# Prestige and Collaboration Among Researchers in the Field of Education and Career Development of ICT Graduates: Is There a Cross-Fertilization of Research and Knowledge?

**Katarina Pažur Aničić**          *kpazur@foi.hr*
*Faculty of Organization and Informatics*
*University of Zagreb, Varaždin, Croatia*

**Blaženka Divjak**          *bdivjak@foi.hr*
*Faculty of Organization and Informatics*
*University of Zagreb, Varaždin, Croatia*

**Krunoslav Arbanas**          *karbanas@foi.hr*
*Paying Agency in Agriculture, Fisheries and Rural Development*
*Zagreb, Croatia*

## Abstract

This paper analyzes state of the art of the research regarding the education and career development of information and communications technology (ICT) graduates based on a comprehensive literature review. Analysis presented in this paper includes 155 papers in two research areas – one related to the education of ICT graduates (101 papers) and the other to their career development (54 papers). The most prestigious papers, most influential journals and groupings of authors in the abovementioned fields are identified by using the citation analysis and Social Network Analysis (SNA). Results show that the most influential papers related to ICT career are research papers dealing with ICT job skills requirements, and related to ICT education are ICT association's related reports and recommendations on curriculum development. In general, results show that there is a lack of cross-fertilization of knowledge in both areas which means that the mixing of ideas that can lead to better research results is missing.
**Keywords:** career development, ICT education, citation analysis, Social Network Analysis (SNA)

## 1. Introduction

Nowadays, Information and Communications Technology (ICT) and related industries make an increasingly important contribution to the economic growth and development of a society in general. The statistics from 2014 shows that in 2010 the ICT services sector in Europe was the only segment that has recorded structural increase since the crisis started in 2008 [1]. According to OECD's statistics, levels of

labour productivity within information industries are more than 60% higher than in the total business sector and higher than average across all OECD economies [2].

ICT sector shows high importance in the total economy, with the tendency of further growth. Such trends imply a need for more skilled workers that will contribute to further growth. Current data shows that, in comparison with other sectors, ICT sector represented 2,7 % of EU total employment in 2010 and the share of ICT employment in total employment remain stable in almost all European countries [1]. Newest data for 2014 shows nearly 8 million persons employed in 2014 as ICT specialists, representing 3,7 % of total employment [3]. While on the one hand there is a high demand for ICT specialists and employment of the ICT specialists across the economy as a share of total employment is high (i.e. 4,75% in UK, 4,66% in Canada, 4,07% in USA) [4], on the other hand many countries are facing difficulties when trying to fill vacancies for jobs requiring ICT specialist skills. Almost 40% enterprises with at least 10 employers experienced hard-to-fill vacancies for ICT specialists in 2014 [3].

Predictions for future growth in demand for ICT specialists are also positive. According to the European Centre for the Development of Vocational Training (CEDEFOP),  Europe is challenged with 700.000 uncovered vacancies including ICT skills by 2015, and it is expected that 90% of jobs will require some sort of ICT skills in future [5]. Moreover, current predictions of future trends in ICT professional jobs and demand in Europe from 2012 to 2020 present three different scenarios [6], and in all three cases, the demand potential exceeds the predictions about the number of ICT graduates.

Presented data show the societal importance of the topic related to the education and future career development of graduates in the field of ICT. Accordingly, that topic should also be relevant in the context of scientific work, in order to provide scientifically researched and argumented solutions for the evident societal issue. Therefore, the overall goal of this paper is to provide short overview of topics covered within the scientific literature related to the education and career development of future ICT professionals and the specific goal is to detect the most influential papers in the field and to define any groupings of authors that streamline the research in the field.

## 2.  Overview of ICT Professionals' Education Research

From the early beginnings of computer science and related disciplines and educational programmes, there was a problem of determining the body of knowledge and the set of skills that graduates with degrees in computer science should demonstrate from education's and employers' point of view [7], [8], [9]. Consequently, there is an evident mismatch between the industrial needs and the skills that computer science graduates possess [10]. As a solution to the evident mismatch in the skills expected from employers and the ones that graduates possess, the authors propose more intensive collaboration between the academia and industry in the form of internships and  cooperative  programs  [10],  [11]  as  well  as  the  development  of  teaching

methodologies for solving real-world problems [10]. Suggestions for the improvements of curriculum design and its delivery have been the topic of many research papers [12], [13], [14], [15].

During the 1970s, a pattern of predictions about future trends in computer science developments and labour market needs for computer science professionals can be observed. For the 1980s, upcoming trends raised the question of the following issues in computer science education: theory versus practice in computer science curriculums, practical exposure of students to real-world problems through laboratory courses and the societal and moral issues included in the educational processes [16]. Predictions about future trends also indicated the continued growth of computer jobs in the 1980s [16], as well as growth in the number of different educational programmes in computer science [17]. In the 1990s, together with computer science, the usage of the term 'information system' became more prevalent in the literature, and emphasis was put on the necessary skills of future information systems professionals. There were several comprehensive studies related to knowledge and skills that future information systems professionals should possess to successfully perform their jobs [18], [19], [20] as well the evolution of information systems job skills during the 20-year period (from 1970 to 1990) [21].

The new trends in the emerging field of computer science discipline affected changes in computer science education, including new emerging topics into curriculum. The year 2000 is associated with the Institute of Electrical and Electronic Engineering (IEEE) Computer Society and Association for Computing Machinery (ACM) Joint Task Force on CC-2001 Computing Curricula project [22]. In a broader view on the changes in education, this year is also associated with Lisbon convention [23] and the Bologna process inception, which resulted in the establishment of The European Higher Education Area (EHEA) in a decade. Those initiatives put also a certain focus on teaching pedagogy, which had not been changed in a significant manner before that time [24]. With the new century approaching, much more attention was paid to this aspect of the education, resulting in more work and improvements in teaching methods: project-based learning [25], peer learning [26], active learning [27], [28], team learning [29], studio-based teaching and learning [30], [31], etc.

Around this period, much effort was also invested on the employability of future ICT professionals. The term 'employability' is defined as a person-centred construct, considering 'the quality of character of being employable' [32] and described with three component dimensions – career identity, personal adaptability, and social and human capital [33]. In line with the understanding of employability as a person-centred construct, the major responsibility for career development is put on individuals and not their employers. However, higher education institutions have tended to take responsibility for enhancing students' employability through their educational provision and learning activities, since the first employment after graduation is used as one of the main indicators of higher education quality [34]. In that process, the potential of graduates as perceived from employers became an important topic. The literature focused on ICT graduates refers to this topic in the context of investigating skills perceived as important by employers, [35], [36], [37], [38], with special emphasis on the importance of both hard skills and soft skills, [39],

[40], [41], gaps in curriculum as viewed by the business sector, [42], [43], [44], and general issues in graduates' employability and trends on the IS/IT job market [45]. The growing gap between supply and demand of skilled information technology professionals is stressed [46].

Additionally, the importance and actuality of the abovementioned topics is supported by recent research findings within relevant research and development projects related to graduates employability and by the implications coming from policy documents. The research within the project The Employability of Higher Education Graduates: The Employers' Perspective [47], conducted among more than 900 employers, indicates the need for both professional and interpersonal skills and the integration of new teaching methods into curriculum that would enhance the development of both professional and generic skills. Main findings from HEGESCO project [48] stress the importance of active learning modes as one of the key factors for generating students competences, but also the curriculum development, the cooperation with employers, the acquisition of relevant work experience during higher education etc. In addition, the results of DEHEMS project [49], based on more than 360 interviews performed in six different countries, stress the need to foster the cooperation between academia and industry on more formal basis i.e. to include the industry representatives in the curriculum development processes, to address the development of both hard and soft skills through the curriculum, to provide students with more actual work experience during their studies etc.

The above short review of the history and trends in ICT education leads to the conclusion that the literature, with slight variations over the period of time, mainly refers to the following aspects: changes in curriculum design and delivery, changes in teaching methods, issues regarding the employability of ICT professionals, importance of both hard (technical) and soft (non-technical) skills for future employment, perceived gaps as seen by employers and the need for closer cooperation between academia and industry.

## 3.   Terminology Related to ICT Professionals' Education

As stated in IS 2002 report [50] and further discussed by Woratschek and Lenox [51], [52], the field of ICT has an excessive bundle of different names, including Information Technology, Information Systems, Information Technology Systems, Computer Information Systems, Management Information Systems, Business Information Systems, Information Management, Informatics, Information Science, Information and Quantitative Science, Computing, etc. Generally, computing can be divided into five main areas, namely Computer Science, Computer Engineering, Information Systems, Information Technology, and Software Engineering [53]. For further analysis within this research paper, it is important to understand and to elaborate the differences between different terms related to ICT discipline and to focus the research.

The Computer Science discipline emerged in the early 1960s [54] and one of the first scientific papers on that topic dates back to 1967, referring to the educational

programme in computer science [55]. Although not all academics agreed with the name 'computer science', the name was accepted by two associations very active within the development process of this profession from its very beginning – ACM and IEEE [54]. The Curriculum 68 represented the culmination of major developments in the computer science curriculum in 1960s [54]. In the 1970s, there was very active work on the development of computer science programmes, parallel with the development of the computer science discipline in general [56]. After Curriculum 68, there were several computer science curriculum updates (Curriculum 78, CC91, CC2001, CC2005, CC2013). The detailed examination of the series of ACM/IEEE curriculum updates provides an understanding of the differences between computer science-related education, as described in the following paragraph.

