation of a new teaching course format with Blended Learning and Social Video Learning can be classed as successful (feasibility) and specifically supportive of learning (target-orientation) in the further education of German football trainers. This is indicated by the overwhelmingly positive feedback from the participants in the online survey and the open discussion (with only a few exceptions), together with the field notes of the lecturer including suggestions for improvements in the sense of cyclical further development (Design-Based Research).

7 **Acknowledgment**

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8 **References**

IELA Award Winner—Social Video Learning with a Blended Learning Framework in German Soccer…


9 Author

F. Vohle is Founder and Managing Director at the EdTech-Company Ghostthinker GmbH, Hamburg, Germany (vohle@ghostthinker.de).

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Learning & Development in Times of Digital Transformation: Facilitating a Culture of Change and Innovation

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Karin Vey
IBM Research, Zürich, Switzerland

Tanja Fandel-Meyer
University of St. Gallen, St. Gallen, Switzerland

Jan S. Zipp
Zeppelin University, Friedrichshafen, Germany

Christian Schneider
University of St. Gallen, St. Gallen, Switzerland
christian.schneider@unisg.ch

Abstract—The digital transformation is the very heart of the Fourth Industrial Revolution, which is about to change our understanding of doing business, of learning & development in a fundamental way – and with unrivaled speed. However, many companies and individuals hesitate to acknowledge the depth and impact of current developments. We suggest to distinguish four reasons: the striking impact of advanced digitization is not yet fully recognized (1); there is a lack of imagination and strategy, coupled with increasing unpredictability (2); a lack of agility and insufficient encouragement towards innovation (3); and a lack of pertinent competencies and insufficient innovation culture (4). New roles and action areas for Learning & Development (L&D) professionals enable possibilities to overcome these innovation barriers: change agent & consultant; designer of an enriched learning portfolio of products and services; shaper of innovation culture. Also facilitating a learning friendly culture by using different pillars is a way to generate innovation and to secure the existence of organizations in times of digital transformation.

Keywords—Change Management, Digital Transformation, Innovation Culture and Management, Learning & Development

1 Digital Transformation: Pressure to Change and its Challenge for Organizations

The world is constantly changing – but now at an unprecedented speed, leading to extensive and fundamental transformations. According to Nolan Bushnell, engineer, entrepreneur, founder of Atari and important venture capitalist (VC), companies today
“have to radically revolutionize themselves every few years just to stay relevant” [1]. Technology and the Internet have changed the business landscape forever. And there is much more to come: we are at the beginning of a revolution that is fundamentally changing the way we live and work, the so-called Fourth Industrial Revolution.

For Klaus Schwab, founder and executive chairman of the World Economic Forum, there are three reasons why today’s transformations represent not merely a prolongation of the Third Industrial Revolution, but rather the arrival of a distinct Fourth one: velocity, scope, and systems impact. Today, enterprises must change constantly, and in an agile manner. Moreover, the changes are disrupting almost every industry, and their breadth and depth herald the transformation of entire systems of production, management, and governance [2].

This fundamental revolution shakes the foundations of our understanding of society and business. “The key building blocks are already in place for digital technologies to be as important and transformational to society and the economy as the steam engine” [3].

Self-driving cars, extremely efficient decision-support systems, sophisticated translation programs, 3D printing, advanced semantic image analysis, and a variety of useful robots have appeared in the past few years. Many things we have long known as Science Fiction are now becoming reality almost simultaneously. Artificial Intelligence (AI), respectively Cognitive Computing is driving many of these innovations. The cloud and all sorts of platforms have revolutionized how to set up and run a business. Innovative ideas can be realized in days, and the corresponding business set up almost “overnight”. The necessary infrastructure, processes, transaction mechanisms and payment schemes are all in place as services – thanks to the cloud. The new kid on the block can come “out of the blue”, from anywhere – it does not have to be a well-known competitor in your industry. “A few years ago, you could see the competition coming. Not anymore. Digital invaders can come from anywhere, anytime, before you even know they’ve arrived” [4]. In IBM’s 2015 Global C-suite Study, 54% of 5247 C-level executives from 21 industries in 70 countries responded that they expect more competition from other industries. This number increased by 26% compared with the 2013 results. In contrast, only 29% of all CxOs expect more competition from within the same industry (39% in 2013) [4].

We live in a “platform economy”: Uber, Airbnb, Facebook and Alibaba are well-known examples. Even five years ago, one could not have imagined that the world’s largest taxi service company will own no vehicles or that the world’s largest accommodation company owns no real estate. Alibaba as the world’s largest retailer carries no inventory, and Facebook as the world’s largest media company creates its own content! It is symptomatic that digital disruptors act as intermediaries by creating digital platforms that exploit on existing infrastructure, products, services, and content. This strategy enables a significantly faster growth rate than more traditional business models based on physical goods do. The widely known examples above show that the impact of digitization is already tremendous, but “the digital disruption of existing business models is still in its early days and will continue to threaten both new businesses and established enterprises” [5]. For existing businesses, these developments create the imperative to innovate.
Another significant innovation driver is the changing behavior of customers. Their expectations towards businesses, products and services rapidly increase. Nowadays, clients are better informed and increasingly expect individualized products and services as well as a unique customer experience. Businesses have to rethink what customers value most, and create operating models that take advantage of the latest technology for competitive differentiation. Sorofman states that 89% of companies expect to compete mostly on the basis of customer experience. Experience design is therefore in high demand [6].

Digitization transforms, and disrupts, businesses on various levels, be it in terms of new products, new services, or completely new business models that redefine and dissolve boundaries of existing industries. “The challenge for companies is how fast and how far to go on the path to digital transformation” [7, p. 1].

1.1 Many businesses hesitate or fail to act or react

Despite the rapidly changing business landscape and the resulting innovation pressure, many companies still hesitate to act. A 2016 survey of the Swiss-based Global Center for Digital Business Transformation, conducted with nearly 1000 business leaders around the world in twelve industries, showed that in about 45% of the companies the digital disruption is not a matter of board-level attention (on average across industries) [8]. In the same study, the respondents assume that half of today’s top ten incumbents (in terms of market share) in each industry will be squeezed out of the market by digital disruption in the next five years. Still, one third of the study participants are taking a “wait and see” approach in hope of emulating successful competitors, whereas only a quarter describe their approach to digital disruption as proactively willing to transform themselves in order to compete.

Reasons for this hesitation or reluctance to act are rather sophisticated and many-faceted, sometimes based on single details and sometimes firmly anchored in the corporate culture. Based on our own experiences with various clients from many branches, we propose to distinguish the following reasons for this hesitation, which may exist by themselves or in combinations.

1.2 The dramatically extensive impact of advanced digitization is not yet fully recognized

First, the truly all-embracing impact of digitization and its concomitant shifts have not yet been recognized by many leaders, despite well-known examples of digital “invaders”, such as Airbnb or Uber, that impressively demonstrate both the speed and impact of an all new way of doing business. A company producing a highly specialized range of physical niche products with long-standing business relations might hardly perceive the potential threat posed by disruptive competitors. Current conditions, such as a steady flow of orders and high revenue, block the view and prevent leaders from fully recognizing the all-changing impact of digitization. Moreover, it may be difficult to even imagine the digital counterparts of physical products and services that are still regarded as being unique and unrivaled.
1.3 Lack of imagination and strategy, coupled with increasing unpredictability

Thanks to digitization, a potential danger can turn into a real threat to existence almost overnight without an aggressor’s big investments or lengthy processes [9]. Trends and competition appear increasingly unpredictable: At the time of a market analysis, competition simply might not yet exist. As a result, businesses no longer seem to have a real strategic influence on their course of action, which can have a paralyzing effect: “It’s really hard to predict the rapidly evolving technology environment; you don’t know what you don’t know but you’re still trying to stay ahead of it” (Ian Cunningham, COO, Tangerine Bank, quoted in [4, p. 6]). Many enterprises still try to relocate themselves in the digital landscape considering the same traditional borders, and not realizing that trade branches and business models have fundamentally changed. Some companies have not yet developed an overall strategy to address the state of the world, which can be described using the trendy managerial acronym VUCA, which stands for volatility, uncertainty, complexity, ambiguity [10]. Although it is said that it is impossible to fully prepare for the VUCA world [10], distinguishing and addressing all of those four elements could help clarify the initial situation in order to establish a versatile strategy and tackle the unpredictability – something many companies fail to develop and execute.

The proactive approach of BMW is an interesting example to illustrate how an agile handling of digitization and its effects can be realized if all hurdles are overcome. Because BMW creates its own internal disruptions by redefining parts of its core businesses, it prevents external digital disruptors from pushing BMW into a reactive mode. The company extended its market segments to a three-layered system. On a physical level, there (still) is the traditional car selling. In digital spheres, BMW enters competition through a joint venture called “DriveNow” (“ReachNow” in Seattle [11]), a carsharing service in several cities across Europe and North America. On the “digital marketplace” level, BMW is about to launch a social car-sharing (known as “ride-sharing”) service rivalling Uber [12]. All three levels can co-exist, there is no hierarchy.

1.4 Lack of agility and insufficient encouragement towards innovation

There are not only new players in the game, the whole game is a different one: just because you are used to play cards, you cannot play chess. Handling such a fundamental change requires lots of imagination. Assume a company’s leaders fully recognize the current development and can even imagine a vision to react to it. This is true for many enterprises that want to tackle the emerging shift and are determined to be a part of it. However, the company’s culture, organization and structure might not be built to be flexible and agile. To tackle possible disruptors, it might be necessary to trigger an internal transformation first that changes the inner core, the corporate DNA with its norms and values. True change needs true authenticity – not just a new makeup. Leveraging an innovation lab or creating an internal position to promote innovation can be an effective starting point: Innovation labs may help to establish the agile innovative power of a start-up culture [13], but may sometimes serve more as an
alibi (“but we are doing something”), than as a first step towards a true redefinition of how a company sees itself and its field of business. Furthermore, external innovation labs might strengthen the development of two separated cultures instead of influencing core norms and values. This happens if there are hardly any exchange processes between the lab and the original part of the company, which may lead to a “Not invented here” (NIH) syndrome [14].

1.5 Lack of pertinent competencies (skills, knowledge, attitude)

Even with a clear vision that takes the tremendous development of digitization into account and an agile approach to realize and encourage innovation, some companies still struggle to tackle the challenges of digitization. If leaders and employees do not have the right competencies, the necessary new processes cannot be executed. With competencies, we refer to a set of skills, knowledge and attitude [15]. An organizational transformation cannot succeed without competent individuals who truly understand the meaning and complexity of digitization.

1.6 Insufficient innovation culture

Listed below are some of the typical barriers and challenges encountered in implementing a strong culture of innovation [16]:

— Uncertainty of managers and employees: What exactly does innovation mean for our organization? Do we share a common understanding?
— Absence of an explicit and motivating mission: Often it is only a blurry appeal from top management to be more innovative. That provides little guidance.
— Insufficient enablement or capability of Learning & Development (L&D) professionals to serve as innovation designers.
— Lack of willingness to take risks and to regard mistakes as an opportunity for learning.
— A management style that is not conducive to innovation: freedom of innovation, recognition, participation and empowerment.
— Insufficient exchange of knowledge within the organization and with customers.

Companies increasingly realize that they have to reinvent themselves and that they have to embark on that journey right now. But the big question is often the how: Where to start? How to stay competitive amid constant turbulence and disruption [17]?

2 New Roles and Action Areas for L&D Professionals

Another important ingredient in addressing the above problem is, in our opinion, the following question: How can an organization, in times of disruptive and continuous change, remain willing to learn and open for change and development? The pervasive trend to digitization does not grant much time to prepare; it is a challenge that needs to be analyzed, addressed and tackled on the go.
How can L&D professionals shape and support change as a “normal mode of operation”?

Moreover, one should also question whether in this context the established notions, competencies and classical training of change management are still current and applicable: “The change processes of today are being addressed using the models and assumptions of yesterday” [17]. The notion still seems to prevail that change processes still obey the traditional sequence of “melting/planning”, change, consolidation, and emergence of new routines. However, organizations typically see continuous change processes, and little or no phase of consolidation. In contrast, they often experience many parallel change processes.

In the following, we would like to show how L&D professionals can generate value for their organization in individually addressing and handling the challenges discussed in Section I.

**Challenges**: The gravity of developments is not yet fully recognized; there is a lack of agility and an insufficient commitment to innovation, and there is a lack of imagination and strategy coupled with increasing unpredictability.

**Role and priority of L&D professionals: Act as Change Agent & Consultant**

We advance the view that the role of L&D professionals should be that of Change Agents and Consultants for their organization to inject stimuli for changes in the organizational structure that allow the organization to deal with changes and to foster innovation. Hereby interesting concepts are Holacracy [18], Innovation Labs, and Acceleration [17, 19]. All these concepts share the aim to create new processes and roles in organizations by means of new structures that empower individuals through more participation and proactivity, thus fostering agility, innovation, and individual as well as organizational learning processes.

In addition to critically assessing suitable existing organizational structures, L&D professionals should also aim to introduce new forms of work and methods that support organizations in their drive to become agile and increase their development potential. Examples are Design Thinking, Scrum frameworks, and virtual tools to enable networked work in a team. Ideally, the L&D teams will themselves experiment with such agile and new organizational structures to increase their credibility and authenticity as consultants.

**Challenge**: Lack of pertinent competencies (skills, knowledge, attitude).

**Role & priority of L&D professionals: Designer of an enriched learning portfolio of products and services**

An expanded product and service portfolio of L&D professionals [20] serves as a fundamental starting point for successfully developing competencies in organizations (Figure 1).

L&D professionals should critically assess the content and learning tools (methodology) of any existing change management trainings and offerings to determine whether they are topical and correctly reflect the organization: Is more modern or different knowledge needed for mastering the continual and deep-reaching change processes in an organization? Is the digital transformation an explicit part of the development of competencies? Which skills are needed, and how can they be developed most efficiently, both methodically and didactically?
**Challenge: Insufficient culture of innovation**

**Role & priority of L&D professionals: Shaper of such a culture**

To shape a culture of innovation is probably the role L&D professionals are least familiar with. Given that their competencies are more in the areas of planning, execution and evaluation of learning concepts, shaping culture seems to be a job where creativity is not immediately needed for a start. However, in view of the challenges mentioned above that arise in our era of digital transformation and continual change processes, the enablement of a culture of innovation appears to be an important sphere of activity, with considerable creative potential for L&D professionals.

Already today various examples exist of how a learning framework that promotes innovation could look. One field of activity for learning professionals is the shaping and creation of learning spaces that promote both learning and innovation [21]. It is interesting that not only internal L&D professionals exploit this possibility, but also external vendors use this instrument and offer such learning and innovation spaces (for a fee). Deloitte, for example, offers its customers an exemplary tool with its “greenhouses” in various locations [22].

The new role of shapers of culture, combined with the traditional roles of change agent and consultant, a vision of the future emerges for L&D professionals that has a much stronger focus on the framework for creating learning and innovation opportunities (see also the notion of platforms/marketplace sketched in Section 1). Framework here refers to the enablement and active shaping of a culture of innovation: a culture of innovation can be regarded as the breeding ground in which notions, values and norms can evolve that promote innovation so that not only manager but also employees feel encouraged as well as empowered to pursue innovation as a fundamental driver in their activities [16].