The discipline of Information Systems (IS) focuses on integrating information technology solutions and business processes to meet business objectives in an effective and efficient way. It emphasizes information and views technology as an instrument for generating, processing, and distributing information. From an academic perspective, undergraduate degree programmes in Information Technology (IT) prepare students to meet computer technology needs of business and other kinds of organizations [53]. The information technology discipline evolves rapidly, affecting both content as well as pedagogy. One of the examples is computer networking, which today is an inevitable aspect of information technology but back in the 1990s was not seen as a major topic [57]. Computer Engineering (CE), as one of the parts of computing, embodies the study of hardware, software, communications, and its mutual interaction, while its curriculum focuses on theories, principles, and practices of traditional electrical engineering and mathematics and their applicability to designing computers and computer-based devices. Software Engineering (SE), as a part of computing, born from computer science, is the discipline of developing and maintaining software systems adjusted according to the customers' requirements [53].

Regarding the abovementioned similarities and differences between the disciplines associated with ICT, we can elaborate the further focus of our research primary to the Information Technology and Information Systems, since these two integrate information technology and business systems. Computer Engineering and Software Engineering are narrower and focused on technology, without strong relation with business, while Computer Science is more comprehensive. Therefore, the focus on information systems and information technology will be broadened with the computer science discipline, as it also covers both technical and business skills. To simplify the communication of this study, we will use the abbreviation ICT when referring to the discipline as the focus of our research. For the purpose of clarity of ICT related terms used in this paper, it is also necessary to distinguish the *ICT graduates* from the *ICT professionals*. The term *ICT professionals* refers to the professionals employed in the ICT industry after finishing their education, while the term *ICT graduates* is used when referring to future *ICT professionals* that are still within the system of education.

## 4.    Methods

In order to get a better insight into the scientific work on the education and career development of future professionals in the field of ICT, a comprehensive literature review was conducted by the authors of this paper, with a main goal to give insight into the current research on the education and career development of graduates in the field of ICT, to observe trends during time, to indicate research gaps and to provide guidelines for further research [58]. This review followed the general systematic literature review (SLR) steps proposed by Kitchenham [59] and guidelines from Webster & Watson [60]. Kitchenham stress several reasons for undertaking a systematic review, out of which the most common are [59]: (1) to summarize the existing evidence concerning the treatment or technology, (2) to identify gaps in current research in order to suggest areas for further investigation, and (3) to provide a framework/background in order to appropriately position new research activities. The idea of conducting a systematic literature review on the education and career development of future ICT professionals lies in the fact that the topic appears to be important for a longer period and there is no systematic work found in the existing literature. In this paper, the authors present results based on the papers used in systematic literature review, referring to the following research questions:

1.    Which are the most influential papers in the fields?
2.    Are there any groupings of authors in the field that streamline the research in the field?

### 4.1.    Literature Search Procedure

The database search was conducted for the purpose of literature review, using several terms which can be divided in three groups. Variations of terms related to ICT, as explained in Chapter *Terminology related to ICT professionals' education*, are terms from the first group: "IT", "ICT", "IS", "Information system", "Computer science" and "Information Technology". In the second group are terms related to education and related contexts such as "Education*", "Graduate*", "Student*", "Curricul*" and "Program*", while the third group contains terms more related to the future careers, employment of students and competences required for their future jobs, i.e. terms "Job", "Career", "Profession*", "Employ*", "Skill*" and "Competenc*" [58]. According to the set terms, database search procedure resulted with two datasets for the analysis – one related to *ICT Education* and the other related to *ICT Career*.

As explained in more detail in [58], the database query was conducted within five databases. Two databases are from the largest professional associations in the research field of ICT: ACM Digital Library and IEEE Xplore Digital Library, and three databases that are considered today to contain the most relevant research papers in spectrum of scientific fields: SCOPUS, ScienceDirect, and Web of Science (WoS). Those databases contain publications from different disciplines, but our research query was limited only to those relevant to the research field according to the predefined categories in each database. Additionally, only the first 500 results

according to the relevance from Scopus and WoS were included in the analysis, without limitation to the year of publishing. In all databases, the search query was limited to the journal papers and conference publications. An initial search was made in the period 24–30 July 2014. From the initial database query, 7179 papers were acquired and read by title. According to the title, 900 papers were selected for the second review phase. After exclusion of the identical papers, 761 papers were obtained to be read by summary. For further analysis of the primary studies selected, inclusion and exclusion criteria were defined for each phase. Inclusion criteria for the third review phase resulted in 155 full papers that were included in the final analysis, 101 within *ICT Education* (Appendix A) and 54 within *ICT Career* (Appendix B).

## 4.2. Data Analysis Methods

For the analysis of research results, several approaches to the analysis of literature were used, including both qualitative and quantitative methods.

In this paper, the authors first present results of the bibliometric method of citation analysis, which refers to counting the references within the bibliography. According to Baker, citation analysis within its short version considers a count of cited journals, papers, or authors and in the advanced version, it can include the investigation between them to discover certain patterns (in [61]). For the purpose of this paper, the simple document citation analysis was used for counting the papers most cited by all the 101 papers within *ICT Education* and 54 papers within *ICT Career* dataset included in final analysis. There are several reasons that only the simple citation analysis is adequate for analysis of the whole set of references of analysed paper: (1) papers from different databases are included in the analysis, using different citation styles and (2) some papers are older and not adequate for optical character recognition. This brings us to the fact that around 2700 references should be manually prepared for the analysis, which increases the possibility of errors. For more advanced examination of co-citation between the papers included in analysis, social network analysis (SNA) was applied in order to determine the density of research networks, interconnection between different authors and the most influential author in the field.

## 5. Research Results

This chapter brings detailed results of citation analysis and the social network analysis on the *ICT Education* and *ICT Career* set of papers.

## 5.1. Most Cited Papers

Tables "Most cited papers in *ICT Education"* in Appendix C and "Most cited papers in *ICT Career"* in Appendix D present papers cited at least in two papers from the observed datasets. Interestingly, four out of five of the most highly cited and co-cited papers in *ICT Career* were published in the middle of 1990-ties, opposite to the most co-cited papers in *ICT Education* that were published ten years later. The most

influential journal for *ICT Career* is *MIS Quarterly*. On the other hand, the most frequently cited papers in *ICT Education* were those published by the ICT associations (ACM and IEEE) and are related to curriculum development recommendations. Although there are more papers analysed related to *ICT Education* (101) in comparison to *ICT Career* (54), the *ICT Career* dataset contains more papers that are found to be highly cited in the Scopus database – 17 compared to only 1 for papers within *ICT Education*. It can be concluded that the most influential papers in *ICT Career* are research papers dealing with ICT job skills requirements, and the most influential papers in *ICT Education* are ICT association's related reports and recommendations on curriculum development. Results of the citation analysis provides one part of the answer to the research question "Which are the most influential papers in the fields?", which will be also amended with the results of social network analysis.

## 5.2. Cross Fertilization within *ICT Education* and *ICT Career*

For further analysis, the Social Network Analysis (SNA) approach and measures were used to estimate cross fertilization of research ideas and results in each area and between areas [62]. The definitions and formulas used in this paper can be found in [63]. First, a directed graph that contained nodes (vertices) representing papers (points in Figure 1 and Figure 2) and oriented lines (arc) representing co-citations was built (lines in Figure 1 and Figure 2).
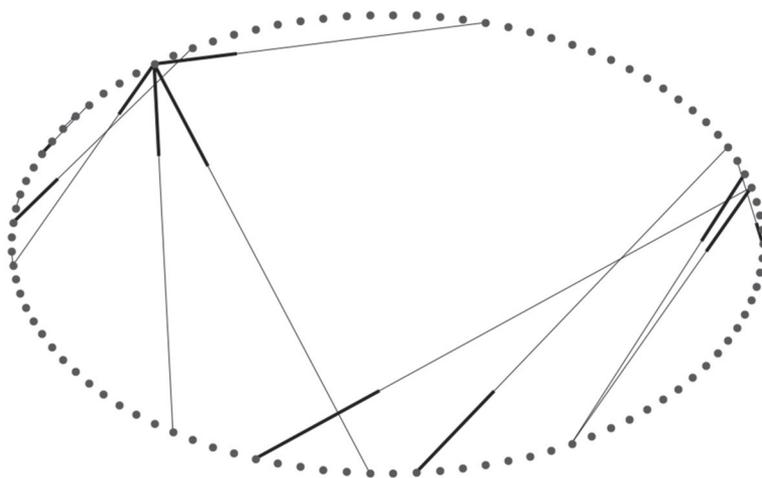


Figure 1. *ICT Education* co-citation network

The origin of an arc is a paper that cited the paper in the head of the arc. Taking into consideration only co-citation within networks, the *ICT Career* network is more interconnected (Figure 1 and Figure 2). This is evident from the network density

measure[1], which shows that the density of the *ICT Career* network is 0,0234 and of the *ICT Education* network is 0,001386. In both networks, there are many independent studies that are not based on similar research backgrounds, but the papers in *ICT Career* share more common references.
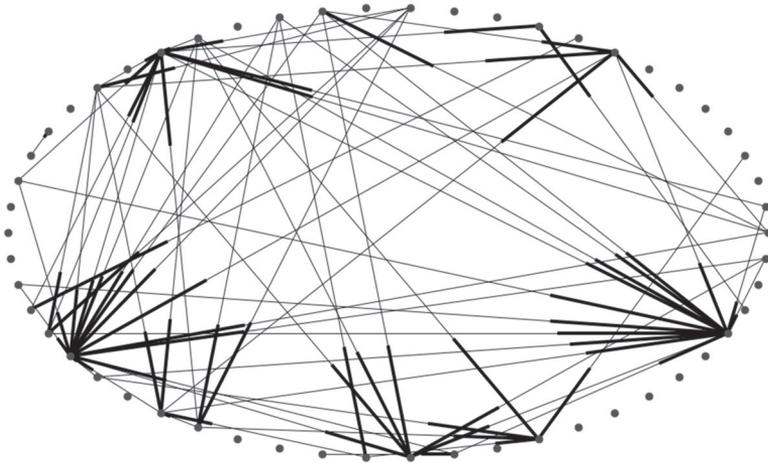


Figure 2. *ICT Career* co-citation network

It is useful to identify the papers that represent the set of common references. For that purpose, the centrality measures in SNA were used. Degree centrality is a measure based on numbers of ties that one node has with others. In directed graphs, as those observed here, it is important to distinguish the centrality based on indegree and the centrality based on outdegree. High indegree centrality indicates the importance or the prominence of a certain node (in this case paper), also called a prestige. A prestigious paper enjoys high popularity, which is in this case shown by being referenced in many other papers. In absolute and standardized (divided with 54) measures, the highest prestige degree within *ICT Career* co-citation network is obtained for the following papers: Lee et al. (1995) [64], cited in 14 papers from the network (0,259), Todd et al. (1995) [21], cited in 13 papers (0,241) and Gallivan (2004) [37] cited in nine other papers (0.1667). Other papers are much less prestigious and cited only six times or fewer. Within the *ICT Education* co-citation network, in absolute and standardized (divided by 101) measures, the highest prestige degree is observed for the paper Hagan (2004) [43], cited in four other papers (0,0396). There are 10 more papers cited only once (0,0099). On the other hand, papers with the high outdegree centrality can be described as very familiar with the research area, since they are citing other papers from the network. Within *ICT Career*, there are two papers: Gallagher et al. (2011) [65] and Goles et al. (2008) [66], that are referencing six other papers from the network, and Donohue & Power (2012) [67] referencing five other papers, and have

---

[1] The density (D) of the ratio of the number of lines present (M) to the maximum possible e.g. D=M/N(N-1), where N is the number of nodes (vertices). The density is always between 0 and 1.

the highest outdegree. Three other papers are referencing four different papers from the network, six papers are referencing three other papers and 14 more papers are referencing only one or two. As with the other measures, the *ICT Education* network shows lower connectivity, with only one paper referencing two others (Sobiesk et al. 2006) [68] and 12 papers referencing only one paper from the network. Based on the indegree and outdegree measure, several types of papers can be recognized. Both *ICT Career* and *ICT Education* networks contain mostly *isolate* papers (24 in *ICT Career*, 79 in *ICT Education*), without any connections with other papers (Table 1). It can be concluded that there are several papers enjoying prestige in the analysed set of papers but without any papers that take into account the previous research. This analysis contributes to answer the research question "Which are the most influential papers in the fields?".

| OUTDEGREES | INDEGREES | |
| --- | --- | --- |
| | >0 | 0 |
| >0 | Carrier (ordinary) <br><br> 12 ICT Career <br> 2 ICT Education | Transmitter <br><br> 14 ICT Career <br> 11 ICT Education |
| 0 | Receiver <br><br> 4 ICT Career <br> 9 ICT Education | Isolate <br><br> 24 ICT Career <br> 79 ICT Education |

Table 1. Types of papers in *ICT Education* and *ICT Career* network

Figure 3 provides a detailed overview of the structure of *ICT Education* co-citation network (extracted arcs from Figure 1), which consists of eight components of connectivity. This graph does not contain any cutpoints (nodes whose removal increases the number of components of connectivity) or bridges (lines that are critical to the connectedness of the graph). There are no cliques (groups of researchers) identified, but from the analysis of all the authors (and not only the first author as shown in Figure 3 and Figure 4), it can be seen that six isolated components are the result of authors' self-citations.

From Figure 4, it can be seen that the *ICT Career* co-citation network (extracted arcs from Figure 2) has a different structure, with only two components of connectivity, where one of them contains the majority of analysed papers and the other represents a case of self-citation.

The earliest papers dates from Cheney in 1990 [18] and Nelson in 1991 [19], followed by two papers with highest indegree centrality of the network in 1995: Lee et al. [64] and Todd et al. [21] The latest three papers have been by all measures very influential in the area of *ICT Career*. The detailed examination of all the authors shows the existence of one research group with four co-cited papers (Nelson et al. 2007 [38];
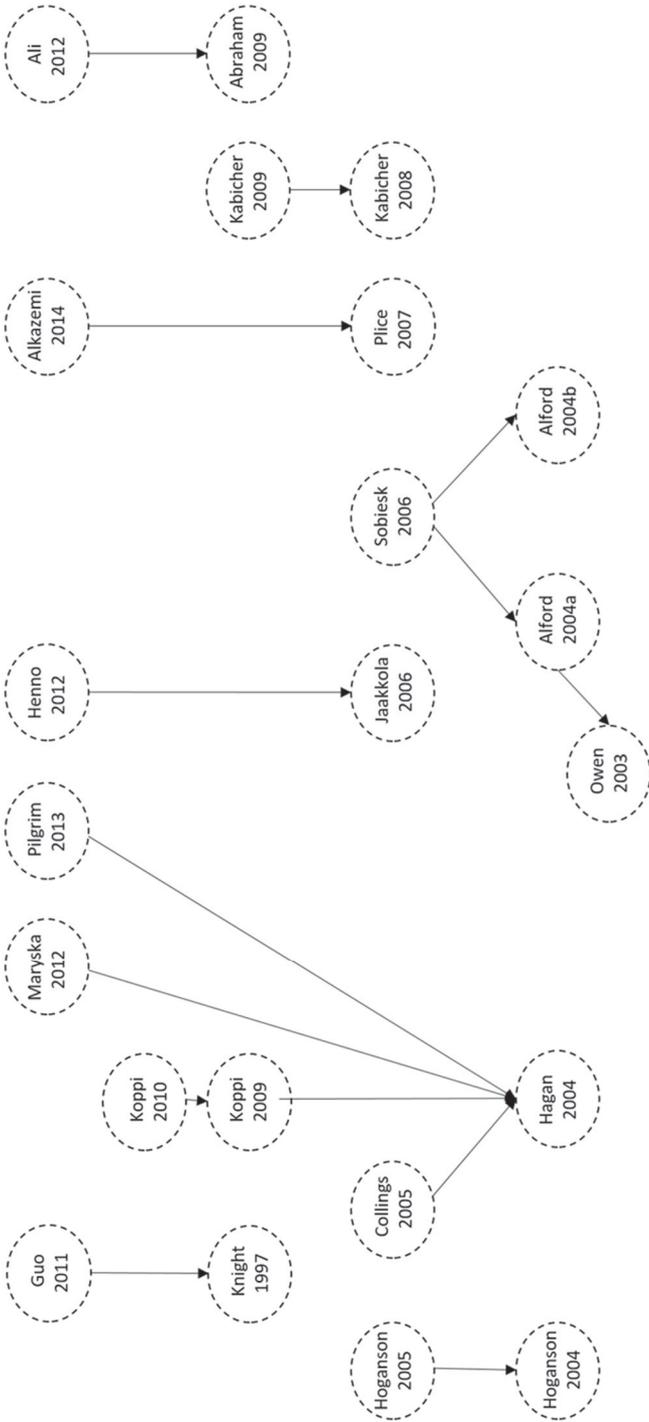
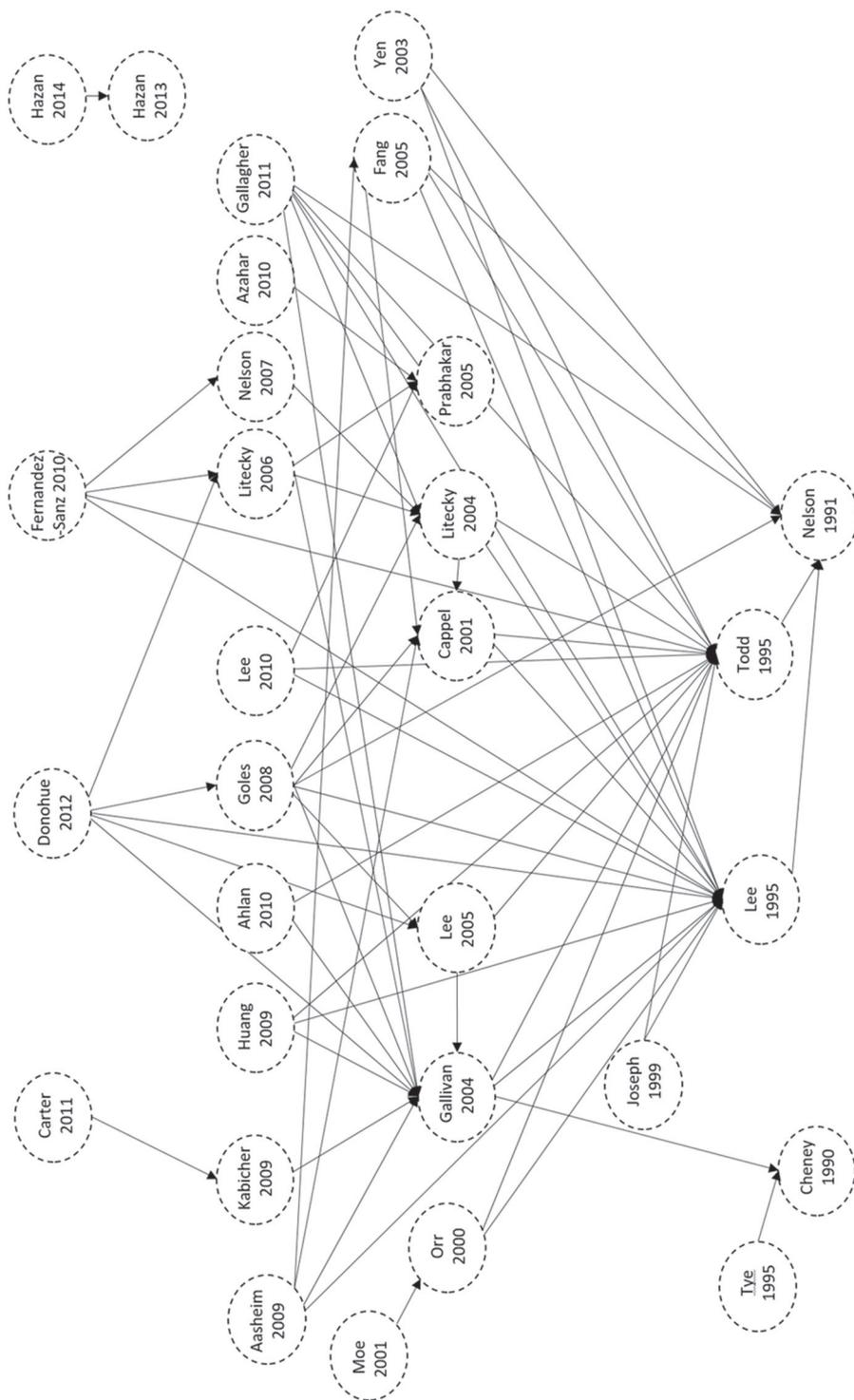Figure 3. Directed graph of co-citations between papers within *ICT Education*