### 3 Facilitating a Culture of Innovation

In an organization, the capability to innovate, and a viable culture of learning are closely connected [23–25]. Learning is a prerequisite for the performance of the organization and for innovation [26]. Learning professionals can shape this culture by various means and thus generate a framework that is conducive to innovation [27].
Various areas exist in which their efforts can be brought to fruition: processes, values, behaviors, recognition and climate [24, 28]. Subsequently, we provide the example of IBM Research – Zurich to illustrate these areas that can be shaped by L&D professionals and to highlight the versatile implementation of innovation:

The 10 pillars of the innovation culture at IBM Research – Zurich

1. **Grand Challenges** (recognition, processes): For grand challenges it is unclear whether they can be solved. They are set to unleash the creative energies of the organization. A prominent example is known as “Watson”, the cognitive computing system that competed and won against the two world champions in the quiz show “Jeopardy!” in 2011.

2. **Innovation Jams** (processes): According to the notion of “the power of the crowd”, members of the organization have the opportunity to add strategic topics to the agenda. It is also possible to put up the values of the organization for a grassroots evaluation.

3. **“Grounded Dreamers”** (resources, values): One key aim of the hiring process is to identify, and hire, people who, on the one hand, are visionaries, with their “head in the clouds”, but on the other hand are firmly rooted in the ground. The ideal candidate is able to move between those two worlds and transform this tension into creative energy.

4. **IBM Fellows** (behavior, recognition): IBM Fellow is the highest grade of recognition of technical eminence, and entails considerable freedom in setting one’s own research agenda.

5. **“Skunkworks” projects** (resources): Employees are given time to work on a project that is not yet considered to be of strategic relevance to IBM, but has potential to become an essential future asset.

6. **Global Technology Outlook** (processes): The GTO is IBM’s annual pulse-taking on emerging trends in the 3- to 10-year time frame in the company, the industry and in society. It is a mixed bottom-up / top-down process. All experts can participate. The ideas are presented to the management board, and are crucial for the development of the company’s overall strategy.

7. **Learning how to listen** (resources, climate): In order to know what is really going on in the company, active listening is key. Here IBM pursues, among others, the concept of Ed Schein (active listening & humble inquiry) [29].

8. **Agile approach** (processes): Agility today does not only refer to a development method, but signifies more and more the state of mind in the organization. It is about an experimental and iterative approach – „start small – measure everything (feedback) – fail fast / fail well & succeed big!”

9. **Treasure wild ducks** (values): Maverick thinkers are respected, valued and wanted.

10. **IBM ThinkLabs** (processes, behavior) Continuous exchange with the external world about innovation challenges and the creation of innovation eco-systems.
4 Conclusion & Outlook

The digital transformation and hereby mandatory change processes pose a multitude of challenges for organizations. L&D professionals can, and must, actively shape these processes and provide guidance to the organization tackling these changes. Respectively, their role and areas of responsibility expand. In addition to their core competencies of designing, teaching and evaluating learning formats, they will increasingly be called upon to perform the following:

- Be able to act in a professional manner in an environment of digital disruption.
- Support the organization as change agent and consultant in times of continuous transformation.
- Actively help shape a culture that is conducive to broad and constant learning, radical change and fundamental innovation.

Especially the role of culture designers promises to hold a large innovation potential. We have used the example of the innovation culture at IBM Research – Zurich lab to illustrate the manifold ways and areas in which innovation can be introduced as a core value and used as permanent excitation to remain in a constant change process.

Extrapolating from the developments sketched here, additional interesting questions arise for research and practice: Which are the key competencies that will enable L&D professionals to support organizations in better managing emerging roles and tasks in the future? What is the role of managers in the era of digital transformation? How will they interact/collaborate with L&D professionals? In view of the rapid rate of change, will the “learn how to learn” eventually become more important than the content itself?

5 References


6 Authors

Karin Vey is Executive Briefing Manager at IBM Research, Zurich, Switzerland.
Tanja Fandel-Meyer was with University of St. Gallen, St. Gallen, Switzerland.
Jan S. Zipp is Ph.D student at Zeppelin University, Friedrichshafen, Germany and Research Assistant at IBM Research, Zurich, Switzerland
Christian Schneider (corresponding author) is Research Assistant and Ph.D. student at the Institute of Business Education and Educational Management at University of St. Gallen, St. Gallen, Switzerland (christian.schneider@unisg.ch).

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**Structural Relationship among Intellectual Capital Dimensions**

Marco Alberto Núñez Ramírez  
Instituto Tecnológico de Sonora, Ciudad Obregón, Sonora, México  
marconunezitson@gmail.com

Joaquin Nunez  
University of Texas at El Paso, Texas, USA  
jr_nunez1996@hotmail.com

Roger Alejandro Banegas Rivero  
Universidad Autónoma Gabriel René Moreno, Santa Cruz, Bolivia  
aleconomista@gmail.com

María Nélida Sánchez Bañuelos  
Instituto Tecnológico de Sonora, Ciudad Obregón, Sonora, México  
nelidasb.21@gmail.com

**Abstract**—The purpose of this research is to address the degree of association among intellectual capital dimensions (human capital, structural capital and relational capital). For this reason, a quantitative methodology and a non-experimental design were used. Using Pearson correlation, structural equation modeling and linear regression we tested the study hypotheses. Through a sample of 103 companies from Cajeme, Mexico, a positive and significant association was found among intellectual capital dimensions, whose results provided empirical evidence that human capital can explain to structural capital and relational capital in organizations.

**Index Terms**—correlation, dimensions, intellectual capital, structural equation modeling.

1 **Introduction**

New changes are occurring in the world economy [1], which have made that intangible assets being considered as basic elements to generate a competitive advantage for the companies [2-5], where intellectual capital (IC) plays an important role [6-9].
IC is a term used to synthesize and evaluate the resources of the organization whose nature is intangible [10].

Although this view was originated from Penrose's approximations [11], as well as Machlup [12] and Drucker's work [13], today, the management of intangible assets is increasingly a necessity. Then, the industrial era is over and was supplanted by the knowledge era [9]. For this reason, managers in this new age must understand that compete with knowledge is the privilege of few [14].

Now, knowledge is the company's most important resource [4, 15]. Knowledge is an asset and, just as all assets, has to be managed, so whoever finds and controls them, triumphs (Stewart, 1998 [9]). Therefore, the management of intellectual capital is a necessity, because only 20% of the knowledge available to the company is used [8].

This is explained by The Resources-Based View (RBV) proposed by Barney [3], which argues that the intangible assets—as long as they are rare, valuable, inimitable and irreplaceable resources—can give the organization a sustained competitive advantage. In special, within The Knowledge-Based View (KBV) proposed by Grant [4], where knowledge is considered as a central resource, which is managed through intellectual capital [10].

The appearance of IC is considered as a product of the knowledge era [16]. This arose from the need to value companies through a more detailed way, going beyond the visible assets, until consider the relevance of the intangibles that the organization has to compete. It represents the fusion between two positions: management and knowledge measurement [15].

Within the principal antecedents of intellectual capital, is possible to highlight Müller's work (1779-1829), who wrote about a scientific and mental capital as a set of constructive powers of man, state and society [17]. Another of the pioneers of his study was Lawrence Dicksse, who was the first to mention the concept of intangible in the company in 1896 [18].

However—although its origins are located within the 19th century—, it was until the late 1950s and early 1960s that the study of intangible assets began to become relevant within organizations. Especially in the Penrose's work [11], where the intangible assets were conceived as generators of value in the organization. On the other hand, Machlup [12] and Drucker [13] argued the economic value of knowledge and, with that, the beginning of the knowledge society.

In that period—especially in 1969—, was when John Kenneth Galbraith called for the first time the intellectual capital as an intellectual action beyond knowledge or pure intellect [19]. However, the study of this variable received more attention until the beginning of the 1990s, with the Skandia model [6], which was the first of different models that have tried to explain this variable.

According to Roos, Roos, Dragonetti, and Edvinsson [15], no model is more important than the other when trying to explain intellectual capital, because of this it is necessary to consider them together. For this reason, within the different theoretical approaches that explain IC is possible to find different models such as Balanced Scorecard (Kaplan and Norton [20], The Skandia Navigator [6], The Technology Broker (Brooking [8]); Western Ontario University Model (Bontis, [7]), Valoración y
It is important to note that these models present their own dimensions to study intellectual capital. For example, Skandia [6] and Edvinsson [22] divide IC in client, financial, human, processes and renovation; Bontis [7], in human, relational and organizational; Brooking [8], in market, human, property and infrastructure; while Stewart [9], in human, technological, structural and client; Edvinsson and Malone (2001) [16], in human, clients, organizational and innovation; CIC [21] in human, organizational, technological, relational, business and social.

From the above, it is possible to observe that within the indicated models there is a certain consensus in the existence of three basic dimensions of intellectual capital: human, structural and relational. However, it is still unclear how is he relationship between these dimensions. For example, within the approximations of Skandia [6], Edvinsson [22] and, Edvinsson and Malone [16], the relationship between these capitals is very close. Even, according to Bontis [7] and, Ahmad, Naji and Bontis [23], there is a mutual interdependence between these dimensions, which together, have an impact on performance.

Also, according to Edvinsson and Malone [16], and Stewart [9], not only is there a close relationship between the variables, but human capital is the basis for the development of structural and relational capital. For Bontis [24], too, there is a causal relationship between human, relational and organizational capital.

These theoretical postulates show the need for empirical evidence which provides information about the relationship among intellectual capital dimensions. This is why the following research questions are proposed: How are intellectual capital dimensions associated with each other? How does human capital influence on structural capital? and How does human capital influence on relational capital?

To answer the research questions the following hypotheses are proposed:

- \( H_1 \): Intellectual capital dimensions are associated by a significant and positive way.
- \( H_2 \): Human capital has a significant and positive influence on structural capital.
- \( H_3 \): Human capital has a significant and positive influence on relational capital.

2 Intellectual Capital

2.1 Definition of intellectual capital

Intellectual capital may seem like a new approach, but in practice it has existed for years through common sense [22]. This theme has become more attractive for companies seeking to gain benefits through innovation and knowledge [25]. In essence, it is a term used to synthesize and evaluate those organization resources whose nature is intangible [10], which has caused controversy about this variable. Although there is no consensus on a definition fully accepted by the academic community about intellectual capital, different visions have emerged to try to conceptualize this variable.
According to Brooking [8] IC is the combination of intangible assets that belong to the company. Moreover, it is knowledge possession, applied experience, organizational technology, customer relationships and professional skills that give a competitive advantage in the market [16]. It includes information, intellectual property, knowledge and experience [7]; organizational processes, technologies, employee skills, as well as information about customers and supplies [9].

Therefore, IC is a term given to all intangibles, which allows organization management [8]. This can be used to create value, considering relationships with customers and partners, innovation, company infrastructure, and knowledge, as well as employee’s skills and talents [15]; which is configured by everything within the company, in other words, its resources, intangibles processes, patents, customers, as well as tacit and explicit knowledge [26]. Consequently, it involves human, structural and relational capital [7], aspects that are described below.

2.2 Human capital

Human capital (HC) is very important for the organization, because it is a necessary resource for innovation and strategic change and, at the same time, has a great influence on how a company must be structured [27]. HC is a combination of inherent genetics, education, experience, as well as life and business skills [28]. Moreover, represents value of knowledge and talent which are embodied or possessed by the people who conform the organization, Including values, attitudes, skills and abilities [29].

In addition to, Brooking [8] classifies HC into two types of assets: intellectual property and individual-centered. The first includes intellectual property assets, know-how, manufacturing secrets, copyright, patents and design rights, brands and services. These are the result of the mind but belong to the company and are protected by law, although varies by country. While human-centered human assets are based on the knowledge. They emerge from a more long-lived population with a greater demand of life quality and include collective experience, creativity, problem-solving ability, leadership, entrepreneurship and management skills. Furthermore, involve psychometric indicators about how individuals can perform in situations such as teamwork and stress.

2.3 Structural capital

Structural capital (SC) includes all non-human knowledge containers, which involves databases, process manuals, strategies, routines and analyzes that value the company [26]. It is important to emphasize that an organization with strong structural capital has a culture that allows people to perform tasks, fail, learn and try again [28].

Also, SC is the set of knowledge and intangible assets derived from the processes of action that are owned by the organization, which remains there when people abandon it. Even it is composed of organizational capital and technological capital. The first is associated with design, processes and culture; while the second type is linked to innovation, the use of technological endowment and its results [21].
2.4 Relational capital

Relational capital (RC) involves knowledge of market channels, customers, supplier relationships, and understanding of government impacts [26]. Among others, includes market orientations, customers, competitors and market learning systems. The essence of this capital is to relate outside and inside the organization [28].

RC can be defined as the set of knowledge that is incorporated into the organization and people as a consequence of the value derived from the relationships, which maintains with the agents of the market and the society in general. It also consists of social capital and social capital [30].

Social capital is the company's set of relations with the social agents that affect the integration, commitment, cooperation, cohesion, connection and social responsibility [31-32]. It consists of relations with public administrations (collaboration and participation in public management), media and corporate image (brand awareness); as well as environmental care, social relations and corporate reputation [30].

3 Method

3.1 Research approach and design

A quantitative approach was employed in this research because numerical data were used to test the study hypotheses [33]. It is also correlational because the association among intellectual capital dimensions was measured [34]. A transversal study was done because the information was collected only once in time; while that its design is not experimental since no manipulation of variables nor subjects was performed [35]. For the analyses and data processing, the statistical package for social sciences (SPSS, version 21) and structural equation modeling software (EQS, version 6.1) were utilized.

3.2 Study sample

In this study, a non-probabilistic sample was obtained for convenience, which was conformed by 103 companies from Cajeme, Sonora, México. Some of the main characteristics of these companies are shown in Table 1.

3.3 Measurement instrument

The general measurement instrument of the study was composed of a socio-demographic section and one instrument whose purpose to measure intellectual capital.
Table 1. Characteristics Of The Studied Companies (N = 103)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size of the companies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro</td>
<td>39</td>
<td>37.9</td>
</tr>
<tr>
<td>Small</td>
<td>32</td>
<td>31.1</td>
</tr>
<tr>
<td>Medium</td>
<td>12</td>
<td>11.7</td>
</tr>
<tr>
<td>Large</td>
<td>20</td>
<td>19.4</td>
</tr>
<tr>
<td><strong>Market orientation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National</td>
<td>79</td>
<td>76.7</td>
</tr>
<tr>
<td>International</td>
<td>10</td>
<td>9.7</td>
</tr>
<tr>
<td>Both</td>
<td>14</td>
<td>13.6</td>
</tr>
<tr>
<td><strong>Activity of the companies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>22</td>
<td>21.4</td>
</tr>
<tr>
<td>Commercial</td>
<td>29</td>
<td>28.2</td>
</tr>
<tr>
<td>Services</td>
<td>52</td>
<td>20.5</td>
</tr>
</tbody>
</table>

In this case, a Spanish version of a questionnaire to measure intellectual capital was used, which was based on Subramaniam and Youndt [36], and comprises 14 items answered using a Likert-type scale with five options to respond, ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*), where higher scores indicated higher levels of agreement.

Moreover, although in the original study the dimensions were called human capital, social capital and organizational capital [36], we chose to name them as human capital, structural and relational capital, as defined by Skandia [6], Bontis [7], Stewart [9], CIC [30] and Edvinsson and Malone [16]. For this reason, the study variable was operationalized as in shown in Table 3.

Exploratory factor analysis was followed to measure the validity of the measurement instrument, using principal component analysis with Varimax rotation. Favorable values were found in the index Kaiser-Meyer-Olkin (0.834), Bartlett’s test of sphericity ($X^2 = 1199.40, gl = 276, p < .001$), and factorial loads greater than 0.45 in all the questions [37-38]. Furthermore, all the items were grouped according to the dimensions proposed by the authors (see Table 2).