Figure 4. Directed graph of co-citations between papers within *ICT Career*

Litecky et al. 2004 [39]; Litecky et al. 2006 [45]; Prabhakar et al. 2005 [69]). Figure 4 also shows (in form of quazi-Hasse diagram) crucial papers for certain time spans (period) for the *ICT Career*. Presentation of co-citation networks provides answer to the research question: "Are there any groupings of authors in the field that streamline the research in the field?"

## 6.    Discussion and Conclusion

Presented research resulted in several outputs relevant for the research area of the education and career development of future professionals in the field of ICT, as will be discussed and summarized in this chapter. This paper provides the analysis 155 papers in two research areas called *ICT Education* (101 papers) and *ICT Career* (54 papers). The number of relevant papers identified and analysed within *ICT Education* is almost double than within *ICT Career*.

Considering the first research question: "Which are the most influential papers in the fields?" it can be concluded that the most influential papers in *ICT Career* are research papers dealing with ICT job skills requirements and the most influential papers in *ICT Education* are professional associations' related reports and recommendations on curriculum development. In both topics, there are many independent studies that are not based on similar research backgrounds, but the papers in *ICT Career* share more common backgrounds. In general, there is a lack of cross-fertilization of knowledge in both areas which means that the mixing of ideas that can lead to better research results is missing.

The SNA approach that represents references in forms of directed graphs reveals the historical development of two research areas and identifies the most prestigious papers that influence development of the areas but also give us information about influential journals and reports. On the one hand, it is found that ASM/IEEE reports and reconditioning of ICT-related curricula have a considerable impact on research in *ICT Education*. On the other hand, *MIS Quarterly Journal* is far from the most influential journal in the *ICT Career* field. Some of the reasons for this are that the fundamental papers in 1990-ties were published there and that those papers have the highest citation rate in general but also a high co-citation (citation obtained by analysed papers in this study) rate. These papers inaugurated the topic of skills for jobs in the ICT-related industry.

Citation analysis extracted only a few papers that were more cited while they provided more fundamental results based on more comprehensive research. This indicates that future research should tackle more successful case studies with evaluation of results and analysis of transferability into new contexts.

The answer to the second research question "Are there any groupings of authors in the field that streamline the research in the field?" was obtained from the co-citation analysis. The analysis of citation graphs demonstrates that the density of both networks is rather low, implying that there is a lack of sharing of research findings, and therefore, it is not feasible to achieve some important theoretical framework or breakthrough. It is especially important for the *ICT Education* area. Therefore, it

would be important to invest in multi-partner projects dealing with the topics of ICT education and graduates' early career development and establish specialized journal(s) and communities of practice in the mentioned research areas.

## Acknowledgements

## Appendix A: List of Papers within *ICT Education*

1.  Abraham, Aju Thomas, and Jayasankar Prasad. 2009. "Industry Institute Interaction for Capability Building in Engineering Education in India a Study on the Indian Information Technology Companies." In 2009 ITI 7th International Conference on Communications and Information Technology (ICICT), pp. 17–22.
2.  Adrion, W.R., W. Burleson, W. Cooper, W.L. Israel, J. Kurose, and K. Watts. 2003. "Excite: Enabling X-Campus Information Technology Education." In 33rd Annual Frontiers in Education, 2003. pp. S4F_18–S4F_23.
3.  Agayev, Firudin, and Gulara Mamedova. 2012. "Development of an Educational Standard of Higher Education for ICT Sphere." In 2012 IV International Conference "Problems of Cybernetics and Informatics" (PCI), pp. 1–3.
4.  Ahlan, Abdul Rahman, Yusri Arshad, Mohd Adam Suhaimi, and Husnayati Hussin. 2010. "The Malaysia IT Outsourcing Industry Skill-Sets Requirements of Future IT Graduates." WSEAS Transactions on Computers 9(7): 738–747.
5.  Alford, K.L., C.A. Carver, E.K. Ressler, and C.W. Reynolds. 2004. "A Curriculum Framework for Evolving an Information Technology Program." In 34th Annual Frontiers in Education, 2004., pp. 882–887.
6.  Alford, Kenneth L., Curtis A. Carter, Daniel J. Ragsdale, Eugene K. Ressler, and Charles W. Reynolds. 2004. "Specification and Managed Development of Information Technology Curricula." In Proceedings of the 5th Conference on Information Technology Education - CITC5 '04, pp. 261-266.
7.  Ali, Asha, and Liyamol Aliyar. 2012. "Re-Engineering of ICT Engineering Education." In 2012 IEEE International Conference on Engineering Education: Innovative Practices and Future Trends (AICERA), pp. 1–6.
8.  Alkazemi, Basem Y., Mohammed K. Nour, Abdulqader Q. Sahrawi, Anas M. Basalamah, Saleh M. Basalamah, Hassan F. Lahza, and Grami M.A Grami. 2014. "A Framework for Designing a Market-Oriented Curriculum for the Degree of Information System Engineering." In 2014 IEEE Global Engineering Education Conference (EDUCON), pp. 695–700.
9.  Barbosa, Fernanda, Helga Guincho, Francisco B. Leite, Jose Luis Nunes, and Carlos Pereira. 2011. "European Computer Science Master Curriculum Development Methodology: Management and Research." In 2011 7th International Conference on Next Generation Web Services Practices, pp. 487–92.
10. Blum, Thomas E., and Margaret M. McCoey. 2007. "Incorporating Business Concepts into a Computer Science Curriculum: A Multi-Tiered Approach." Journal of Computing Sciences in Colleges 22(3): 175–182.
11. Borys, Magdalena, Marek Milosz, and Malgorzata Plechawska-Wojcik. 2012. "Using Deming Cycle for Strengthening Cooperation between Industry and University in IT Engineering Education Program." In 2012 15th International Conference on Interactive Collaborative Learning (ICL), pp. 1–4.

12. Buckley, Michael, Helene Kershner, Kris Schindler, Carl Alphonce, and Jennifer Braswell. 2004. "Benefits of Using Socially-Relevant Projects in Computer Science and Engineering Education." In Proceedings of the 35th SIGCSE Technical Symposium on Computer Science Education - SIGCSE '04, pp. 482-486.

13. Calitz, Andre P., Jean H. Greyling, and Margaret D. M. Cullen. 2011. "ICT Career Track Awareness amongst ICT Graduates." In Proceedings of the South African Institute of Computer Scientists and Information Technologists Conference on Knowledge, Innovation and Leadership in a Diverse, Multidisciplinary Environment - SAICSIT '11, pp. 59–68.

14. Carbone, Angela, and Judy Sheard. 2002. "A Studio-Based Teaching and Learning Model in IT: What do First Year Students Think?." In Proceedings of the 7th Annual Conference on Innovation and Technology in Computer Science Education ITiCSE'02, pp. 213–217.

15. Cardoso, João M. P. 2005. "New Challenges in Computer Science Education." Proceedings of the 10th annual SIGCSE conference on Innovation and technology in computer science education - ITiCSE '05, pp. 203-207.

16. Chen, Dan, and Nian-feng Fu. 2010. "On Computer Science Reform of Curriculum Structure." In 2010 Third International Symposium on Electronic Commerce and Security, pp. 21–24.

17. Chengxia, Liu, Cai Ying, and Shen Meie. 2011. "Using Cooperation between University and Enterprise to Improve the Comprehensive Competitiveness of Student in Computer Science." In 2011 6th International Conference on Computer Science & Education (ICCSE), pp. 772–775.

18. Chin, Kum Leng, and E. Chang. 2009. "Sustainable ICT Education Ecosystem." In 2009 3rd IEEE International Conference on Digital Ecosystems and Technologies, pp. 271–277.

19. Chin, Kum Leng, and Elizabeth Chang. 2011. "A Sustainable ICT Education Ontology." In 5th IEEE International Conference on Digital Ecosystems and Technologies (IEEE DEST 2011), pp. 350–354.

20. Chin, Kum Leng, Elizabeth Chang, and Doug Atkinson. 2008. "A Digital Ecosystem for ICT Educators, ICT Industry and ICT Students." In 2008 2nd IEEE International Conference on Digital Ecosystems and Technologies, pp. 660–673.

21. Chookittikul, Jaruek, and Wajee Chookittikul. 2008. "Six Sigma Quality Improvement Methods for Creating and Revising Computer Science Degree Programs and Curricula." In 2008 38th Annual Frontiers in Education Conference, pp. F2E – 15–F2E – 20.