Moreover, it is important to mention that a reliability assessment of the variables of the measurement instrument and its dimensions was performed by means of the Cronbach’s alpha coefficient, where all coefficients resulted above the normal levels of acceptance: human capital ($\alpha=0.823$), structural capital ($\alpha=0.842$) and relational capital ($\alpha=0.85$) (see Table 3).
Table 2. Exploratory factor analysis (N = 103)

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Qualified Employees</td>
<td>.813</td>
</tr>
<tr>
<td>Employees are the best</td>
<td>.698</td>
</tr>
<tr>
<td>Creative employees</td>
<td>.826</td>
</tr>
<tr>
<td>Skilled employees</td>
<td>.587</td>
</tr>
<tr>
<td>Develop of new ideas</td>
<td>.525</td>
</tr>
<tr>
<td>Use of patents</td>
<td>.055</td>
</tr>
<tr>
<td>Knowledge in databases</td>
<td>.131</td>
</tr>
<tr>
<td>Organizational culture</td>
<td>.189</td>
</tr>
<tr>
<td>Conversion of knowledge</td>
<td>.182</td>
</tr>
<tr>
<td>Relationship between employees</td>
<td>.408</td>
</tr>
<tr>
<td>Information sharing and learning</td>
<td>.300</td>
</tr>
<tr>
<td>Interaction and exchange of ideas</td>
<td>.293</td>
</tr>
<tr>
<td>Relationship with suppliers and partners</td>
<td>.046</td>
</tr>
<tr>
<td>Applied knowledge</td>
<td>.114</td>
</tr>
</tbody>
</table>

Note: Boldface indicates highest factor loading. 

h² = communality

Table 3. Dimensions and Reliability (N = 103)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dimensions</th>
<th>Elements (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intellectual capital</td>
<td>5</td>
<td>0.823</td>
</tr>
<tr>
<td>Human capital</td>
<td>4</td>
<td>0.842</td>
</tr>
<tr>
<td>Structural capital</td>
<td>5</td>
<td>0.85</td>
</tr>
<tr>
<td>Relational capital</td>
<td>5</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Note: α = Cronbach’s alpha coefficient.

4 Results

After obtain favorable results, both in the validity analysis –exploratory factorial analysis– and the reliability, Structural Equation Modeling (SEM) was performed. Using the EQS software, a standardized structural model was obtained through the three types of intellectual capital: human capital (HC), structural capital (SC) and relational capital (RC).

Figure 1 shows that the IC dimensions were significantly and positively associated. Moreover, adequate values were found in the adjustment measures of the structural model, through the indicators: χ²/gl, RMSEA, CFI, IFI y NNFI (see Table 4). These results coincide with those obtained by Pearson correlation in the relation between: HC-SC (r = 0.369; p < .001), HC-RC (r = 0.617; p < .001), SC-RC (r = 0.267; p < .001), as is shown in Table 5. In this way, the empirical evidence could support H₁.
Table 4. goodness-of-fit indicator of the models for capital intellectual dimension (N= 103)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Accepted value</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$</td>
<td>120.49</td>
<td></td>
</tr>
<tr>
<td>df</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>$\chi^2$/df</td>
<td>&lt;3.0</td>
<td>1.324</td>
</tr>
<tr>
<td>RMSEA</td>
<td>0.06&gt;RMSEA&lt;1.0</td>
<td>0.083</td>
</tr>
<tr>
<td>CFI</td>
<td>&gt;0.90</td>
<td>0.924</td>
</tr>
<tr>
<td>IFI</td>
<td>&gt;0.90</td>
<td>0.926</td>
</tr>
<tr>
<td>NNFI</td>
<td>&gt;0.90</td>
<td>0.903</td>
</tr>
</tbody>
</table>

Note. The accepted values were taken from Ho [34]

Table 5. Correlation of factors (N = 103)

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>HC</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>SC</td>
<td>.369</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>RC</td>
<td>.617</td>
<td>.267</td>
<td>---</td>
</tr>
</tbody>
</table>

Note. $p < 0.01$ (two tails).

On the other hand, linear regression was used to test $H_2$ and $H_3$, where we found that human capital influences structural capital and relational capital. In both cases, the effect was positive and significant; however, the explanation was 13% and 38% according to the statistic $R^2$ (see Table 6).
Table 6. Regression analysis considering to “human capital” as independent variable

<table>
<thead>
<tr>
<th>Factor</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC*</td>
<td>.511</td>
<td>.128</td>
<td>.369</td>
<td>3.990</td>
<td>.000</td>
</tr>
<tr>
<td>RC**</td>
<td>.666</td>
<td>.085</td>
<td>.617</td>
<td>7.871</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note. *R² = 0.136; **R² = 0.380.

5 Conclusion

It is important to consider that the value of knowledge is in growth [15], because money has become dematerialized and intangible assets have become more valuable and powerful than natural resources, large factories or bank accounts [8]. Therefore, the study of intellectual capital has become increasingly important, especially within the Latin American context.

From a theoretical approach, according to Grant [4], KBV is based on the process of transfer, absorption capacity, appropriation, specialization and transformation of knowledge into products and services within the company. However, to be a reality, this requires intellectual capital, which through the development of human capital allows the transfer of knowledge through structural capital, and then, this can be reflected in the relationship that the company has with its customers, suppliers and society [19].

The results obtained with 103 companies from Sonora, Mexico, show that there is a significant relationship between the three dimensions of intellectual capital. This consists with Skandia [6], Bontis [7], Edvinsson [22] and, Ahmad, Naji and Bontis [23]. In addition to, this empirical evidence shows that human capital –through the attitudes, knowledge and skills–, allows the development of structural and relational capital, as proposed by Bontis [7], Edvinsson and Malone [16], and Stewart [9].

Consequently, through Pearson correlation and structural equations modeling, the three hypotheses of study were sustained; however, the evidence found does not allow the generalization of the findings. Nevertheless, the most important thing of this study is that it showed how these capitals are associated from a structural perspective.

For future research, would be convenient to perform a validation study for the instrument proposed by Subramaniam and Youndt [36], in spanish version. This could favor the study of intellectual capital with Latin American organizations, because this instrument is short, easy to administer and clear; in addition, this showed adequate results within the exploratory factor analysis and structural equations modeling, as well as the level of reliability.

On the other hand, it is recommended to do a study with a larger sample within the Mexican context, where it also includes other intangible variables such as knowledge management, innovation, learning, organizational culture, and other intangible variables, in order to measure their association.

Considering that the principal limitation of the study is the size of the sample—103 companies—, because Jackson [39] recommends to have at least 200 subjects for the use of structural equations. However, according to Ho [34] there is still no consensus about the minimum sample to use this statistical technique. Therefore, for future re-
search it would be advisable to do the study with a larger sample, especially if the instrument will be validated.

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7 References


8 Authors

Marco Alberto Núñez Ramírez is with the Department of Management, Instituto Tecnológico de Sonora, Calle 5 de febrero 818 Sur, C.P. 85000, Ciudad Obregón, Sonora, México (marco.nunez@itson.edu.mx).

Joaquín Nunez is mechanical engineering student at the University of Texas at El Paso, Texas, USA. (jr_nunez1996@hotmail.com).

Roger Alejandro Banegas Rivero is with the Universidad Autónoma Gabriel René Moreno, Santa Cruz, Bolivia. He is also Director of the Institute of Economic and Social Research “José Ortiz Mercado” (IIES-JOM) (aleconomista@gmail.com).

María Nélida Sánchez Bañuelos is master’s student of organizational management at Instituto Tecnológico de Sonora (nelidasb.21@gmail.com).

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The Importance of e-Learning as a Teaching and Learning Approach in Emerging Markets

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Amy Wong
GlobalNxt University, Kuala Lumpur, Malaysia
amy.wong@globalnxt.edu.my

Karin Sixl-Daniell
MCI Management Center Innsbruck, Innsbruck, Austria
karin.sixl@mci.edu

Abstract—Technological advances in information and communication technologies have led to the emergence of e-learning systems that can be used effectively as a teaching and learning approach. For emerging markets, e-learning is of special relevance, as it can provide access to education at a relatively low cost compared with traditional settings as there is no associated travel or housing costs. Additionally, internet access in emerging markets has increased steadily in the recent years.

This paper discusses the importance of e-learning as a teaching and learning approach and its relevance in emerging markets. The paper presents some findings from four sections of a Faculty Certificate of Online Training (FCOT) program conducted by GlobalNxt University. The learners consist of faculty from India (n=20), South Africa (n=19) and Malaysia (n=9), which are representative of countries in the emerging markets. The paper examines the implications of the findings, and concludes with possible directions for the future of e-learning as a teaching and learning approach in emerging markets.

Keywords—E-Learning, Emerging Markets, Faculty Online Training Certification, Faculty Training Program

1 Introduction

Technological advances in information and communication technologies have led to the emergence of e-learning systems that can be used effectively as a teaching and learning approach. E-learning relates to learning that utilizes electronic technologies to access educational curriculum outside of a traditional classroom. It can refer to a course, program, or degree delivered completely online (North Carolina e-Learning Resources, 2015 [1]). There are many terms used to describe learning that is delivered online, via the internet, ranging from distance learning, to computerized electronic learning, online learning, or internet learning, among others.
It is important to note that e-learning differs from distance learning, as the former is interactive and can be delivered through a variety of means both synchronously as well as asynchronously, while the latter is non-interactive (i.e., hardly any or no interaction between the learner and the professor and between the students) and can be delivered via the internet, a DVD or CD-ROM, in an asynchronous mode. Although the recent years have seen a proliferation of massive open online courses (MOOCs) offered on platforms such as edx.org, coursera.org and futurelearn.com, these courses tend to have a certain element of interaction but are, due to their nature with up to tens of thousands of learners in one course, less interactive than other e-learning programs.

This paper discusses the importance of e-learning as a teaching and learning approach and its relevance in emerging markets. The paper presents some findings from four sections of a Faculty Certificate of Online Training (FCOT) program conducted by GlobalNxt University. The learners consist of faculty from India (n=20), South Africa (n=19) and Malaysia (n=9), which are representative of countries in the emerging markets. The paper examines the implications of the findings, and concludes with possible directions for the future of e-learning as a teaching and learning approach in emerging markets.

2 Benefits and Limitations of E-Learning

A major advantage of e-learning is the elimination of face-to-face training and development costs (i.e., travel, lodging, meals), both in monetary terms as well as in terms of productivity loss, as learners spend time away from their daily activities and jobs in order to participate in the face-to-face training sessions.

E-learning courses are available 24/7, location independent, and provide effective and efficient training means for learners in geographically dispersed areas and across time zones. Such delivery allows for portability of the training (i.e., tablet/iPad, laptop, mobile phone that can be used for downloading files or assessing video and webinar links, etc.), which makes the learning convenient and on-the-go, especially with the proliferation of network, computers, laptops, PDAs and mobile learning.

Learners can also self-pace their study progress, catering to their own work-life balance, hence bringing about increased learner satisfaction and success. Not only can the interactive content in a good learning management system (LMS) or massive open online course (MOOC) captivate and engage the learner, it can also deliver the learning material in a more comprehensive and concise manner and can be designed to suit a variety of learning styles by using e.g. videos, text, discussions, vodcasts and other means.

Compared to traditional classroom learning, e-learning allows for a consistent delivery of the course content, as the online videos can be pre-recorded and shared with the rest of the class. This leads to scalability of e-learning, as the same course can be delivered immediately to numerous learners worldwide.

Moreover, with a good learning management system (LMS) or massive open online course (MOOC), expert knowledge can be communicated to and captured
effectively by an unlimited number of learners supported by interactive user forums and communities, while updated content and information can be disseminated quickly and cost effectively. Further benefits include the possibility of continued management of course quality as the entire course content, contributions and communications both from the professor as well as from the students are recorded in the LMS.

Despite the above benefits, there are a few limitations of e-learning such as upfront investment and development costs in e-learning solutions. Technology can also be a hindrance if there is a lack of infrastructure to accomplish the learning goals and processes, whether it is hardware or software related. There might exist a cultural barrier in e-learning and technology adoption, depending on the demographics, psychographics and the geographical location of the learners, which may predispose them against using computers, laptops, tablets, or smartphones for e-learning [2]. Finally, the lack of face-to-face interaction can be a potential disadvantage due to the impersonality and lack of body language related communication. To a large extent, this can be overcome with the increased use of synchronous tools in the e-learning environment.

3 Relevance of e-learning to emerging markets

For emerging markets, e-learning is of special relevance, as it can provide access to education at a relatively low cost compared with traditional settings as there is no associated travel or housing costs. E-learning can also be utilized as an educational tool to complement existing literacy programs in emerging markets (e.g. Philippines, South Africa, India, and Malaysia) where limited resources, poor infrastructure, and lack of physical access to higher education is widespread. Additionally, internet access has increased steadily in the recent years, with an internet penetration rate of 63 percent in China [3]. According to the World Bank, there is increased internet usage worldwide, both in developed as well as emerging markets [4]. Internet usage continues to be highest in the most developed regions, however, the increase in usage is highest in emerging markets, particularly in markets with the lowest usage in 2008 (e.g. annual growth of 23 percent in Sub-Saharan Africa over the period 2008 until 2015). As reported by Internet Society, there are currently more than one billion users in emerging Asia Pacific countries [5].

Given the high usage of smart mobile devices in remote areas, internet accessibility has become less of an issue in recent years. It is not uncommon to have more than one subscription/number which leads to extremely high internet penetration rates, especially in developed markets where rates can exceed 100 percent. Compared to some developed markets, this rate is not as high in emerging markets, however, the growth rate is certainly projected to outpace developed markets (e.g. central and Latin America with a projected annual growth rate of 23%) [6].

Although internet penetration rates have been growing in emerging markets, bandwidth might still pose an issue for users. This place added emphasis on appropriate instructional design and facilitation customized for emerging markets (e.g. limited/no videos, limited/no webinars and other live streams). E-learning offers plenty of oppor-
tunities for people in remote areas to connect and communicate with others, and exchange views and ideas through various means (e.g. email, chat, discussion board, team assignments).

4 E-Learning tools

Several e-learning tools can be used in the teaching and learning approach to enhance transfer of knowledge and aid better recall among learners [7]. Some of the tools are as follows:

- Announcement tools, emails
- Discussion Boards, Blogs, Wiki
- Videos, vodcast, podcast
- Content Authoring Tools
- Live Webinars
- Instant messaging, Skype, Whatsapp
- Social media tools - Facebook, Twitter

With the increased variety of e-learning tools, selecting a single format for an e-learning program can be challenging as there are a plethora of options to choose from, ranging from the very basic off the shelf type e-learning tools to the very complex, customized models that may be quite expensive [8]. Moreover, the format of the e-learning program could determine the effectiveness of the program in many ways. As internet access and bandwidth speeds vary greatly depending on the region and culture, synchronous web camera enabled webinars and 100 percent web-based programs with large graphical files, animations, and high definition videos may not be ideal.

In emerging markets where bandwidth is limited, an entirely new program may needs to be devised. Given the potential issues with bandwidth in emerging markets, the use of bandwidth-intense tools may not necessarily be feasible. Although streaming videos might work well in some areas with good connectivity and appropriate bandwidth, in emerging markets with limited bandwidth, connectivity and expensive access, text-based tools might be more suitable. Specifically, the process of designing and facilitating online classes in emerging markets requires a good understanding of preferred teaching and learning approach, as well as the strengths and limitations of the technology available for delivering the e-learning program.

5 E-Learning as a teaching and learning approach in emerging markets

Data for this study was collected from four Faculty Certificate of Online Training (FCOT) programs conducted at GlobalNxt University in 2015. The FCOT is a 6-week online program, conducted via both synchronous and asynchronous mode. It is designed for faculty involved with some form of online teaching and/or who wish to embark on online teaching. The program aimed to equip learners with the basic
knowledge on teaching and facilitating online classes, designing online courses, assessments, and providing an effective online learning experience for students. The program covered aspects of e-learning including learning theory, learning design, learning tools and technology, online facilitation and interaction, online assessments, and academic integrity. To collect data, a qualitative online discussion forum approach was adopted.

The participants of the four FCOT programs consisted of faculty from India (n=20), South Africa (n=19) and Malaysia (n=9), which are representative of countries in the emerging markets. Participants were asked to post their views and perspectives on how they would go about designing and facilitating an online class in their own institutions. They were also asked to reflect on the plethora of e-learning tools and technology introduced in the program, and choose their preferred communication tools.

They were also encouraged to interact with the rest of the participants by probing and discussing further via the online discussion boards. This led to heightened social interaction among the participants as well as increased contextual influences, which impacted on the participants’ statements and helped generate rich data [9], [10], [11], [12].

Qualitative content analysis was used to analyze the discussion board data [13]. Categories for coding were defined following an inductive approach where both authors separately analyzed the postings submitted on the discussion boards. To identify the emergent themes, each author separately listed the themes that resulted from the discussion board question. Next, the emergent themes were compared and consolidated, resulting in a subsumption of all categories, with an inter-rater reliability of 100 percent. A final analysis of the data further guaranteed summative reliability and allowed for a summative analysis.

6 Discussion and Findings

The following section presents the results of the summative qualitative analyses conducted.

The four main areas for categorizing the participants’ preferred e-learning and communication tools included the (1) course opening, (2) course delivery, (3) course assessment, as well as (4) faculty attributes. As can be seen, participants used these four main areas to plan, organize, design, and implement a new online class. Within each area, participants documented the various e-learning and web 2.0 tools that they intend to use as their preferred communication tools, taking into consideration the profile and needs of students in emerging markets.

6.1 Course Opening

Participants recommended introductory webinars, both compulsory as well as non-compulsory sessions. Some participants suggested the use of a web camera for their introductory webinars, however, they were mindful that this might not always be
feasible in emerging markets due to potential bandwidth issues. Some participants recommended that the facilitator post an introductory announcement, opening the class few days prior, and detailing its syllabus and content overview to set clear expectations and guidelines.

The participants also advocated the use of an introductory video. Given the potential issues with bandwidth, participants agreed that this would work as an additional method as the students can choose to download the short video at their own free time. The participants suggested posting an introductory note and photo to the discussion board, which might be something both the facilitator and the students could adhere to, so that they can connect with everyone in the class. One participant mentioned the use of “selfies” to break the ice at an introductory level so that students would get to know each other better. Alternatively, the use of narrated PowerPoint presentations was proposed.

Another preferred method for opening a course include the use of emails for introductory purposes. The participants suggested the inclusion of course outlines, objectives, and outcomes in these opening emails. They also recommended the use of a “course overview document for clarity” that includes information on suggested readings and articles. This could be augmented by sending photos of the facilitator in his/her email.

The participants also proposed to use social media such as Facebook and LinkedIn to break the ice, although some participants voiced concerns about moving out of the LMS into social media, as seen by the quote

“Staying within one virtual space (the LMS), in my views, serves to support coherence and logical thought in student discussion and interaction. The sense of a single “learning space” also sustains social presence. External social network sites like Facebook, that are essentially open-ended, seem likely to encourage distractions and tangential activities rather than a focus on the course”.

An important area mentioned was an orientation session to the LMS, possibly with videos to explain the steps required in maneuvering the LMS. It should be noted, however, that such sessions are usually offered prior to the start of the program, for new students who are taking the online class for the first time. Again, videos may pose a problem in emerging markets due to potential bandwidth issues.

Some participants recommended an introductory face to face session to explain the LMS features and to avoid subsequent technological issues. However, this might not necessarily work in emerging markets with potential long distances to/from campus and insufficient infrastructure, which is the main reason why students are opting for an online study program. Participants also suggested the use of “navigation screenshots” to explain the LMS, though this should be the job of the tech support or student care team. Finally, participants suggested creating additional informal discussion boards, such as a peer support forum and a student care forum designed to enable students to get help when needed.
6.2 Course Delivery

To help students stay on track throughout the course, various approaches were suggested. First, the participants suggested to “Be sure to get students to participate right from the start”. Another participant recommended the use of a “participant diary” to record the daily activities that took place in the online class. The participants recommended the use of “online calendar tracking” to help students stay on track, which can be used by the facilitator to actively monitor student performance and “email those who are struggling”.

Further measures proposed were the use of discussion boards with set topics, and new ones regularly added on a timely manner to show faculty presence. This can be complemented with the use of open discussion boards for relevant topics. The results clearly indicated the importance of facilitator presence and engagement, and that the facilitator needs to open and close discussions in a timely manner, be active on the discussion boards, and promptly replies to messages and provides frequent feedback. If discussions go off track, the facilitator has to “steer discussions” or “manage discussions”. One participant mentioned the use of “role play in discussion boards”, although it was not explained how this would work. Discussion boards were recommended to be both graded as well as ungraded so it can be seen as a “fun, non-credit bearing exercise”.

The participants also suggested conducting webinars, both at regular and irregular intervals. These webinars should include discussions and polls as well as Q&A. Separate Q&A sessions (e.g. “fixed consultation slots”) can be scheduled to help weaker students. Additionally, webinars conducted by industry speakers as well as students can be organized.

The participants proposed the need for the LMS to be mobile friendly. The use of social media such as Facebook, Whatsapp, SMS and GooglePlus as well as Youtube, Skype and phone calls were mentioned. Indeed, social media generates instantaneous posts and eliminates geographic and time boundaries, connecting learners that are physically separated but digitally connected. Social networks are capable of reaching a greater audience as it allows learners to share information, resulting in more online discussion and views. Social media is an economical and affordable alternative to traditional face to face teaching and learning methods, as it allows for two-way communication between students and the professor. To reinforce this, one participant suggested the need to:

“Encourage students to share personal stories and experiences and set an example; use the tools available to create a sense of immediacy; encourage students to become involved, allow the uploading of files including images, PowerPoint and videos.”

The use of case studies, wikis and reflective blogs were also recommended. For group work, the participants suggested the use of a name for each group and the use of a group logo to build team cohesiveness and bonding.

The participants also suggested the use of blended learning though, it should be noted that this might not necessarily be the best approach for emerging markets.
The use of interactive graphs, images and charts was suggested in addition to webinars and videos, while podcasts and mobile apps were suggested. Announcements and the use of emails (“if necessary, for one-on-one communication”) throughout course delivery were recommended. The use of an e-library, articles, and links to external sources were also seen as an important component of effective course delivery. To sum up on course delivery, one participant mentioned:

“I think that as a facilitator, we have to have a "bag of tricks" at hand” ... the time consuming way of interaction means a need to plan online presence to avoid 24/7 presence ... we must balance the use of technology/bag of tricks with our role as a facilitator/academic/lecturer”.

6.3 Course Assessment

For course assessment, the participants proposed the use of relevant rubrics for evaluating the following: discussion boards, quizzes, essays, individual assessments, team assessments, self-assessments, peer assessments, weekly multiple choice questions, self-assessments with feedback, learning portfolios, summary videos, and rankings. Discussions about open book vs. closed book exams and plagiarism/academic integrity and honesty also took place.

6.4 Faculty Attributes

In terms of faculty attributes, the participants recommended that faculty members should have the ability to connect and to be dynamic, knowledgeable both in the subject as well as an “authority in an online setting”. Other important attributes of an online facilitator cited include: be a motivator, encourage students and make them feel safe, possess good planning and time management skills, confidence, patience, respect, trust, and power.

7 Conclusion

This paper discusses the importance of e-learning as a teaching and learning approach and its relevance in emerging markets, where bandwidth is limited, and an entirely new e-learning program needs to be devised. Contrary to developing markets, the findings showed that the use of bandwidth-intense tools may not necessarily be feasible in emerging markets. The findings reinforced the use of four main areas for categorizing the preferred e-learning and communication tools in emerging markets, namely (1) course opening, (2) course delivery, (3) course assessment, as well as (4) faculty attributes.

Online facilitators can use these four main areas to effectively plan, organize, design, and implement teaching and learning initiatives in emerging markets. Within each area, various e-learning and web 2.0 tools can be used, taking into consideration the profile and needs of students, as well as the internet access and bandwidth speeds in the various emerging markets.
Given that the growth rate in internet usage in emerging markets is projected to outpace developed markets [14], institutions need to prepare for the future growth in e-learning in emerging markets. As a start, institutions can consider designing and delivering learning content in a mobile-friendly environment, or take a step further to invest in the creation of mobile learning apps where learners can view and share content on the go [15]. This would certainly contribute to a rise in access of e-learning to learners from all around the world, especially in emerging markets.

8 References


9 Authors

Amy Wong is with GlobalNxt University, Kuala Lumpur, Malaysia (e-mail: amy.wong@globalnxt.edu.my).

Karin Sixl-Daniel is with MCI Management Center Innsbruck, Innsbruck, Austria (e-mail: karin.sixl@mci.edu).

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Software Server for Automatic Generation of Audio Lectures (uListenSrv)

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Milen Petrov
Sofia University, Department of Software Engineering, Sofia, Bulgaria
milenp@fmi.uni-sofia.bg

Asen Asenov
Sofia University, Department of Software Engineering, Sofia, Bulgaria
aasenov.bg@gmail.com

Adelina Aleksieva-Petrova
Sofia University, Department of Software Engineering, Sofia, Bulgaria
Technical University, Sofia, Bulgaria
aaleksieva@tu-sofia.bg

Abstract—Facilitation of new methods for learning materials delivery and adoption of new learning experiences and practices in e-learning is always a challenge. Using synthesis of digital audio learning assets and learning objects as one of main sources for conducting learning is not new, but research on using audio lectures or combined audio with presentation lecture is not well investigated and adopted in traditional online learning environments. The main goal of current paper is to present requirements elicitation, software analysis, design, construction and testing of secure and reusable software architecture for production and delivery of learning resources with audio elements in university programming courses. Paper presents different architecture styles for designing the system and finish with presentation of development and usage of contemporary Software Server for Automatic Generation of Audio Lectures (uListenSrv). Main difference here is support of languages, not only in English, but not so popular languages, like Bulgarian language.


1 Introduction

1.1 Overview

Current work represents analysis, design, implementation and testing of software server called uListenSrv - that is web–based, platform independent system that gives opportunity to transform wide variety of presentation and text files into voice readings, available for download. As input system takes existing provided presentation
documents (lectures) or other learning resources, then transfigured into online based presentations with embedded sound. The system cope with information security management and works with user accounts, where registration and its use is entirely free of charge. The developed architecture satisfies following software requirements: multi-tenant, configurable, client-server, service-oriented, modular, and extensible in nature. Communication between client and server components in the system are protected with secure channel, using standard HTTPS protocol. End users communicate with the server and explore system functionality using web client. The server layer provides access to core functionality via software services through network, which are documented to facilitate usage from external software systems, and learning management systems (LMS).

<table>
<thead>
<tr>
<th>Criteria for evaluation</th>
<th>Appearance</th>
<th>Google Translate</th>
<th>YakiToMe!</th>
<th>iSpeech!</th>
<th>SpokenText</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote access</td>
<td></td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Offline use</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Open source</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Free use</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Extensibility</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Search in files</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>User friendly interface</td>
<td>10</td>
<td>9</td>
<td>6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Voice quality</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Main functionality, provided by the proposed software server system, can be summarized as follows:

- Reading of HTML, TXT, PDF, DOC and many other file types, generating and playing audio recordings (WAV).
- Parse PPT and PPTX presentation formats and visualize them in web based presenter, with embedded slides reading.
- Adding file ratings.
- Enable searching in uploaded files name and content.
- Maintain user accounts, allowing registration, login, logout, file sharing, and custom settings.

System is divided into subcomponents and each subcomponent is designed as sub-project in order to foster reuse of software and architecture decisions.

1.2 State of the art

In the literature audio lectures widely are used in general in language learning, for example [1]. In other research [2] audio readings were introduced into two courses (ten offerings) using Apple Computer's iPod audio player for delivery and total of 20 audio files were created to use in the courses which results in suggested three signifi-
cant factors: preference, usability, and experience of end-of-course surveys indicated that there is significantly higher satisfaction scores for those courses with audio readings compared to those courses without audio readings.

Interesting study [3] which contributes to personalization in multimedia learning by evaluating if there are differential effects between using audio that is instructor-narrated (i.e. all the students personally know the narrator) versus expert-narrated (i.e. none of the students know the narrator). In this study there are created two identical instructional audio files about a difficult conceptual topic. The only difference between these two treatments is that one audio was done by an "expert" that the students did not know and the other was done by their instructor whom they saw in class at least once a week. In both cases the content of the audio was exactly the same. Students in a large undergraduate nutrition course listened to two audio case study analyses as part of an online module about vitamins and minerals and their satisfaction is studied.

As next step to previous study we propose to measure satisfaction of students with adding generated audio lectures with the lecture which they know very well, and using lecturers words, but audio is produced by usage of audio-generation software, known as text-to-speech software. Finding a good free software for non-English language is a challenge, especially for not popular languages, such as Bulgarian language.

Good support for audio and other multimedia resources in W3C recent recommendation HTML 5 [4] in browsers, as well as other devices such as e-book readers like Kindle Fire, smart watches [5] becomes more and more popular. Common usage of audio-visual lecture today is by facilitating YouTube platform [6] or similar general purpose media services with live-recorded lectures or screencasts.

Using recorded audio materials or audio materials with images is not that common in university courses. For example in Software Programming courses and courses in Software Engineering stream or learning in corporate environment, workplace or by lifelong learners. In our opinion in general: using audio resources as learning experience is under used in general education systems, if used at all. There are several factors for such situation:

- It is not easy to create only audio lecture as that cannot be fully replaced by presentation materials and live lectures, given by human instructor.
- Audio resources in general are not searchable, if transcript is not created (which is not easy/cheap to achieve). It is even harder to automatically generate transcripts in non-English languages.
- It is huge and time-consuming task to create recorded audio lectures. Moreover if there is need to search, update, edit or delete such a resources-can be a challenge.

We come to the idea to design and implement secure software architecture, which addresses these challenges:

1. Fast and easy creation of audio resources from text slides, using open source components.
2. Make resources searchable.
3. Being time consuming task - once done - it is important to make easily re-used audio lectures in Personal Learning Environment (PLE) [7, 8] and as general learning resources in Learning Management Systems (LMS) [9] such as Moodle.

Making resources easy reusable is very important goal as tools, extracting course content can perform repackaging of the content for reuse in different learning environments [10].

In table 1 are compared several existing tools for text-to-speech transformation such as “Google Translate” [11], “YakiToMe!” [12], “iSpeech!” [13], and “Spoken-Text” [14]. Selected criteria for evaluation are: remote access, offline use, open source, free license, extensibility, search (in files), user friendly interface, and voice quality. As result we concluded, that there is need for new server software system, which satisfied initial user requirements, which are described in details in section III below.