22. Collings, P., D. Sharma, and D. Walker. 2005. "IT Education and the Knowledge Society: an Australian Perspective." In 3rd International Conference on Information and Communication Technology, pp. 57–73.

23. Couger, J. Daniel, Gordon B. Davis, Dorothy G. Dologite, David L. Feinstein, John T. Gorgone, A. Milton Jenkins, George M. Kasper, Joyce Currie Little, Herbert E. Longenecker, and Joseph S. Valacich. 1995. "IS'95: Guideline for Undergraduate IS Curriculum." MIS Quarterly: Management Information Systems 19 (3): 341–359.

24. Darrah, Marjorie, Rebecca Giorcelli, and Tracie Dodson. 2007. "A Comprehensive Program for Expanding Pathways to IT Careers." In Proceedings of the 8th ACM SIGITE Conference on Information Technology Education - SIGITE '07, pp. 195–200.

25. Doboli, Simona, Gerda L. Kamberova, John Impagliazzo, Xiang Fu, and Edward H. Currie. 2010. "A Model of Entrepreneurship Education for Computer Science and Computer Engineering Students." In 2010 IEEE Frontiers in Education Conference (FIE), pp. T4D – 1–T4D – 6.

26. Domingo-Ferrer, J. 2003. "Networking in the New ICT Curricula." In Proceedings of the International Conference on Information Technology: Computers and Communications (ITCC'03), pp. 20–24.

27. Falkner, Nickolas J.G., Rebecca Jade Vivian, and Katrina Elizabeth Falkner. 2013. "Computer Science Education: The First Threshold Concept." In Learning and Teaching in Computing and Engineering (LaTiCE) 2013, pp. 39–46.

28. Fellers, Jack W. 1996. "Teaching Teamwork: Exploring the Use of Cooperative Learning Teams in Information Systems Education." Data Base for Advances in Information Systems 27 (2): 44–59.

29. Floyd, Ronald C. 2004. "A Model for Information Technology Curriculum." In Proceedings of the 5th Conference on Information Technology Education - CITC5 '04, pp. 83–89.

30. Fossum, T. V., and S. M. Haller. 2005. "A New Quantitative Assessment Tool for Computer Science Programs." In Proceedings of the 10th annual SIGCSE conference on Innovation and technology in computer science education ITiCSE '05, pp. 153-157.

31. Fulbright, Ron. 2011. "Teaching Innovation-on-Demand in an Undergraduate Information Technology Program." In Proceedings of the 2011 Conference on Information Technology Education - SIGITE '11, pp. 233-238.

32. Furst, Merrick, Charles Isbell, and Mark Guzdial. 2007. "ThreadsTM: How to Restructure a Computer Science Curriculum for a Flat World." Proceedings of the 38th SIGCSE technical symposium on Computer science education SIGCSE '07, pp. 420-424.

33. Ghosh, S. 1998. "A New Metric for Assessing Quality in Advanced Graduate Courses in Computer Science & Engineering." In FIE '98. 28th Annual Frontiers in Education Conference, pp. 628–633.

34. Gorgone, John T., and Paul Gray. 1999. "Graduate IS Curriculum for the 21st Century." In Proceedings of the 32nd Hawaii International Conference on System Sciences, pp. 1-7.

35. Guo, Weibin, Jianhua Li, Jianguo Yang, Gaoqi He, and Hong Zheng. 2011. "Practical Education for Computer Science Undergraduates at East China University of Science and Technology." In 2011 International Conference on Control, Automation and Systems Engineering (CASE), pp. 1–4.

36. Gupta, Gopal K. 2007. "Computer Science Curriculum Developments in the 1960s." IEEE Annals of the History of Computing 29(2): 40–54.

37. Hagan, Dianne. 2004. "Employer Satisfaction with ICT Graduates," In Proceedings of the Sixth Australasian Conference on Computing Education ACE '04, pp. 119–123.

38. Hazzan, Orit, and Gadi Har-Shai. 2014. "Teaching and Learning Computer Science Soft Skills Using Soft Skills: The Students' Perspective." In Proceedings of the 45th ACM Technical Symposium on Computer Science Education - SIGCSE '14, pp. 567–572.

39. He, Xiao-Qi, Yi-Gang Wang, Zhuo-Yuan Wang, Sheng-Li Fan, and Jia-Lin Cui. 2010. "Illuminations from the Experience in Computer Science Education at Foreign Universities." In 2010 5th International Conference on Computer Science & Education, pp. 806–808.

40. Helps, C. Richard G. 2006. "Instructional Design Theory Provides Insights into Evolving Information Technology Technical Curricula." In Proceedings of the 7th Conference on Information Technology Education - SIGITE '06, pp. 129-134.

41. Henno, J., H. Jaakkola, and J. Makela. 2012. "Quo Vadis, IT Education?" In Proceedings of the 35th International Convention MIPRO 2012, pp. 1232–1238.

42. Hoganson, Kenneth. 2004. "Computer Science Curricula in a Global Competitive Environment." Journal of Computing Sciences in Colleges 20(1): 168–177.

43. Hoganson, Kenneth. 2005. "A Strategic Approach to Computer Science Curriculum." In Proceedings of the 43rd Annual Southeast Regional Conference on ACM-SE, pp. 365-370.

44. Intayoad, Wacharawan. 2014. "PBL Framework for Enhancing Software Development Skills: An Empirical Study for Information Technology Students." Wireless Personal Communications 76(3):419–33.

45. Jaakkola, Hannu, Jaak Henno, and Imre Rudas. 2006. "IT Curriculum as a Complex Emerging Process." In 2006 IEEE International Conference on Computational Cybernetics, pp. 1–5.

46. Jamaludin, Zulikha, and Ariffin Abdul Mutalib. 2005. "IT-Graduate Abilities: Performance Gap as an Input for Curriculum Improvement." In ITRE 2005. 3rd International Conference on Information Technology: Research and Education, 2005., pp. 348–51.

47. Jiangyu Li. 2009. "Theoretical Study and Practice on Training Model of Information Technology Competency for College Students." In 2009 4th International Conference on Computer Science & Education, pp. 1820–1824.

48. Kabicher, Sonja, Michael Derntl, and Renate Motschnig. 2008. "Approaching Inclusive Universal Access on the Computer Science Curriculum Level." In 2008 38th Annual Frontiers in Education Conference, pp. F2H – 14–F2H – 19.

49. Kabicher, Sonja, Renate Motschnig-Pitrik, and Kathrin Figl. 2009. "What Competences Do Employers, Staff and Students Expect from a Computer Science Graduate?" In 2009 39th IEEE Frontiers in Education Conference, pp. W1E-1 – W1E-6.

50.    Knight, John C., Jane C. Prey, and William A. Wulf. 1997. "A Look Back: Undergraduate Computer Science Education: A New Curriculum Philosophy and Overview." In Proceedings Frontiers in Education 27th Annual Conference. Teaching and Learning in an Era of Change, pp. 722–27.

51.    Koh, Christine Siew Kuan, and Damien Joseph. 2011. "Occupational Commitment of IT Students: A Social Cognitive Career Theory Perspective." In Proceedings of the 49th SIGMIS Annual Conference on Computer Personnel Research - SIGMIS-CPR '11, pp. 62-64.

52.    Koppi, Tony, Sylvia L. Edwards, Judy Sheard, Fazel Naghdy, and Wayne Brookes. 2010. "The Case for ICT Work-Integrated Learning from Graduates in the Workplace." In 12th Australasian Computing Education Conference (ACE 2010), pp. 107–116.

53.    Koppi, Tony, Judy Sheard, Fazel Naghdy, Joe Chicharo, Sylvia L. Edwards, Wayne Brookes, and David Wilson. 2009. "What Our ICT Graduates Really Need from Us: A Perspective from the Workplace," 09 Proceedings of the Eleventh Australasian Conference on Computing Education, pp. 101–110.

54.    Kruus, Helena, Peeter Ellervee, Tarmo Robal, Priit Ruberg, and Margus Kruus. 2013. "Involving Students in Teaching Process — Encouraging Student-Generated Content in ICT Studies." In 2013 Proceedings of the 24th EAEEIE Annual Conference (EAEEIE 2013), pp. 76–81.

55.    Kulkarni, Vidya, Christelle Scharff, and Olly Gotel. 2010. "From Student to Software Engineer in the Indian IT Industry: A Survey of Training." In 2010 23rd IEEE Conference on Software Engineering Education and Training (CSEE&T), pp. 57–64.

56.    Lee, J. A. N. 2002. "The Emporium Approach to Computer Science Education." Proceedings of the 7th annual conference on Innovation and technology in computer science education ITiCSE '02, pp. 203-207.

57.    Leon, Gonzalo. 2008. "Public-Private Partnerships in ICT Education from the Open Innovation Perspective." In 2008 ITI 6th International Conference on Information & Communications Technology, pp. 19–25.

58.    Lethbridge, Timothy C. 1998. "A Survey of the Relevance of Computer Science and Software Engineering Education." In Proceedings 11th Conference on Software Engineering Education, pp. 56–66.

59.    Levano, Marcos A., and Oriel A. Herrera. 2012. "Validation Strategies of Competences in a Computer Science Curriculum." In 2012 31st International Conference of the Chilean Computer Science Society, pp. 9–11.

60.    Li, Minjie. 2010. "A Model for Information Technology Education for Undergraduates of Engineering." In 2010 2nd International Conference on Education Technology and Computer, pp. V3–94 – V3–98.

61.    Li, Weibin, Shunli Zhang, and Zongling Li. 2009. "Open Source Movement and Computer Science Education Innovation." In 2009 International Conference on Information Engineering and Computer Science, pp. 1–4.