1.3 Structure of paper

In next section of paper, named "Analysis of Web-based Software Architectures" there is presented one attempt for categorization of different type of web-based Software Architectures which are elicitied as possible software design for our server system according to number of servers and number of web clients and their disposition (local or remote), for both client and server – as in Table 2. Different architecture characteristics has their positive sides and drawbacks, discussed here.

### 2 Analysis of Web-based Software Architectures

#### 2.1 Software architecture categorization

Here we made categorization of several software architectures, which are elicited as possible software design for our server system according to number of servers and number of web clients and their disposition (local or remote), for both client and server – as in Table 2. Different architecture characteristics has their positive sides and drawbacks, discussed here.

<table>
<thead>
<tr>
<th></th>
<th>Single client</th>
<th>Different clients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single server/single database</td>
<td>Traditional client-server</td>
<td>Traditional client-server</td>
</tr>
<tr>
<td>Multiple server (single database)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Multiple server (Multiple database)</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2. Web architecture classification.
On Fig. 1 is depicted first scenario (1) - one local server, which accepts connections from multiple clients. Multiple ‘local’ clients, connects to same local ‘server’ and share same data; can produce and share audio lectures asynchronous/sequential to potentially different local users. This software architecture can be called kiosk system – any user can be served, but only one user in same time.

On Fig. 2 is depicted use case scenario (2) - remote server is on the left on the figure and several clients on the right. Mixed mode means remote and local clients are allowed. We can have synchronous and asynchronous client-server communication. Usage scenario here can be called Personal Learning Environment (PLE). Allows roaming client user to different places with multi-homing hardware and/or software environments.

On Fig. 3 is depicted scenario (3) - typical server model-view controller (MVC) deployment architecture. This means, that it cannot be used offline as PLE. This can limit some of the usage scenarios.

On Fig. 4 are depicted packages and on Fig. 5 is software architecture of multi-tenant scenario (4) - which allows same client to connect to different servers – one at a time. Thus with one client can achieve both – having possibility for using as PLE or LMS.

Looking at different possible architectures, we decided to implement last architecture, as giving great flexibility, security and reusability.
Fig. 3. Software architecture: traditional server-only deployment

Fig. 4. Package dependencies and operations
3 Architecture for Audio Presentation System

3.1 Introduction

As initial data for the system is needed existing presentation documents (for example ppt). Next these are transformed into online based presentations with embedded sound. Selected software architecture is multi-tenant software architecture (on Fig. 5).

3.2 Software functional requirements

Current work represent elicitation, analysis, design, implementation, and testing of web based software, platform independent system, with main feature to transform wide variety of text files and file formats into voice lecture. In current sub-section main functionality provided by the system can be summarized as follows – functional requirements, which corresponds to the software requirements of the system:

• REQ1: File processing - reading input files. Reading of HTML, TXT, PDF, DOC and many other file types, generating and creating files with audio speech synthesis (WAV).
• REQ2: Presentation processing - parsing and pre-processing presentations. Parse PPT and PPTX presentations and visualize them in web based presenter, with embedded slides reading.
• REQ3: Resource ratings - adding file ratings.
• REQ4: Searching in content - enable searching in uploaded files name and content.
• REQ5: User preferences - maintain user accounts, allowing registration, user login, user logout, file sharing, custom settings.
• REQ6: Multilanguage support – support at least English and Bulgarian languages.

3.3 Software non-functional requirements

Non-functional requirements are specified as well:
\begin{itemize}
\item **NFREQ1**: Modularity, system is divided into subcomponents and each subcomponent is implemented as subproject in order to foster reusability of software and architecture decisions.
\item **NFREQ2**: Multi-tenant user-interface, allowing one user with client software is able to configure and use different content provider server.
\item **NFREQ3**: Service-oriented decomposition allowing to evaluate different quality characteristics of services.
\item **NFREQ4**: Easy to distribute and install - for lower newcomers to use the server.
\item **NFREQ5**: User-friendly and simplicity in graphical management interface allowing good user experience, without heavy settings for administration.
\end{itemize}

4 Implementation of Audio Lecture Generation Software

4.1 Module structure of software

Main identified modules for implementation are as follows:

\begin{itemize}
\item Module 1: Content extraction.
\item Module 2*: Auto-correction.
\item Module 3* for manual review and process improvement (enrich dictionaries and tools, which filters, compacts and/or enrich presentations). Also possible cross-cutting concern for modules injection using IoC software principle.
  \begin{itemize}
  \item dictionary module interceptions;
  \item terms dictionary;
  \item abbreviations dictionary;
  \item quiz and pre-/post- assignments.
  \end{itemize}
\item Module 4: Searching and indexing of extracted text (Elasticsearch).
\item Module 5: Web services layer (Restlet);
\item Module 6: Web user interface layer (SPA);
\item Module 7: Database layer and database design (SQLite).
\end{itemize}

Requirements for modules 2 and 3 was discovered after completing the system, discovering gaps and defects in initial implementation and elicited need for advanced quality tools.

The implemented system uses few third party libraries and resources. For file content extraction is used Apache Tika [16]. For searching in extracted text is used Elasticsearch [17]. Web services are developed using Restlet platform [18]. Used database is SQLite [19].

All third party software libraries and platforms are successfully combined, used, extended and refined to accomplish the goal for maximum user satisfaction. The system can be successfully used by education institutions, as tool in training and learning on workplace, serious games, by disabled people, and regular users. Such working server software can easily be used for making research and experimenting with different quality characteristics of software systems (such as availability, security and so on). User-interfaces are designed as multi-tenant software and currently are tested and
adopted for using on one server, but system is designed to be distributed via different 'tenants'. Each tenant can select any server available. One of the aims of the system is to be easy-to-install and easy to use software system. On table 3 are given classification of different of architectures that can be achieved with current implementation. As conclusion using last scenario is hard to achieve. It give to user flexibility to use learning environment in the way they want – either as traditional Learning Management System or as Local/Personal Learning Management System.

### Table 3. Web architecture classification

<table>
<thead>
<tr>
<th>Server</th>
<th>Case name</th>
<th>Access different devices</th>
<th>Multiple users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local One client (1)</td>
<td>YES NO Personal Learning Environment (PLE)</td>
<td>NO NO NO</td>
<td></td>
</tr>
<tr>
<td>Local many clients (2)</td>
<td>YES NO Group Learning Environment (GLE)</td>
<td>NO YES NO</td>
<td></td>
</tr>
<tr>
<td>Remote One/many client/s (3)</td>
<td>NO YES Remote Learning Environment (RLE)</td>
<td>YES NO YES</td>
<td></td>
</tr>
<tr>
<td>Remote many clients (4)</td>
<td>YES YES Multi-tenant learning (MTL)</td>
<td>YES YES YES</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Module dependencies

On Fig. 4, named “Package dependencies and operations” above - main modules and their dependencies are depicted.

We have three layers:

- 1st layer: data-store and server middleware – responsible for parsing presentation, indexing content, produce text-to-speech generation.
- 2nd layer: web services layer – with RestletWadlExt module and RestAPI – responsible for reuse of functionality. It decouples client from server, and thus give us possibility to change implementations of client or server in any given time, without breaking functionality of the other layer.
- 3rd layer: client layer – contains of AdminUI module – which is “fat” client (desktop application) and second module is initial prototype of Client UI software (named WebUI).

4.3 Implementation

Authenticated resources case implementation is depicted on Fig. 6 below. Building blocks here are start component, basic state of client software application, authenticated clients, decision module for resources that requires authentication and finally two kinds of audio resources- with public access and with access which requires authentication and authorization processes.
Here we have main **UltimateSpeakerBasic Application**, which checks if requested audio resource requires authentication. If yes, then go to **UltimateSpeaker AuthenticatedApplication**, authenticate first, and then access the resources. If no, then get access to public audio resources.

**Fig. 6.** Public and authenticated resources scenario

**Fig. 7.** Main user management use cases
Main scenarios of user management use cases are depicted on diagram Fig. 7. Alongside with common user management use cases such as registration, login, log-out and profile creation and update - there are Software Settings, available even before the user is logged to the system. This allow user to change configuration where desired server is located. For example servers can be at local computer (localhost), or at remote IP address.

Depending on the server, there can be located different audio resources – for different courses. Or even resources for the same course, but with different level/skills pre-requests and different intensity of the learning. Scope of the each of the servers can be logically defined and recommended for different types of learners.

Main scenarios of authenticated (registered and logged) user are depicted on use case diagram on Fig. 8. User story here include use cases such view online presentation use case, preview presentation use case, download original file use case, download speech synthesis use case, rate resources use case, and share resource to other registered users.

![Fig. 8. Main authenticated user use cases](image)

Developed Software Server, called uListenSrv supports all of the described server functionality. How this looks like and how it is tested – is described in next section of current paper.

5 **Usage of the system**

Here are provided description of basic steps for creation and sharing audio lecture.
5.1 Server-side – start and configure server

First we start server (Fig. 9). Then configure server settings (fig 10), where we follow requirements NFREQ4 and NFREQ5 (as described in section IV) – for simple and user-friendly customer interface.

![Screenshot of admin client](http://www.i-jac.org)

**Fig. 9.** Screenshot of admin client

Administration client, which itself contains all the server software and management client has modest, but powerful set of options. From here it is possible to conduct major operation with the server software – to start and stop server, to clear cache, to manage server settings, and monitor server log.

Server setting dialog is depicted on Fig. 10 below. There is option to edit server port (by default it is 8181, but can be easily changed. Last, but not least – support of different client is done by configuration of server directory.

![Screenshot for server settings](http://www.i-jac.org)

**Fig. 10.** Screenshot for server settings
5.2 Client-side software prototype – create audio lecture

When user is authenticated he or she may or may not change settings of speech synthesis and document processing details (where is appropriate). As available settings are default document encoding (important for pronunciation of digits, numbers and dates, support of markup in the learning material text and many others, mainly related to speech synthesis options. On Fig. 11 is given screenshot from settings panel of client. You need to setup server address, port and audio generation preferences. Here port and URL/IP of the server are combined as one setting.

![Server Settings](image)

**Fig. 11.** Screenshot for web client settings

Before start usage of the system, the user is required to register first (Fig. 12), using appropriate email and password.

![Registration Form](image)

**Fig. 12.** Screenshot of registration form
Paper—Server for Automatic Generation of Audio Lectures (uListenSrv)

After successful registration the user will be logged into the system (Fig. 13), then is needed to go to upload tab page (Fig. 14), and to upload desired learning material presentation file (commonly power point format). Newly registered user has no available files. Next they can log in with old user with already existing files (Fig. 15).

Before registering a new user or login into the system – it needs to configure URL address and port of the desired server. When user is registered for first time it needs to configure its settings. After registration there are no available files (see Fig. 13).

When uploaded – resources are already available and listed in convenient way. You can navigate to the next or previous page or directly to any specific page with resources.
In order to make available generated audio lecture to other external user of the system it is need to share it (see Fig.16). Press Share button for the audio resource for sharing, new Share File Dialog appears and then enter email address of the user or users and press again Share button. As result selected resource is shared to specified user.

These steps are enough to start using shared document. Usage of shared documents are described in more details in next section.
5.3 Client-side – use audio lecture

Login with another account, which already has shared resources. Example from the client prototype on Fig. 17 is depicted screenshot from rating component in client module in the system. When rate any given resource – you change general rate index of that resource.

![Fig. 17. Screenshot of view and rating by user in web client](http://www.i-jac.org)

First use-case for shared resource can be started by pressing View button, then new window is opened and presentation is appeared (Fig. 18). Then you can navigate through the slides, start, stop, pause and mute presentation with standard controls. Moreover there are two modes – for auto play of slides when open new slide, or by manual starting audio.

![Fig. 18. Screenshot of audio-lecture as presented to user in web client](http://www.i-jac.org)

Next you can delete audio presentation or download original presentation (in initial ppt format). You can press Download button and system will ask if you prefer to download original file, or speech file (Fig. 19). If you select Speech button – the file will be saved locally. Then user can open it with default audio player of the operating system or on mobile device. Use case scenario for downloading only audio file describes a new approach for sharing and using learning materials.

Next you can search all available presentations in search tab. There are available two scenarios – searching in the file name – when stat typing – it shows autocomplete dialog (Fig. 20) – if file name starts with first letters. Or second scenario – you can do full-text search (see Fig. 21).
When resource is located as a result from the search – preview of content is given and keywords are highlighted.

User can view all documents, where matches searching criteria, ordered by their rank. Other feature such as rating of the resource is used to see the rating, credibility or quality of the resource. Searching and free rating of the resources can help different users to create and share lectures.

Last feature, presented here is packaging resources in single page and offline use. That can be achieved as in web client you can press CTRL+S keyboard shortcut or save from the browser menu, point download folder and audio presentation with all resources will be saved to local storage for offline use.

Fig. 19. Screenshot of download audio file dialog

Fig. 20. Screenshot of search for resource and file name auto-complete

Fig. 21. Screenshot of full text search for resource
6 Conclusions and Future Work

Defined requirements for design and building software server are achieved. Main activities for future work are planned as follows: Firstly we need to use created software architecture of server and tools to measure satisfaction of students with adding generated audio lectures with the lectures, where are known very well, and using lecturer words, but audio should be produced by usage of audio-generation software, (known as text-to-speech software) compared to recorded audio lecture, by the same known lecturer, and compared to unknown ‘expert’ reader.

Second we can improve and use proposed software architecture to develop tools for measuring quality characteristics of services (QoS) by using different servers – local and remote, and to measure satisfaction of end user of the system. Proposed architecture is developed in order to investigate and provide a base for experimentation with quality of provided services. As one user (or client) can connect to different providers of functionality (in our case audio lectures) - further building blocks for measure quality of a services can be proposed. Also building quality modules 2 (for auto-correction of incorrect pronounced words) and module 3 (for manual review of audio lecture), as mentioned above.

Modules for measuring quality of services can be added on both sides:

1. In client side – each client can decide for themselves what quality of the services are provided, namely:
   (a) Time to response;
   (b) Price - for server-side services: hosting of service, and required hardware or software;
   (c) Quality of learning materials – such as audio, preferences - quality of voices, configurability, etc.;
   (d) Isolation of learning materials in means of securing the materials from external users;
   (e) Sharing of materials (is possible materials to be shared across different users/learners);
   (f) Required hardware or software for client.

With presented scenario there is no need for server-side module – data from the real usage are collected locally. As main advantage here is we know origin of the data and as main disadvantage – it is possible to have small amount of data for each of the services and different characteristics. This can lead to incorrect results.

2. Server side mode – we can have centralized approach for gathering quality characteristics. Clients only deliver satisfaction data for services. Services are activated according to their quality with their functionalities. Decision of which service to be provided is taken on the server-side. Advantage: approach is implemented centrally. Disadvantage: complexity of the transmission protocols – as there is need to negotiate quality of the service properties between multiple clients.

3. Mixed mode – client and server side modules. Client module communicates with server module (which collects quality characteristics of services) from the client.
modules. Advantage: can collect potentially huge amount of data. Disadvantage: complicates server-side implementation has security implication - possibly users are sensitive to sharing their data, which can lead to less data gathered for the improvement of quality of the service.

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8 References


9 Authors

Milen Petrov is assoc. prof. at Sofia University, Faculty of Mathematics and Informatics, Department of Software Engineering, J.Baucher 5 blvd, Sofia, BULGARIA (e-mail: milenp@fmi.uni-sofia.bg).