62.    Machanick, Philip. 2003. "Principles versus Artifacts in Computer Science Curriculum Design." Computers & Education 41(2):191–201.

63.    Shao, Kun and Peter Maher. 2009. "Populating the Global Software Talent Pool: An Effective Approach to Computer Science Education in China." In Proceedings of 2009 4th International Conference on Computer Science & Education, pp. 1539–1544.

64.    Manacero, Aleardo, Rildo R. dos Santos, Norian Marranghello, Aledir S. Pereira, Adriano M. Cansian, and Jose C.L. Ralha. 2001. "A Flexible Curriculum for Computer Science Undergraduate Major." In 31st Annual Frontiers in Education Conference. pp. F3D-20 – F3D-25.

65.    Mansour, Samah S., and John Reynolds. 2009. "Development of a Baccalaureate Major in Information Technology: Adding a Third Dimension to a Comprehensive Computing Program." In Proceedings of the 10th ACM Conference on SIG-Information Technology Education - SIGITE '09, pp. 108-114.

66.    Marshall, Linda. 2012. "A Comparison of the Core Aspects of the ACM/IEEE Computer Science Curriculum 2013 Strawman Report with the Specified Core of CC2001 and CS2008 Review." In Proceedings of Second Computer Science Education Research Conference - CSERC '12, pp. 29–34.

67. Maryska, Milos, Petr Doucek, and Renata Kunstova. 2012. "The Importance of ICT Sector and ICT University Education for the Economic Development." Procedia - Social and Behavioral Sciences 55:1060–1068.

68. Nai-xiang, Li. 2009. "Innovating IT Education and Accelerating IT Service Outsourcing Talent Training." In 2009 International Conference on Computer Technology and Development, pp. 443–447.

69. Nelson, R. Ryan. 1991. "Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements." MIS Quarterly 15 (4):503–525.

70. Orr, Jo, and Liisa von Hellens. 2000. "Skill Requirements of IT&T Professionals and Graduates: An Australian Study Research-in-Progress." In Proceedings of the 2000 ACM SIGCPR Conference on Computer Personnel Research - SIGCPR '00, pp. 167–170.

71. Owen, William. 2003. "Focus Tracks: Specializing in IT Education." In Proceeding of the 4th Conference on Information Technology Education - CITC '03, pp. 135-138.

72. Pardas, Montse, and Antonio Bonafonte. 2011. "Work in Progress — Cooperative and Competitive Projects for Engaging Students in Advanced ICT Subjects." In 2011 Frontiers in Education Conference (FIE), pp. F2G – 1–F2G – 3.

73. Pardede, Eric, and Judith Lyons. 2012. "Redesigning the Assessment of an Entrepreneurship Course in an Information Technology Degree Program: Embedding Assessment for Learning Practices." IEEE Transactions on Education 55(4):566–72.

74. Philippovich, A.Yu. 2013. "Integrating Vendors Educational Content and Official Courses into Russian Technical Universities' IT Curriculums." In 2013 IEEE 11th International Conference on Emerging eLearning Technologies and Applications (ICETA), pp. 315–319.

75. Pigford, Darleen V. 2001. "Designing and Implementing Active Learning in the Computer Science Curriculum: An Interactive Tutorial." Journal of Computing Sciences in Colleges 17(2):199–204.

76. Pilgrim, Chris J. 2013. "Industry Involvement in ICT Curriculum: A Comparative Survey." In 2013 35th International Conference on Software Engineering (ICSE), 1148–53.

77. Pirker, Johanna, Maria Riffnaller-Schiefer, and Christian Gütl. 2014. "Motivational Active Learning - Engaging University Students in Computer Science Education." In Proceedings of the 2014 Conference on Innovation & Technology in Computer Science Education - ITiCSE '14, pp. 297–302.

78. Plice, Robert K., and Bruce A. Reinig. 2007. "Aligning the Information Systems Curriculum with the Needs of Industry and Graduates." Journal of Computer Information Systems 48 (1): 22–30.

79. Poulova, Petra, and Ivana Simonova. 2013. "IT and Management from Graduates' View: 20-Year Evaluation of the Study Programme." In 2013 12th International Conference on Information Technology Based Higher Education and Training (ITHET), pp. 1–5.

80. Ren, Xiang-min, and Xue-yan Zhou. 2009. "Research and Practice on Cultivation of IT Talents in Appied Undergraduate Education through Business- Education Partnership." In 2009 4th International Conference on Computer Science & Education, pp. 1469–1472.

81. Said, Hazem, Louise Chaytor, Daniel Humpert, John Nyland, Robert Schlemmer, Mark Stockman, et al. 2004. "An Implementation of a Core Curriculum in an Information Technology Degree Program." In Proceedings of the 5th Conference on Information Technology Education - CITC5 '04, pp. 94-100.

82. Shi, Hao. 2008. "Maximising Computer Science Student Career Opportunity through ICT Industry Placements." In 2008 International Multi-Symposiums on Computer and Computational Sciences, pp. 228–31.

83. Simmons, Chris B., and Lakisha L. Simmons. 2010. "Gaps in the Computer Science Curriculum: An Exploratory Study of Industry Professionals." Journal of Computing Sciences in Colleges 25(5): 60–65.

84. Simpson, Matthew, Jay Burmeister, Alan Boykiw, and Jihan Zhu. 2003. "Successful Studio-Based Real-World Projects in IT Education." In Proceedings of the Fifth Australasian Conference on Computing Education ACE, pp. 41–51.

85. Sobiesk, Edward J., Jean R.S. Blair, James D. Cook, John C. Giordano, Bryan S. Goda, and Charles W. Reynolds. 2006. "Designing an Interdisciplinary Information Technology Program."

In Proceedings of the 7th Conference on Information Technology Education - SIGITE '06, pp. 71-76.

86. Sweeney, Robert B. 2003. "Creativity in the Information Technology Curriculum Proposal." In Proceeding of the 4th Conference on Information Technology Curriculum - CITC '03, pp. 139-141.

87. Tatnall, Arthur. 2008. "Factors Affecting the Adoption of ICT Curriculum Innovations and Educational Technology." In 2008 ITI 6th International Conference on Information & Communications Technology, pp. 11–16.

88. Tatnall, Arthur, and Bill Davey. 2002. "Understanding the Process of Information Systems and ICT Curriculum Development: Three Models," Proceedings of the IFIP 17th World Computer Congress - TC3 Stream on TelE-Learning: the Challenge for the Third Millennium, pp. 225-232

89. Tharp, Alan L. 2007. "Innovating: The Importance of Right Brain Skills for Computer Science Graduates." In Proceedings of the 12th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education - ITiCSE '07, pp. 126–130.

90. Timmerman, B., and R. Lingard. 2003. "Assessment of Active Learning with Upper Division Computer Science Students." In 33rd Annual Frontiers in Education Conference (FIE). pp. S1D-7 - S1D-12

91. Topi, Heikki, Joseph S. Valacich, Ryan T. Wright, Kate Kaiser, Jay F. Nunamaker, Janice C. Sipior, and Gert Jan de Vreede. 2010. "IS 2010: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems." Association for Computing Machinery (ACM) and Association for Information Systems (AIS)

92. van Veen, Maarten, Fred Mulder, and Karel Lemmen. 2004. "What Is Lacking in Curriculum Schemes for Computing/informatics?" Proceedings of the 9th annual SIGCSE conference on Innovation and technology in computer science education, pp. 186-190.

93. Xiangmin, Ren. 2009. "Diffluence Cultivation of IT Talents in Appied Undergraduate Education through College-Enterprise Cooperation." In 2009 International Forum on Computer Science-Technology and Applications, pp. 168–71.

94. Xue, Jiwei, and Lifeng Zhang. 2011. "Application of Task-Driven Approach in Information Technology Education." In 2011 International Conference on Electrical and Control Engineering, pp. 2024–2026.

95. Ying, Lin, Zhang Yan, and Li Tong. 2010. "Strategies for Promoting Better Interaction between Higher Education and IT Industry." In 2010 International Conference on E-Business and E-Government, pp. 5520–22.

96. Yuan, Dongqing, and Jiling Zhong. 2010. "Design and Implement a Networking Curriculum in Light of ACM IT Curriculum Recommendations and Bloom's Taxonomy." In Proceedings of the 2010 ACM Conference on Information Technology Education - SIGITE '10, pp. 155-156.

97. Zamyatina, Oxana M., and Polina I. Mozgaleva. 2013. "IT Implementation in the Educational Process of Future Engineers by Means of Project Activities and Competences Assessment." In 2013 IEEE Global Engineering Education Conference (EDUCON), pp. 1170–1176.

98. Zendler, Andreas, and Christian Spannagel. 2008. "Empirical Foundation of Central Concepts for Computer Science Education." Journal on Educational Resources in Computing 8(2): 1–15.

99. Zhang, Qianfan. 2010. "An Ability Demand-Oriented Curriculum Design for IM & IS Degree Program." In 2010 International Conference on Electrical and Control Engineering, pp. 2655–2658. doi:10.1109/iCECE.2010.649

100. Zhu, Duan, Wu Di, and Zhao DanTing. 2010. "The Interaction between IT Corporations and Education: Exploration on Talents Cultivating Modes of Higher Education." In 2010 5th International Conference on Computer Science & Education, pp. 1547–1549.

101. Zhu, Nanli, Suling Yang, and Wumei Ye. 2009. "Research on the Student-Oriented Role-Shift Teaching Model in the Computer Information Technology Course." In 2009 First International Workshop on Education Technology and Computer Science, pp. 256–260.

## Appendix B: List of Papers within *ICT Career*

1.  Aasheim, Cheryl L., Susan Williams, and E. Sonny Butler. 2009. "Knowledge and Skill Requirements for it Graduates." Journal of Computer Information Systems 42(3): 48–53.
2.  Ahlan, Abdul Rahman, Yusri Arshad, Mohd Adam Suhaimi, and Husnayati Hussin. 2010. "The Malaysia IT Outsourcing Industry Skill-Sets Requirements of Future IT Graduates." WSEAS Transactions on Computers 9(7):738–747.
3.  Archibald, J. A., and M. Katzper. 1974. "On the Preparation of Computer Science Professionals in Academic Institutions." In Proceedings of the National Computer Conference and Exposition - AFIPS '74, 313-319.
4.  Azahar, Dayana, Norehan Abdul Manaf, Nalini Dharmarajan, and Wan Adilah Wan Adnan. 2010. "Malaysia IT Career Opportunity Analysis Based on Classified Advertisement in the New Straits Times (2000–2008)." In 2010 International Conference on Information Retrieval & Knowledge Management (CAMP), 348–52.
5.  Bakar, Azuraini Abu and Choo-Yee Ting. 2011. "Soft Skills Recommendation Systems for IT Jobs: A Bayesian Network Approach." In 2011 3rd Conference on Data Mining and Optimization (DMO), pp. 82–87.
6.  Boyeena, Manoj, and Prakash Goteti. 2011. "A Blended Approach to Course Design and Pedagogy to Impart Soft Skills: An IT Company's Experiences from Software Engineering Course." In IEEE Technology Students' Symposium, pp. 6–10.
7.  Braught, Grant, Craig S. Miller, and David Reed. 2004. "Core Empirical Concepts and Skills for Computer Science." In Proceedings of the 35th SIGCSE technical symposium on Computer science education SIGCSE '04. pp. 245-249.
8.  Calitz, Andre P., Jean H. Greyling, and Margaret D. M. Cullen. 2011. "ICT Career Track Awareness amongst ICT Graduates." In Proceedings of the South African Institute of Computer Scientists and Information Technologists Conference on Knowledge, Innovation and Leadership in a Diverse, Multidisciplinary Environment - SAICSIT '11, pp. 59–68.
9.  Cappel, James J. 2001. "Entry-Level IS Job Skills: A Survey of Employers." Journal of Computer Information Systems 42(2): 76–82.
10. Carter, Lori. 2011. "Ideas for Adding Soft Skills Education to Service Learning and Capstone Courses for Computer Science Students." In Proceedings of the 42nd ACM Technical Symposium on Computer Science Education - SIGCSE '11, pp. 517-522.
11. Cheney, Paul H., David P. Hale, and George M. Kasper. 1990. "Knowledge, Skills and Abilities of Information Systems Professionals: Past, Present, and Future." Information & Management 19(4): 237–247.
12. Darrah, Marjorie, Rebecca Giorcelli, and Tracie Dodson. 2007. "A Comprehensive Program for Expanding Pathways to IT Careers." In Proceedings of the 8th ACM SIGITE Conference on Information Technology Education - SIGITE '07, pp. 195–200.
13. Deng, Changshou, Yuan Mei, and Qing Xie. 2009. "Job Position Oriented Experiment Courses of Computer Science." In International Conference on Information Engineering and Computer Science ICIECS 2009, pp. 1–4.
14. Donohue, Patrick, and Norah Power. 2012. "Legacy Job Titles in IT: The Search for Clarity." In Proceedings of the 50th Annual Conference on Computers and People Research - SIGMIS-CPR '12, pp. 5-10.
15. Fan, Jianbo, Liangxu Liu, Rina Su, Hua Yu, and Qingfeng Li. 2011. "Reform and Practice of Training Engineering Professionals in 2C+E Computer Science." In 2011IEEE 10th International Conference on Trust, Security and Privacy in Computing and Communications, pp. 1308–1312.
16. Fang, Xiang, Sooun Lee, and Seokha Koh. 2005. "Transition of Knowledge/skills Requirement for Entry-Level Is Professionals: An Exploratory Study Based on Recruiters' Perception." Journal of Computer Information Systems 46(1): 58–70.
17. Fernandez-Sanz, L. 2010. "Analysis of Non Technical Skills for ICT Profiles." In 2010 5th Iberian Conference on Information Systems and Technologies (CISTI), pp. 1-5.

250

18. Figl, Kathrin, and Renate Motschnig. 2008. "Researching the Development of Team Competencies in Computer Science Courses." In 2008 38th Annual Frontiers in Education Conference, pp. S3F – 1–S3F – 6.

19. Gallagher, Kevin P, Tim Goles, Stephen Hawk, Judith C. Simon, Kate M. Kaiser, Cynthia M. Beath, and Wm Benjamin Martz Jr. 2011. "A Typology of Requisite Skills for Information Technology Professionals." In 2011 44th Hawaii International Conference on System Sciences, pp. 1–10.

20. Gallivan, Michael J., Duane P. Truex III, and Lynette Kvasny. 2004. "Changing Patterns in IT Skill Sets 1988-2003: A Content Analysis of Classified Advertising." Data Base for Advances in Information Systems 35(3): 64–87.

21. Gardiner, Adrian, Vladan Jovanovic, and Han Reichgelt. 2004. "Second Thoughts about a Career in IT?" In Proceedings of the 5th Conference on Information Technology Education - CITC5 '04, pp. 194-201.

22. Goles, Tim, Stephen Hawk, and Kate M. Kaiser. 2008. "Information Technology Workforce Skills: The Software and IT Services Provider Perspective." Information Systems Frontiers 10 (2): 179–194.

23. Hagan, Dianne. 2004. "Employer Satisfaction with ICT Graduates," In Proceedings of the Sixth Australasian Conference on Computing Education ACE '04, Australian Computer Society. pp. 119–123

24. Hazzan, Orit, and Gadi Har-Shai. 2013. "Teaching Computer Science Soft Skills as Soft Concepts." In Proceeding of the 44th ACM Technical Symposium on Computer Science Education - SIGCSE '13, pp. 59-64.

25. Hazzan, Orit, and Gadi Har-Shai. 2014. "Teaching and Learning Computer Science Soft Skills Using Soft Skills: The Students' Perspective." In Proceedings of the 45th ACM Technical Symposium on Computer Science Education - SIGCSE '14, pp. 567–572.

26. Huang, Haiyan, Lynette Kvasny, K. D. Joshi, Eileen Trauth, and Jan Mahar. 2009. "Synthesizing IT Job Skills Identified in Academic Studies, Practitioner Publications and Job Ads." In Proceedings of the Special Interest Group on Management Information System's 47th Annual Conference on Computer Personnel Research - SIGMIS-CPR '09, pp. 121-128.

27. Intayoad, Wacharawan. 2014. "PBL Framework for Enhancing Software Development Skills: An Empirical Study for Information Technology Students." Wireless Personal Communications 76(3):419–433.

28. Janz, Brian D., and Ernest L. Nichols. 2010. "Meeting the Demand for IT Employees: Can Career Choice be Managed?." In Proceedings of the 2010 Special Interest Group on Management Information System's 48th Annual Conference on Computer Personnel Research - SIGMIS-CPR '10, pp. 8-14.

29. Jiangyu Li. 2009. "Theoretical Study and Practice on Training Model of Information Technology Competency for College Students." In 2009 4th International Conference on Computer Science & Education, pp. 1820–1824.

30. Joseph, Damien, Soon Ang, and Sandra Slaughter. 1999. "Soft Skills and Creativity in IS Professionals," Proceedings of the 32nd Hawaii International Conference on System Sciences, pp 1-5.

31. Kabicher, Sonja, Renate Motschnig-Pitrik, and Kathrin Figl. 2009. "What Competences Do Employers, Staff and Students Expect from a Computer Science Graduate?" In 2009 39th IEEE Frontiers in Education Conference, pp. W1E-1 – W1E-6.

32. Lee, Choong Kwon. 2005. "Transferability of Skills over the IT Career Path." In SIGMIS CPR'05 - Proceedings of the 2005 ACM SIGMIS CPR Conference on Computer personnel research, pp. 85–93.

33. Lee, Denis M.S., Eileen M. Trauth, and Douglas Farwell. 1995. "Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/industry Investigation." MIS Quarterly: Management Information Systems 19(3): 313–40.

34. Lee, Kyootai, and Dinesh Mirchandani. 2010. "Dynamics of the Importance of IS/IT Skills." Journal of Computer Information Systems 50(4): 67–78.

35. Levano, Marcos A., and Oriel A. Herrera. 2012. "Validation Strategies of Competences in a Computer Science Curriculum." In 2012 31st International Conference of the Chilean Computer Science Society, pp. 9–11.

36. Litecky, Charles R., Kirk P. Arnett, and Bipin Prabhakar. 2004. "The Paradox of Soft Skills versus Technical Skills in Is Hiring." Journal of Computer Information Systems 45(1): 69–76.

37. Litecky, Chuck, Bipin Prabhakar, and Kirk Arnett. 2006. "The IT/IS Job Market: A Longitudinal Perspective." In Proceedings of the 2006 ACM SIGMIS CPR Conference on Computer Personnel Research Forty Four Years of Computer Personnel Research: Achievements, Challenges & the Future - SIGMIS CPR '06, pp. 50-52.

38. Mammadova, Masuma, and Faig Mammadzadeh. 2012. "Formation of Supply and Demand for IT Specialists on the Base of Competency Model." In 2012 IV International Conference Problems of Cybernetics and Informatics (PCI), pp. 1-3.

39. Miller, Craig S., and Lucia Dettori. 2008. "Employers' Perspectives on It Learning Outcomes." In Proceedings of the 9th ACM SIGITE Conference on Information Technology Education - SIGITE '08, pp. 213-218.