Asen Asenov is Master Thesis Student at Sofia University, Faculty of Mathematics and Informatics, Department of Software Engineering, J.Baucher 5 blvd, Sofia, BULGARIA (e-mail: aasenov.bg@gmail.com).

Adelina-Aleksieva-Petrova is assoc. prof. at Technical University of Sofia, BULGARIA (e-mail: aaleksieva@tu-sofia.bg).

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Online Research for the Impact of ICTs on Greek Women’s Employability and Entrepreneurship

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Marios A. Pappas*
National Center for Scientific Research “Demokritos”, Agia Paraskevi, Attica, Greece
mpap@iit.demokritos.gr

Athanasios S. Drigas
National Center for Scientific Research “Demokritos”, Agia Paraskevi, Attica, Greece
dr@iit.demokritos.gr

Yannis Papagerasimou
National Center for Scientific Research “Demokritos”, Agia Paraskevi, Attica, Greece
ypapa@iit.demokritos.gr

Helen Dimitriou
National Center for Scientific Research “Demokritos”, Agia Paraskevi, Attica, Greece
lena.dimitriou@yahoo.com

Maria Giannacourou
National Center for Scientific Research “Demokritos”, Agia Paraskevi, Attica, Greece
m-gianna@otenet.gr

Nadia Katsanou
National Center for Scientific Research “Demokritos”, Agia Paraskevi, Attica, Greece
nadia.katsanou@gmail.com

Sofia Papakonstantinou
Creative Thinking Development, Rafina, Greece
spapakon@hotmail.com

Evangelia Daratsanou
Creative Thinking Development, Rafina, Greece
edaratsanou@gmail.com

Christina Agoritsa
General Secretariat for Gender Equality, Athens, Greece
xragoritsa@isotita.gr

Abstract—Due to the increasing demands of highly skilled employees on ICT, European industries could face shortage of employees in the ICT sector. In the existing problem of lack of ICT executives in the European labour market it is added the problem of low representation of women in jobs related to ICT. In Greece this problem is even more intense as a result of the economic conditions...
in the last six years. Our online research for the impact of ICT on Greek women’s employability and entrepreneurship revealed that women overwhelmingly recognize that the field of digital entrepreneurship is one of the most important indicators of success in the 21st century economy, as well as that there are large gaps and mismatches between the supply and demand for ICT skills. Women believe that they are under-represented in the ICT sector and there is a gender-based gap in both ICT professionals and new occupations associated with new communication technologies. The problem of under-representation of women in the ICT sector, highlights the need for design and implementation of actions which will enable the female population in training and participation in entrepreneurship and employment with focus on ICT.

1 Introduction.

As the world becomes more digital, so does the economy. In the near future, all businesses will have a digital footprint. The main reason is that digital technologies can help companies reach a wider audience. But technology has a lot more to offer since being the key for business growth. Technology can help a business increase efficiencies, reach new customers, reduce cost, be more agile, flexible, and in other words be more competitive.

For example, cloud computing can offer organizations, both big and small, the opportunity to scale their computing resources whenever they deem it necessary. This is done by either increasing or decreasing the required resources, meaning they are not paying for resources which they are not utilizing. The same holds true for data analytics that enable companies to analyze all data relating to their customers and the market sector in which they operate. As this data contains a wealth of information concerning the brand, products, customer service satisfaction and customers’ preferences help companies to make better informed decisions regarding many areas of their business.

Thus, by helping entrepreneurs implement new technologies we can facilitate prosperity not only in individuals and firms, but also support regional and state development.

However, the implementation of new technologies requires skilled personnel which reports show that are missing. In Europe, most of the EU Member States have made substantial improvements over the past decade at the level of macroeconomic skills mismatch, also through upskilling of their population. However, in Greece a strong deterioration in labour market outcomes, as a result of the crisis, has led to a worsening of skills mismatch.

2 The “e-Women” project.

The purpose of the “e-Women” project is to determine the current state of the art of the participation and awareness of women, particularly young women in ICT and the benefits arising from their use in the field of employment and entrepreneurship. The project will focus on exploring how social networks and internet can combat em-
employment inequalities and promote new opportunities for entrepreneurship and self-employment of women, especially young.

The project involves the detection and evaluation of the existing possibilities provided by digital tools, as well as professional, educational, social networking platforms and e-learning. A parallel research will analyze the current use of the internet for employability purposes and awareness of young women in Greece.

The aim of this study is to conduct:

- A research on the impact of ICT, social networks and media on the creation of new employability paths (research on the labor market for job opportunities through internet).
- A research on social and gender equality aspects, security of social networks for women, women’s empowerment and e-mentoring techniques.
- A research on the possible ways for the adaptation of traditional economic practices with internet capacities and social media.

The “e-Women” project aims also to share experience, knowledge and skills on trends in employment paths for women and in supporting them to proactively take their future and carrier in their own hands, to gather inspiration from good experiences, exchange and share experiences and guidance, even from other countries (inside and outside Greece, i.e. Greece and Norway) and to identify, analyze and explore different concepts and new technologies leading to new forms of knowledge and employment opportunities for women.

Furthermore, the project refers to the configuration and presentation of the general framework of research (literature research and online survey) based on previous studies and research, design and conduct of qualitative research through personal interviews with persons who belong to the parties involved and finally the reference for cognitive and social research on the use of ICT.

2.1 Questionnaire

Within the project, a questionnaire was prepared, containing specific questions about the new necessary ICT skills and the role of women in relation to these skills, as well as the opportunities provided by the utilization of ICT. The questionnaire was forwarded online from June 29 to October 2 2016. In order to establish the appropriate questionnaire, the following actions were preceded:

1. Identification and specialization of the research objective.
2. Literature review for the selection of characteristics (variables) to be controlled.
3. Selection of the data collection method.
4. Understanding the characteristics of respondents.

The survey covered a sample of the female population of Greece, from the age of 16 and above (93.6% of the participants were between 16 and 44 years old). For the purpose of the research, we used simple random sampling in women who had at least basic knowledge of MS Office, as the questionnaire was administered and answered
electronic. We also sought an evenly distributed participation of the whole Greek territory. In order to obtain the data, we used structured questionnaires with closed questions (dichotomous, calibration and multiple choice) and only a few open type questions.

Before the questionnaires were administered, a pilot questionnaire was used in order to ascertain whether the terms used were easily perceived, the order of questions could cause distortion, the way of drafting the questions allowed the collection of desired data and whether the questionnaire was not particularly extensive, causing disinterest. The questionnaires were sent massively via e-mail while posted at the same time posted to social media (Facebook, Linkedin, Twitter and Foursquare). The goal was to collect answers from at least 1,000 questionnaires, which were collected and gave the data for the analysis. From the women Participated, 71.8% resides in Athens, 4.1% in Thessaloniki, 15.1% in other cities in Greece, while 2.2% lives outside the Greek territory. 61.5% of women were employees, 19.8% were unemployed and 12.1% were entrepreneurs.

2.2 Interview

This method is in the center of qualitative research, concerning the direct communication between interviewer and interviewee and enables the researcher to listen carefully, gather essential information and experiences and to analyze appropriately for the research purpose. For the purpose of this study we chose the method of direct, in depth, structured interviews.

3 Results

3.1 Women's employability and ICT.

Employability is commonly defined as the combination of factors and processes that enable people to progress toward or find employment, to remain employed, and/or to advance in the workplace and as such employability emphasizes an individual’s skills and skill development. The popularity of this concept has grown as global business has moved away from a workforce based on long-term tenure in favor of shorter-term, transitory arrangements. The employment trend today is that employees usually stay a few years at a job in contrast to past generations in which employees used to spend entire careers with one company. In addition, employability represents a conceptual and policy shift away from collective workforce approaches, such as full employment, and toward individual employee assets. With technology skills and processes at the heart of economic transactions, ICT training is closely connected to employability, upward mobility and higher compensation schemes. These themes were investigated through the survey questionnaire.

Gender Perceptions Regarding ICT skills: Although the majority of the responders 56.2 believe that there is no differentiation between genders regarding ICT skills, showing a quite high level of confidence and self-efficacy in digital skills, in
the following questions, a large percent (38.6%) believes that men are more knowledgeable than women. It seems that although gender role and expectations stereotypes are changing, some gender polarization still exist, evident in the perceptions of a large group of participants.

Most studies recognize that differences between men and women in use of and attitudes toward ICT stem from gender role socialization. Gender identity is formed through a process by which societal norms and attitudes are internalized. It seems that many men and women still regard computers as a male rather than a female, or common domain, preventing or steering away women from this field.

In addition, other studies show that women have low self-confidence believing that learning and working with computers are difficult tasks, and that computers are in "the masculine domain", a fact that might influence motivation and retention of women in the Computer and Information Science.

Studies on self-efficacy models of motivation suggest that women’s beliefs about their ability to succeed at a learning task are more important that their actual skill levels or the difficulty of the task (Cross & Steadman, 1996). Thus, it is important to motivate women to increase their skills and knowledge in what still, a lot of them, perceive as a male dominated domain.

**Upward Mobility:** The contradicting responses regarding women’s access in managerial and decision making positions (51% vs 49%) reveal women’s indecisiveness regarding this variable. Fifty-one percent of the participants believe that women face no difficulties in upward mobility, while 49% believe that women do face difficulties. It is interesting that unmarried women and those belonging to the 25-34 and 35-44 age groups seem to believe more strongly that women are not promoted to the high managerial and decision making positions at the same rate as their male counterparts. A possible explanation could be found in the drive for career advancement that these groups are exhibiting. Regarding the age effect, although late twenties up to early forties are considered as the most productive years, family–career compromises are starting to take their toll. Thus, the impenetrable barriers between women and the executive suite could be experienced more strongly by women belonging to these groups as lack of career opportunities.

Despite a dramatically growing presence in the workplace, women remain underrepresented in management positions in business as artificial barriers, generally known as the “glass ceiling” effect are inhibiting their advancement. Literature review has shown that upward mobility seems to be influenced by a variety of factors, such as:

- Labor market and organizational characteristics,
- Gender roles and in particular balancing both motherhood and career obligations,
- The reluctance of men to accept women in management because of stereotypes, and their exclusion from powerful male networks, and
- Personal traits that are considered necessary for managerial success.

It seems that because of the complexity of factors influencing women’s workplace advancements, for which the term “labyrinth” has been recently suggested (Guerrero, 2011, p. 382) indicating the complicated, exhausting challenges that women must
navigate on their way to senior roles, the evidence from the survey is mixed and inconclusive since the women’s responses are split almost equally into the two categories.

**Barriers to Upward Mobility:** Participants seem to attribute difficulties in accessing higher rank positions mostly in stereotypes and male attitudes, which are compatible to literature findings.

A major barrier to women’s progress in management worldwide, according to several studies, continues to be the gender stereotyping of the managerial position. Schein (2007) in an overview of women in management worldwide states that the persistent stereotype that associates management with being male is the most important hurdle for women in management in all industrialised countries.

Occupational stereotypes are clusters of assumptions about the sorts of activities and interests that are associated with the roles of men and women in society. Gender segregation creates a set of jobs which are considered as appropriate for men or women and this affects perceptions of performance based on the masculine or feminine attributes that best fit the role. Occupational gender stereotyping is important to consider because of labour market outcomes especially in terms of recruitment, hiring, pay, and promotion that may result from them. Further, gender stereotyping of occupations may discourage individuals from pursuing careers in occupations typed as gender-inappropriate for them, even though they may actually be well-suited for such careers.

There are also studies which show a tendency by men to describe women managers as less self-confident, less emotionally stable, less analytical, less consistent, and having poorer leadership abilities than male managers influencing thus their attitudes towards female managers (Stroh et al. 1996, Chuang, 2003). Such beliefs lead to assumptions that contribute to negative stereotypes. These assumptions may include statements such as: women tend to place family demands above work considerations, or that women work for supplemental income and as a result, they lack the necessary drive to succeed in business, women are too emotional, etc. Such assumptions, despite if they are true or not, do not take into consideration women’s conscious choice to pursue a managerial career thus making injustice to individual preferences and efforts.

The second most popular answer in the survey regarding barriers in female upward mobility is the attitudes of men, although the percentage is not very high (9%). A possible explanation could be, despite the myriad of different barriers stated by women, that it is difficult to isolate “male attitudes” from general gender stereotyping. However, it could also signify that nowadays sexism has become more elusive than in the past (Barreto, et al. 2009) making it difficult to promptly identify it. Even when individuals personally agree with and adopt equal and fair practice, they can still harbour subconscious sexism. “The result is that prejudice is often expressed outside a person’s awareness, even when people are subjectively convinced that they do not endorse prejudicial beliefs or are trying hard not to express them” and this might explain the low but visible percentage of women’s answers regarding male attitudes.

**Skills for Employability:** Regarding skills prioritization, digital skills are considered as very important by 69% of the participants. This finding is compatible with the literature review since many studies (Felstead, Gillie, & Zhou, 2007; Riley, 2007)
reveal the relationship between ICT skills - employability and especially on the effect of computer skills on compensation and opportunities for upward mobility. Participants noted as key skills ICT management, teamwork, communication skills, problem solving skills, and interpersonal skills. Less important skills seemed to be the business architecture, interpretation of numerical data and operations planning.

Most industries and sectors recognize that as they become increasingly digitalized, there will be more demand for staff in general to have digital skills to varying degrees. The UK forum for Computing Education (UKforCE, 2014) took as its starting point the view that ‘every business is a digital business’, and that the people in most professions and technical jobs will require some degree of digital skills in the next 2-3 years.

In addition, it was presented that the vast majority of the workforce will soon need basic digital skills named as ‘digital citizenship skills’, in order to use digital technologies when searching for information and purchasing goods and services online.

The importance of digital competence was recognized by the European Parliament and the European Council in 2006 in its recommendation on key competences for lifelong learning when it identified digital competence as one of eight key competences essential for all individuals in a knowledge-based society.

Digital competence can be defined as follows:

"Digital competence involves the confident and critical use of information Society technology (IST) for work, leisure, learning and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, access, store, produce, present
and exchange information, and to communicate and participate in collaborative networks via the Internet.”

Many European reports also reveal that although we live in a digitalized world and that countries have become better at adopting new technologies, they are getting worse at putting them into widespread use, limiting thus any possible benefit. Despite however, the importance attributed to ICT skills by survey participants, basic digital skills and usage as well integration of digital technologies are still quite low in Greece.

3.2 Female entrepreneurship and ICT

Gender Differences in the Capacity for Entrepreneurship: Survey participants believe that women are equally capable to men in owning and leading businesses and believe that women possess the characteristics necessary to be business leaders. An interesting finding is that younger women belonging to the 16-24 age group believe the same, but to a lesser degree showing that stereotypes are less challenged among young and inexperienced women.

However, there is a mismatch between participants’ beliefs on women entrepreneurship regarding women’s ability to succeed in entrepreneurship and actual data. Despite the growing recognition of the vital role women entrepreneurs play in boosting economic productivity and growth, the ratio of female entrepreneurs is quite low in comparison to their male counterparts, thus making for a huge equality gap.

According to the statistical data from the project Women Entrepreneurs in Europe carried out for DG Enterprise and Industry of the European Commission published in 2014 it was reported that in the year of the study (2012), around 30% of all entrepreneurs in Greece were women compared to 31% in the EU-28. The vast majority of these women entrepreneurs (82%) were solo entrepreneurs. Women entrepreneurs constituted about 24% of the women in the active labor force (entrepreneurship rate). This was significantly higher than the EU-28 average entrepreneurship rate (10%). The proportion of men entrepreneurs of men in the active labour force in Greece (37%) was also significantly higher than the EU-28 average.

Most women entrepreneurs in Greece work full-time. In 2012, about 11% of all women entrepreneurs worked part-time in their enterprise and this percentage was significantly lower compared to the EU-28 average (30%).

Female Entrepreneurship in ICT: The number of women entrepreneurs in areas that require ICT skills is low compared to other sectors. According to the results, 76.8% of respondents consider that the number of women entrepreneurs in sectors that require ICT skills is low. Although women believe that they are capable as men to lead a business, very few choose to start a business in the ICT sector. Studies show that the ICT industry is still male dominated and women feel intimidated to enter in this industry (Berg et al., 2002). Women in Europe represent around 33% of total graduates in science and technology and around 32% of employees of the ICT sector (Women Active in ICT Sector, 2013). Women represent only 19.2% of all entrepreneurs in the ICT sector, in Europe, while they represent 53.9% of entrepreneurs in the non-ICT service sectors and constitute 31.1% of all European self-employed (all sec-

http://www.i-jac.org
From all self-employed women in Europe, only 2% work in the ICT sector, while 3.5% of self-employed men work in the ICT sector.

Due to the traditional position that still women in Greece occupy, some women believe that women are uninvited in the ICT sector, to the point that some participants in the focus groups use terms such as “vertical segregation” between genders or even “stigma”. Studies also show that women do not give themselves enough credit, since they undervalue their ability and intellect while men overstate them. Thus, it seems that there are cultural beliefs which consciously or unconsciously exclude women from entering this field. Although there seems to be a correlation between a STEM education and employability in the tech sector, there are examples showing that success in the technology industry doesn't really require a technical degree as CEOs in tech firms such as Oracle, Hewlett-Packard or the Chief Operating Officer of Facebook suggest. All of them had degrees in law or economics.

**Importance of Digital Entrepreneurship:** The vast majority of the sample (90.1%) states that digital entrepreneurship is among the most important success indicators in 21st century economy. From the literature is evident that in addition to the economic facts, i.e. lower project costs, diverse teams in tech companies exhibit better performance regarding creativity, innovativeness, time management, but also it seems that digital technologies are practical and tangible tools for women to overcome longstanding inequalities. ICT can help women to gain employment through telework or newly created information jobs, obtain cost-effective health services and education (such as through online courses or software-based literacy programs) and to increase their income (such as through e-business channels and online transactions).

Thus, ICTs and digital entrepreneurship are important for women because they:

- offer a new field which is more open for female access than other fields
- require less resources in cash and physical terms than traditional alternatives for women
- empower home-based operation, leading to cost savings and to better family-work life balance
- enable “invisibility”, thus preventing gender stereotypes
- provide a route to further personal development and growth via e-learning and via participation in eBusiness, and
- provide a route to develop more than one business, to participate in the development of different types of business and to find more easily than traditional means.

However, women seem to be at a disadvantage to benefit from the digital revolution because they are less tech savvy, according to the longstanding argument that technology is gendered (Lohan and Faulkner, 2004; Puente, 2008), and more technophbic, and because the technology is not built for their needs and intuition. In addition, it is possible that the increasing socio-economic importance of ICT could add a new dimension to the already existing vicious circle between discrimination and women’s backwardness, which can be expected to be particularly severe in the near future taken into consideration the advances in technology.

**Entrepreneurial Skills:** Skills emerged as important for entrepreneurship in the 21st century include innovation and vision /imagination, organizational skills, creativ-
ity, the ability to negotiate, resourcefulness and initiative. Thus, it seems that the women participating in the survey place more emphasis on skills that will help them enter the job market, such as vision and creativity, as well as those that will help them develop and maintain a business such as organizational skills, bargaining skills and initiative. Although the 3 competence areas are tightly intertwined, the refraining of the sample participants in addressing specific resources such as personal skills (self-awareness, self-efficacy, motivation and perseverance) may indicate that women do not feel less capable to develop entrepreneurial projects. This is a recurring finding in women’s answers in previous questions in this survey: women again and again state that they are no gender differences regarding entrepreneurial abilities, attributing any observed differences in cultural attributes. The selection of skills most commonly associated with the entrepreneurial activity, such as the identification of opportunities is similar to that of their male counterparts.

Fig. 2. Entrepreneurial Skills

However, entrepreneurship has a gender bias, women being less active in this task than men. Traditionally and historically, the figure of entrepreneur was male and therefore it emphasizes more skills and abilities that society believe are inherent to men. This could be one of the reasons that, when the profile of the perfect female entrepreneur is outlined, it includes characteristics mostly attributed to men, implying that gender stereotypes may still have an important role.

However, recent studies seem to show a change in the perceptions of which are the skills and abilities that a successful entrepreneur should possess, allowing for abilities more specific to women, such as perseverance, social and relational abilities such as empathy or social sensitivity, or abilities related to dealing with people and
communication. These abilities and skills are an advantage over the characteristics of the male norm, as they are facilitators of the development of entrepreneurship, but also considered as demanded in the labour market.

3.3 Gender Differences in ICT

The majority of the sample participants (54.4%) believe that women are not equally motivated to men in attaining studies in science, technology, engineering, and mathematics (STEM) fields and sixty-eight percent (68%) state that there exists a gap between genders regarding ICT professionals. Unmarried women and younger women (16-14) feel more strongly this lack in motivation and the existence of the gap. These findings mirror the fact that although the gender gap has narrowed in recent decades, women remain underrepresented in STEM fields. One of the most prominent explanations points to a sense of incompatibility or mismatch between being female and succeeding in STEM. In Greece, according to PISA 2015 findings boys seem to perform better in science than girls, a trend evident in most OECD countries.

Almost seventy eight percent of the women in the sample believe that women are under-represented in the ICT sector, with younger women (16-24) stating more strongly this belief, attributing the low participation of women in the ICT sector in social stereotypes and the perceptions of male dominance in the sector.

The majority of the sample (56.3%) states that women have different attitudes than men regarding computers. An interesting finding is that women with higher education (university or post graduate degrees) seem more convinced than women with lower education. Thus, gender discrepancy does not seem to diminish over time as students gain experience with computers. There is a number of empirical studies showing that men tend to perform better and hold more positive attitudes toward computers than women. Evidence from a study conducted in Greece among 165 freshman students show also that male students are more positive in the idea to use computers than women (Bebetsos and Antoniou, 2009). Computers appear to be perceived primarily as a masculine technology, and this tends to be confirmed by the distribution of genders in computer classes. Possible explanations could involve innate gender capabilities, attitudes regarding the importance of computers, or involvement/familiarization.

4 Conclusions

If we try to identify the main challenge areas for the improvement of digital skills and the main findings, according to EU and OECD relevant policies, we should focus on:

1. Education and Vocational Training,
2. Women & Girls as Digital Citizenship,
3. Female talent on labour force, and
4. Women and Girls as ICT professionals.
Below is an overview of the corresponding policies and the focus challenges identified above focusing on the situation in Greece, as it is evident through the analysis of statistical data and reports.

4.1 Education and Vocational Training

Given that boys and girls come from all kinds of backgrounds and attend all kinds of schools (at least in countries where participation in schooling at age 15 is universal), differences in their self-reported experience with computers do not reflect material constraints, but rather students’ interests and families’ and educators’ notions about what is suitable for them (see also OECD, 2015). Parents, for instance, may place more restrictions on girls’ use of the Internet out of safety concerns. Literacy Study (ICILS) show that in almost all participating countries, girls in the eighth grade feel less confident than boys in their ability to do advanced ICT tasks, such as building a webpage (Fraillon et al., 2014). Greece lacks on early exposure to computers by gender as it reports the relevant figure from OECD (2015).

Tertiary education has expanded worldwide to support the supply of highly educated individuals and meet rising demand. Policy makers are particularly interested in the supply of scientists and engineers because of their direct association with technological progress, industrial performance and economic growth. Over the last period of growth in higher education participation, the gender gap has narrowed slightly with women accounting for 35% on average of all NS&E graduates in 2012, with shares ranging from 14% in Japan to 45% in Italy. But despite the fact that Greece ranked as the fifth worst position according to the previous figure, according to the OECD statistics (2015) is one of the top five in Tertiary education graduates in natural sciences and engineering.

Training helps to improve and maintain the human capital of firms by endowing workers with the skills and knowledge needed to perform on the job and adapt to change. Training also increases the productivity of workers and thus enhances the performance and productivity of firms. While the percentage of workers receiving on-the-job training is comparatively higher in large firms in all the economies considered, the percentage of value added invested in training is generally higher for micro and small and medium-sized companies than for large enterprises. While progress is being made in modernising our education and training system, it is still very much a patchwork. While in some countries and schools there are high levels of equipment, skilled teachers and modernised curricula, it is not the case everywhere. Indeed, on the basis of the last available data only 20-25% of students in Europe are taught by digitally confident and supportive teachers having high access to ICT and facing low obstacles to their use at school. Additionally, new educational tool raised with the ICT evolution. On line courses such as MOOCS becomes important as a LLL tool. However, Greece is lagging comparing to EU average.
4.2 The Digital Citizenship

Citizens need digital skills for more and more aspects of their lives. Yet still too many people do not have the basic skills they need to succeed in an increasingly digital society. Around 45% of EU citizens still do not have basic digital skills with around half of this figure having none at all. In some Member States, a majority of citizens do not go online on a regular basis or cannot function effectively online. They miss out on many life enriching opportunities and economic benefits. This is particularly the case for certain segments of the population including older people, the less educated and those on low incomes. Moreover, there is a need to strengthen confidence in digital by ensuring that citizens are equipped to protect their privacy and security online.

The Internet permeates every aspect of the economy and society and is also becoming an essential element of children’s lives. On average, for countries where data are available, less than 0.5% of 15 year-olds report never having accessed the Internet. Age of first access to the Internet varies largely across countries from 80% to 30% in Greece. Greece also shows the strongest difference in uptake between the young and the old. In more focused statistics, participating in social networks Greek users are behind the European average. The same problem is facing the Greek enterprises where the broadband access is lagging the European average.

4.3 The labour force

As digitisation spreads to all sectors of the economy, digital skills are increasingly needed for most jobs. Indeed, most jobs already require basic digital skills. In the future this will only increase and it can be argued that all labour force participants need these skills to remain employable and for entrepreneurship. Despite this, around 37% of the labour force (employed, self-employed and unemployed) in the EU does not have even basic digital skills. The European labour force needs to be re-skilled for its digital future beyond basic digital skills with a view to professional-related digital needs. Special attention should be paid to skills related to security.

Occupations provide another way of looking at changes in employment. Job losses affect different types of workers in different ways, depending on their skills and the type of tasks carried out on the job. According to the OECD (2015), women in non-routine and routine-intensive occupations tend to suffer proportionally less during crises and to benefit relatively more during expansions. Among the factors that may contribute to explaining these gender-specific patterns are differences in the distribution of employment of men and women in the public and private sectors, industry-and-gender specific dynamics such as the marked decline of construction activities (a male-dominated sector), and the specific type of job accomplished (e.g. personal care).

The results from the first OECD Programme for the International Assessment of Adult Competencies (PIAAC) show large differences in computer use at work across countries. The increasing use of ICTs at work requires workers to perform different tasks and to develop complementary skills. On average, intensive use of ICTs at work
is associated with greater interaction between co-workers and clients, more problem solving, less physical work and higher numeracy. For most tasks, correlations with ICTs tend to decrease with the skill level of the occupation. Job recovery is becoming more widespread and gaining momentum with unemployment declining in most countries, including those hardest hit by the crisis (OECD, 2015b). According to OECD statistics (2015), youth employment rates remain of particular concern, especially in Europe, with average unemployment rates for younger workers (15-24 years old) at over 20%, rising to above 40% in Spain, Greece and Italy. Employment growth varied widely for different groups during the recovery, with unemployment rates for women slightly above those for men.

4.4 ICT professionals

Digitisation is also leading to increasing demand for ICT professionals in all sectors of the economy. Indeed already more than half of all ICT professionals work outside the ICT sectors in ICT-using industries such as automotive, pharmaceuticals and the like. Employment of ICT professionals has increased by around 1.5 million over the last five years alone. However, supply is not keeping pace with demand and it is expected that by 2020 Europe could have around 756,000 unfilled vacancies for ICT professionals. At the same time, we have almost 20% youth unemployment in the EU. We need to train more young people for these new digital jobs.

In Greece, despite the fact that the percentage of the ICT sector on GDP is decreasing for the last 5 years, the number of persons employed in the ICT sector as % of the total employment increased during the same period of time.

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7 Authors

Marios A. Pappas (B.Sc., M.Ed.) is a research associate at N.C.S.R. Demokritos, Institute of Informatics and Telecommunications, Net Media Lab, Athens, Greece (e-mail: mpap@iit.demokritos.gr)

Athanasios Drigas is a Senior Researcher at N.C.S.R. Demokritos. He is the Coordinator of Telecoms Lab and founder of Net Media Lab since 1996. From 1985 to 1999 he was the Operational manager of the Greek Academic network. He has been the Coordinator of Several International Projects, in the fields of ICTs, and e-services (e-learning, e-psychology, e-government, e-inclusion, e-culture etc). He has published more than 200 articles, 7 books, 25 educational CD-ROMs and several patents. He has been a member of several International committees for the design and coordina-
tion of Network and ICT activities and of international conferences and journals. (e-mail: dr@iit.demokritos.gr).

**Yannis Papagerasimou** (B.Sc., M.Sc.) holds a Bachelor degree in Electronic and Computer Engineering and a Master’s degree in Data Communications. He is a research associate at N.C.S.R. Demokritos, Institute of Informatics and Telecommunications, Net Media Lab, Athens, Greece (e-mail: ypapa@iit.demokritos.gr).

**Helen Dimitriou**, graduated from the department of Philosophy, Pedagogy and Psychology of University of Athens. She also holds a Med in Special Needs & Inclusive Education from the University of Sunderland. She is currently working as a qualified teacher in secondary education at the Ministry of Education of Greece and is also an external research associate at N.C.S.R. Demokritos, Institute of Informatics and Telecommunications, Net Media Lab, Athens, Greece (lena.dimitriou@yahoo.com).

**Maria Giannacourou** is an Organizational Psychologist and Human Factors Specialist, currently a Member of the Adjunct Faculty at Hellenic Open University (School of Social Sciences). She holds a B.A. in Psychology from the University of Maryland, USA, an M.Sc. in Industrial Psychology from Hull University, U.K. and a PhD in Decision Making, Strategic Planning & Ergonomics from the University of Piraues (GR). She is an external research associate at N.C.S.R. Demokritos, Institute of Informatics and Telecommunications, Net Media Lab, Athens, Greece (e-mail: mgianna@otenet.gr).

**Nadia Katsanou** (M.Sc.) holds a Master's degree in Computer Science-Artificial Intelligence. She is a Senior Telecommunications Scientific Expert at the Hellenic Telecommunications and Post Commission and an external associate at N.C.S.R. Demokritos, Institute of Informatics and Telecommunications, Net Media Lab, Athens, Greece (e-mail: nadia.katsanou@gmail.com).

**Sofia Papakonstantinou** holds a MA Degree in Publishing from LCC University, United Kingdom, a BA Degree in Interdisciplinary Human Studies from University of Bradford, United Kingdom and a Diploma in Special Education from National and Kapodistrian University of Athens. Her current position today is dealing with European Erasmus projects with CRE.THI.DEV, Rafina, Greece (e-mail: spapakon@hotmail.com)

**Evangelia Daratsanou** (B.Sc., MA), holds a Bachelor Degree in Business Administration from Athens University of Economics and Business and an MA in Marketing Management from De Montfort University Business School. She is a Business Consultant and a Project Manager in the fields of Entrepreneurship and Innovation with CRE.THI.DEV., Rafina, Greece (e-mail: edaratsanou@gmail.com)

**Christina Agoritsa** holds a Bachelor degree in Law and is also a graduate of the National School of Public Administration & Local Government. For the past 10 years she has been senior official of the General Secretariat for Gender Equality (Ministry of Interior), the governmental agency competent to plan, implement, and monitor the implementation of policies on equality between women and men in all sectors (e-mail: xragoritsa@isotita.gr).

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Tracing Knowledge Flow as Strategy towards Measuring Corporate Knowledge

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S.M.F.D Syed Mustapha
Taif University, Taif, Saudi Arabia
smfdsm@gmail.com;syed.malek@tu.edu.sa

Abstract—Corporate knowledge is essential mainly to knowledge-intensive organizations. Its success is always associated with the performance of the organization through ROI (Return of Investment). While the scope of corporate knowledge is wide, we redefine in the context of computational environment and demonstrate how corporate knowledge can be modelled and subsequently enabled it to be measured. With this new ability, the knowledge flow within the learning activities can be traced and the individual performance can be measured based on the learning goal being set.

Keywords—knowledge management, knowledge transfer educational technology, learning technology

1 Introduction

Management of corporate knowledge is essential to maintain organizational performances; it allows continuous regeneration of knowledge and innovation through effective knowledge sharing, retention of corporate skills and knowledge as well as efficiencies in making corporate decision.

Our literature indicates that corporate knowledge has no concrete definition even though it has been used widely and its meaning has been elaborated in the context of the author who used the term. For example, Pierre et al stated that corporate knowledge requires one to have information that is accessible throughout the organization as well as an information technology framework to support them [1]. Yang et al argued that corporate knowledge is managed by agents who were acting on managing the knowledge in a dynamic and uncertain environment and at the same time cooperating each other in achieving corporate goal [2]. Gregoris et al [3] describes corporate knowledge as having knowledge artefacts to be managed by computer-based corporate memory and at the same time having appropriate methodologies and tools as processes in managing the knowledge. Some may refer corporate knowledge as interchangeable term with corporate knowledge as knowledge which is characteristically explicit. For example, Van et al [4] defined it to be an explicit, not embedded within the organization and continuously to be presentable in the form of information or knowledge within and organization; while Nagendra et al [5] defined knowledge as
tangible things like company products, clientele profile, marketing and financial reports and business goals.

Having said about how organizations conceptualize the corporate knowledge, it can be assumed that management of corporate knowledge is essential and understanding the principles to ensure addressing the success factor is taken place. The essential factors for having a successful Knowledge Management or Knowledge Management System (thereafter, KM/KMS respectively) have been discussed in many literatures. It is commonly agreed that the essentials factors should not be addressed in silo manner as it requires a holistic approach and integration among the KM/KMS components [6]. Nevertheless, this paper focuses on one aspect in KMS which is the learning aspect within the organization.

Learning in organization has been mentioned in the literature as a significant process in the entire architecture of the KM/KMS. In a corporate environment, measuring the learning among the corporate members and its affiliations can be a daunting task as it involves internal and external parties such as managers, customers, suppliers, management, shareholders and others. Usually, the learning is assumed to take place based on the ROI performance [12]. In other words, the members of certain departmental unit who have gone through certain training period and demonstrate an increase of productivity or decrease in cost indicates a return on ROI [7]. Whether this is commonly accepted view, a survey which is done by Mumma et al [8] indicated that only 12% of the surveyed companies observed that the learning process through training had strong alignment with the business strategies. Most companies fail to demonstrate direct benefit from the staff training since they do not have an integrated and comprehensive learning or training plan. Hence, the learning and ROI seemed to show low correlation to some of these corporations. To overcome these issues, Deking [9] as cited in [10], formulated a framework for measuring the knowledge and knowledge management in terms of the value and status using several types of instruments such as balance scorecard, knowledge portfolio, cost saving analysis, scoring models and cross organizational benchmarking. Bersin [11] established a practical model for measuring performance based on corporate training for individual in four phases which include problem definition, training solution, individual performance and organizational performance.

Based on the literature above, there is a gap in between the learning plan, learning process and measuring the competency attributes of the learner. In some corporations, a clear mapping between the training program or organization learning with the expected learning outcomes or the training effectiveness are not known. The simple reason is that the effectiveness of the training and learning processes in meeting the business goals are taken as the result of collective effort of every member in the organization. In our paper, we describe the concept of tracing knowledge flow in monitoring the corporate learning environment for every individual and how learning is measured. In the next section, we discuss the type of corporate knowledge that is applicable in our context followed by another section that explained the learning process based on the corporate knowledge that can be measured and traced.
2 Corporate Knowledge

The focus on corporate knowledge for this work is on codifiable corporate knowledge in computational form. Codifiable knowledge is referred to explicit knowledge that may derive from articulated tacit knowledge or structured or unstructured knowledge that are presentable in explicit form and in digital media [13]. Corporate knowledge differs by the sectors such that knowledge-intensive organizations may be require dynamical change in knowledge generation, more volatile and innovative compared to production-based or regulated-based organizations where knowledge is embedded in its standard operating procedure and changes are less affected with business trends. Industries such as consultancy, finance, advertisement, banking, education, healthcare are the targeted sectors for this research.

Organizational structure is not the primary issue as the principles in managing corporate knowledge should be applicable in all organization embracing the same knowledge management system and practices [mentioned in [14,15] for guiding principles in KM. We believe with the advent of information and communication technologies; geographical distance is not an obstacle to maintain efficacy in the communication flow. In our proposed corporate structure, the information and communication takes place mainly in ICT platform such that data, information and knowledge can be retained in computational form. Hence, multinational corporations (MNCs) or transnational corporations (TNCs) or single-location operated corporation shall be able to adopt the same principles in KM.

Corporate knowledge can be categorized into format which are structured documentations that are stored in corporate database and DMS (Document Management System) and unstructured where knowledge is sparsed and uncategorized. The unstructured corporate knowledge (UCK) is the interest in our work as it allows sharing of knowledge on multiple views, regeneration of ideas, sharing of experiences and identification of knowledge expert. Hence, the ICT platform is an open platform that allows corporate members to post opinions and share relevant materials in various forms.

3 Learning Organization

According to Argote [16], learning organization takes place in three sub-processes: creating, retaining and transferring of knowledge. Learning product could be in the form of new knowledge artifact such as new architectural design, product design, marketing brochure; another type of learning product is in the form of opinion, argument, debate, analysis and others that co-occur during the development of knowledge artifact. The latter is more significant as the thinking process and discussion thread can be recorded and captured for future review and consideration, in order to avoid repetition in similar decision making process. Another aspect of learning which is important in the organization is the individual’s learning lifecycle since every individual contributes towards achieving the overall business objectives. Every individual is set with the learning goals, learning process and finally the learning outcome.
Learning goal consists of targeted knowledge domain, learning activities, learner’s participation network and learner’s profile. Learning process defines the phases of learning that a learner must go through to determine the level of mastery s/he has attained, the number of knowledge domain to be assigned and building of expertise. Learning outcome is associated with the learning goals in which it is measured numerically. In the next subsections, we describe the learning artifacts, corporate learning and learning strategy.

3.1 Learning Artifacts

Learning artifacts is defined as object that has characteristics of being “durable, made public, long lasting and materially presented” [17]. It is a concept adopted by educational psychologist for students to demonstrate their understanding in the classroom with artifacts such as paintings, drawing, sculptures and these are not perishable. In the context of corporate knowledge, learning artifacts are the products that are developed as a result of social or business communications in the formal and informal settings such as meetings, serendipitous drop-in, chats, online discussion, asynchronous communication, meeting minutes, contract agreement and also individual learning such as visiting web page, downloaded internet resources and multimedia objects (images, video, audio etc.). In a computational environment, these learning artifacts are available and traceable.

3.2 Corporate Learning

Corporate learning is performed in two environments – Traditional Learning (TL) and Online Learning (OL). TL is an environment where learning takes place in non-computational form and not discernible in digital format, for examples, attending seminar, ICT skill-based training or other professional courses. We argue that it is possible to transfer knowledge based on these types of training into a repository of corporate knowledge using the current information technology [18]. Sharing of training modules, PowerPoint slides and personal notes that are associated with the trainings are ways to reposit learning artifacts for the use of other members. OL has been widely accepted in many corporations as alternative to TL and it is done in-house. OL can be conducted on web-based or client-server based or standalone machine. There are various e-learning packages that are pedagogically organized which includes assessment and the content is tailored uniquely for the corporate use. OL also supports social communications such as online chatting, forum discussion, blogging, Wikipedia development, resource creation and sharing. In an integrated environment where these features are available, learner has the opportunity to use various platforms to demonstrate one’s learning.
3.3 Learning Strategy

Individual learning is the focus in this research work albeit the entire learning strategy is a composition of all individual towards achieving the corporate’s business goal. The followings are the five factors needed in setting the learning strategy:

1. Knowledge domain (KD) identification – KD can be a specialized or general subject matter that the learner needs to comprehend. KD can be built using ontology automatically or semi-automatically from the textual document [19,20,21]. The collection of relevant texts emphasizing certain key concepts can be used as the basis to build KD. A learner can be assigned to one or more KDs depending on the training needs.

2. Learning Phases (LPh) – an individual deal with two types of knowledge; tacit and explicit knowledge. The knowledge is transformed from one another depending on the activities. For example, reading transform the explicit knowledge from the reading text into tacit knowledge. The learner processed his/her understanding with cognitive pre-processing and possibly regenerate new understanding or conflicting argument. This process happened between implicit and implicit knowledge. New ideas or arguments are externalized in various forms such as oral presentations, video recording, blogs and other form of explicit materials.

3. Learning Profile (LPr) – some levels of recognition are labelled to each learner based on his/her learning profile. Learning profile is built based on one’s commitment and activities during the Learning Phases. For example, one who is an active participation in a discussion and being dominant in a discussion on a specific domain, will earn higher recognition in his profile.

4. Social Status (SSt) – some levels of recognition and identity established among the corporate members as a result of one’s leadership, dominance behavior, influences and communication effectiveness. In a computation form, these can be captured and can be calculated based on the frequency of interactions and number of reference made by others to him/her as point of reference. The influences can be observed from the responses and replies that indicate support to one’s idea and these can be computed.

5. Measurement – data are captured for every actions made by the learners, hence, these data can be captured and measured to be translated to a more meaningful results. Measurement requires computation on the gap between the learning goals and learning outcomes. Learning goal consists of the targeted KD, LPh, LPr and SSt which can be set for every individual or standard goal set at corporation level for everyone.

In the following section, we demonstrate the application of the knowledge transfer and knowledge trace for measuring corporate performance.
4 Measuring Corporate Knowledge

In the proposed application of building a corporate knowledge, the followings are the items that comprise a corporate knowledge unit (CKU):

1. Knowledge Object (KO) – personal’s opinions, explanations, arguments, recommendations, suggestions that are possibly presented with other sources such as design, PowerPoint slides, statistical figures, factual information and others;
2. Multimedia (MM) – using video clips, audio, animation, guidelines, reports, text, web page, physical objects that are presentable in multimedia format;
3. Semantic Tagging of Knowledge Object (STKO) – the semantic content is described in text format in order to allow text processor to extract keywords describing the essence of the knowledge object.

The CKU is initiated at every action performed by the corporate learner in the learning phases (LPh). For example, learner A posted his opinion with an attached resource, CKU will be formed as integrated unit shown in Fig. 1.

Fig. 1. Schematic diagram of CKU

Each CKU is characterized into measurable unit based on the quantity and quality of the content. For example, in KO, the length of the text gives the quantity value while the relevancy to the context is the quality value. Context refers to the content of the current discussion or content. For STKO, the semantic tag has details on content which is labelled with named-entity attributes such as location, organization, quantity, time etc.; and these details are used for retrieval and matching purpose. MM is an additional resource that is used to enhance the content of the knowledge that is described in text form as in STKO by using video, audio and others. In the following subsections, we illustrate further on the use of CKU for tracing knowledge.

4.1 Tracing Knowledge Flow

CKU is owned by every learner who initiated learning actions such as posting argument, uploading video, creating blogs. As CKU has the content (in KO) and semantic descriptors (in STKO), the flow of CKU within among the members can be traced.

In our work for tracing knowledge, the focus is on Learning Phases (LPh) as one of the learning strategy. With CKO, the tracing for knowledge transformation such as “tacit-to-explicit (TE)”, “explicit-to-implicit (EI)” and “explicit-to-explicit (EE)” will be possible. The examples of learning actions that are characterized by different knowledge transformation is shown in Table 1.
**Table 1. Examples of Knowledge Transformation**

<table>
<thead>
<tr>
<th>Knowledge Transformation</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE</td>
<td>Posting personal notes, arguments, Creating Wikis, Blogs</td>
</tr>
<tr>
<td>EI</td>
<td>Watching video clips, Listening to audio, Reading blogs</td>
</tr>
<tr>
<td>EE</td>
<td>Classifying documents, cataloging resources</td>
</tr>
</tbody>
</table>

The examples for each knowledge transformation can be expanded further depending on the available technologies supporting them. The only limitation is the transformation between “tacit-to-tacit” which occur within internal oneself.

Once the activities are converted into CKO form, the flow can be traced. For example, Learner A has been tasked to learn on Topic A and the keywords for this topic is defined in KD identification (ref Learning Strategy). As he performed the activity, the keywords defined in KD is matched against KO and STKO to determine the relevancy. Since a learner is allowed to participate in various knowledge domain, the matching on keywords to determine the relevancy for each CKO he/she produced has to be done to ensure that he/she participated in the knowledge transformation processes for each knowledge domain set for him/her at the Learning Profile (LP) and Social Status (SSt). Finally, the flow of the knowledge can be traced and the measurement is calculated based on the goal set at LP and her/his final achievement. In a corporate environment, monitoring is a continuous process.

6 Conclusion

Corporate knowledge retention and reuse have gained interest mainly on how it influences the ROI performance. While many effort focus on the overall ROI as the yardstick to measure corporate learning, our focus is on individual learning. We describe how corporate knowledge can be modelled in computational format and processing them to trace its flow throughout the learning activities. The work is significant such that corporate knowledge can be measured and the flow can be traced.

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9 Author

**S.M.F.D Syed Mustapha** is a professor in Computer Science Department, College of Computers and Information Technology, Taif University, Saudi Arabia. His main research interest is on building intelligent techniques through knowledge modelling for learning in which he had applied in various domains such as rheology, inorganic chemistry, social communication and community of practice. He received his PhD and MPhil from University of Wales, UK and Bachelor of Science (Computer Science) from University of Texas, USA. He has served in various positions in the university as head of department, deputy dean, dean of faculty in the previous employment in various institutions of the past 15 years. His last administrative position was as Vice President (International) and prior to that as the Vice President (Operations and Technology). He has published more than 80 papers at the international journals and conferences in which 70% of the papers as the first author or single author. He serves as board of reviewers in various scientific committee for international and local conferences and journals. He is a Fellow member of British Computer Society. He completed his postdoctoral programme under Hitachi Fellowship Foundation in University of Tokyo, Japan (smfdsm@gmail.com; syed.malek@tu.edu.sa).

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