40. Moe, Carl Erik, and Maung Kyaw Sein. 2001. "Meeting the IT-Skill Shortage in Europe Head-On: Approaching in Unison from Practice and Academia." In Proceedings of the 2001 ACM SIGCPR Conference on Computer Personnel Research - SIGCPR '01, pp. 29–36.

41. Nelson, H. James, Altaf Ahmad, Nancy L. Martin, and Charles R. Litecky. 2007. "A Comparative Study of IT/IS Job Skills and Job Definitions." In Proceedings of the 2007 ACM SIGMIS CPR Conference on 2007 Computer Personnel Research: The Global Information Technology Workforce - SIGMIS-CPR '07, pp. 168-170.

42. Nelson, R. Ryan. 1991. "Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements." MIS Quarterly 15 (4):503–525.

43. Orr, Jo, and Liisa von Hellens. 2000. "Skill Requirements of IT&T Professionals and Graduates: An Australian Study Research-in-Progress." In Proceedings of the 2000 ACM SIGCPR Conference on Computer Personnel Research - SIGCPR '00, pp. 167–170.

44. Peng, Xu. 2011. "Exploration and Practice of Training Practical IT Professionals by the Cooperation of the University and Enterprises." In 2011 IEEE 3rd International Conference on Communication Software and Networks (ICCSN), 268–271.

45. Prabhakar, Bipin, Charles R. Litecky, and Kirk Arnett. 2005. "IT Skills in a Tough Job Market." Communications of the ACM 48(10): 91–94.

46. Ross, Jeanne, and Karen Ruhleder. 1993. "Preparing IS Professionals for a Rapidly Changing World: The challenge for IS educators." In Proceedings of the 1993 Conference on Computer Personnel Research - SIGCPR '93, pp. 379–384. doi:10.1145/158011.158250.

47. Shi, Hao. 2008. "Maximising Computer Science Student Career Opportunity through ICT Industry Placements." In 2008 International Multi-Symposiums on Computer and Computational Sciences, pp. 228–231.

48. Simmons, Chris B., and Lakisha L. Simmons. 2010. "Gaps in the Computer Science Curriculum: An Exploratory Study of Industry Professionals." Journal of Computing Sciences in Colleges 25(5): 60–65.

49. Smits, Stanley J., Ephraim R. Mclean, and John R. Tanner. 1992. "Managing High-Achieving Information Systems Professionals." In Proceedings of the 1992 ACM SIGCPR conference on Computer personnel research SIGCPR '92, pp. 314-327.

50. Tharp, Alan L. 2007. "Innovating: The Importance of Right Brain Skills for Computer Science Graduates." In Proceedings of the 12th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education - ITiCSE '07, pp. 126–30.

51. Todd, Peter A., James D. McKeen, and R. Brent Gallupe. 1995. "The Evolution of IS Job Skills: A Content Analysis of IS Job Advertisements from 1970 to 1990." MIS Quarterly: Management Information Systems 19(1): 1–27.

52. Tye, Eugenia M.W.Ng, Ray S.K. Poon, and Janice M. Burn. 1995. "Information Systems Skills: Achieving Alignment between the Curriculum and the Needs of the IS Professionals in the Future." DATABASE for Advances in Information Systems 26(4): 47–61.

53. Vesisenaho, Mikko, Helena Puhakka, Jussi Silvonen, Erkki Sutinen, Marjatta Vanhalakka-Ruoho, Pirkko Voutilainen, and Leena Penttinen. 2009. "Need for Study and Career Counselling

in Computer Science." In 2009 39th IEEE Frontiers in Education Conference, pp. W2B-1 - W2B-6.

54. Yen, David C., Houn-Gee Chen, Sooun Lee, and Seokha Koh. 2003. "Differences in Perception of IS Knowledge and Skills between Academia and Industry: Findings from Taiwan." International Journal of Information Management 23(6): 507–522.

## Appendix C: Most Cited Papers in *ICT Education*

| No. | Paper | Co-citation frequency (from papers in SLR_r3) | Co-citation frequency in Scopus (10th August 2015) |
|---|---|---|---|
| 1. | ACM/IEEE Computer Society (2005). Computing Curricula 2005. The Overview Report. ACM/IEEE Comp. Society | 6 | 0 |
| 2. | Engel, G. and Roberts, E. (Eds) (2001). *Computing Curricula 2001 – Computer Science*. IEEE Computer Society and Association for Computing Machinery | 6 | 0 |
| 3. | Gorgone, J.T.; Davis, G.B.; Valacich, J.S.; Topi, H; Feinstein, D.L. and Longenecker, H.E. (2003). IS 2002: Model Curriculum and Guidelines for undergraduate degree program in Information Systems. Communications of the Associations for Information Systems | 6 | 33 |
| 4. | Hagan, D. (2004). Employer satisfaction with ICT graduates, Sixffi Australasian Computing Education Conference (ACE2004), Conferences in Research and Practice in Information Technology, vol 6, Australian Computer Society | 4 | - |
| 5. | Nunamaker, J.F., Couger, J.D., and Davis, G.B. (1992). 'Information Systems Curriculum Recommendations for the 80s: Undergraduate and Graduate Programs,' Communications of the ACM (25:11), pp. 781-805. | 4 | - |
| 6. | Tucker, A. (1991). 'Computing Curricula 1991' *Communications of the ACM*, (34: 6), pp. 68-84, June 1991. | 4 | - |
| 7. | ACM/IEEE Computer Society Joint Interim Review Task Force (2008). Computer Science Curriculum 195 2008: An Interim Revision of CS 2001, Report from the Interim Review Task Force | 3 | - |
| 8. | Career Space Consortium (2002). Curriculum Development Guidelines. New ICT Curricula for the 21st Century: Designing Tomorrow's Education. | 3 | - |
| 9. | Davis, G.B., Gorgone, J.T., Couger, J.D., Feinstein, D.L., Longenecker, H.E., Jr. (Eds.) (1997). 'IS'97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems,' *DATABASE*, Volume 28, Number 1, pp. Bi-B94. | 3 | - |
| 10. | Ekstrom, Joseph J. and Barry Lunt (2003). Education at the Seams: Preparing students to stitch systems together; Curriculum and Issues for 4-Year IT Programs *CITC4'03*, October 16–18, 2003, Lafayette, Indiana | 3 | - |
| 11. | Fishbein, M., & Ajzen, I. (1975). Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Reading, MA: Addison-Wesley. | 3 | - |

| 12. | Longnecker, H.E., Jr., Feinstein, D.L., Cougar, J.D., Davis, G.G., and Gorgone, J.T., (1994-1995). 'Information Systems '95: A Summary of the Collaborative IS Curriculum Specifications of the Joint DPMA, ACM, AIS Task Force,' *Journal of Information Systems Education,* Volume 6, Number 4, Winter, pp. 174-186 | 3 | - |

## Appendix D: Most Cited Papers in *ICT Career*

| No. | Paper | Co-citation frequency (from papers in SLR_r3) | Co-citation frequency in Scopus (10th August 2015) |
|---|---|---|---|
| 1. | Lee, D., Trauth, E., and Farwell, D. (1995). 'Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation.' *MIS Quarterly*, 19(3), 313-340. | 14 | 400 |
| 2. | Todd, P., McKeen J., and Gallupe R. B. (1995). „The Evolution of IS Job Skills: A Content Analysis of IS Job Advertisements from 1970 to 1990,' MIS Quaterly, 19:1, March 1995, pp. 1-27. | 13 | 168 |
| 3. | Leitheiser, R. (1992). 'MIS Skills for the 1990s: A Survey of MIS Managers' Perceptions.' *Journal of Management Information Systems*, 9(1), 69-91. | 10 | 95 |
| 4. | Gallivan, M., Truex M, D., and Kvasny, L. (2004). 'Changing Patterns in IT Skill Sets 1988-2003: A Content Analysis of Classified Advertising.' *Database for Advances in Information Systems*, 35(3), 64-87. | 9 | 39 |
| 5. | Trauth, E., Farwell, D., and Lee, D. (1993). 'The IS Expectation Gap: Industry Experience Versus Academic Preparation.' *MIS Quarterly*, 17(3), 293-307. | 9 | 182 |
| 6. | Nelson, R.R. (1991). 'Educational Needs as Perceived by IS and End-user Personnel: A Survey of Knowledge and Skill Requirements,' MIS Quarterly, 15:4, December 1991, pp, 503-525 | 6 | 133 |
| 7. | Arnett, K. and Litecky, C. (1994). 'Career Path Development for the Most Wanted Skills in the MIS Job Market,' Journal of Systems Management, Vol. 45, No. 2, pp. 6-10. | 5 | - |
| 8. | Cheney, and Lyons N.R. (1980). 'Information Systems Skill Requirements: A Survey', *MIS Quarterly, 4:* 1 (March 1980) 35-43. | 5 | - |
| 9. | Nunamaker, J.F., Cougar, J.D. and Davis, G.B. (eds.) (1982). 'Information Systems Curriculum Recommendations for the 80s: Undergraduate and Graduate Programs – A Report of the ACM Curriculum Committee on Information Systems', Communications of the ACM, 25: 11 (November 1982) 781-805. | 5 | - |
| 10. | Prabhakar, B., Litecky, C. R., & Arnett, K. (2005). *IT Skills in a Tough Job Market*, Communications of The ACM, p91-94. | 5 | - |

| | | | |
|---|---|---|---|
| 11. | Cappel, J. (2001/2002). 'Entry-Level IS Job Skills: A Survey of Employers.' *Journal of Computer Information Systems*, 42(2), 76-82. | 4 | 54 |
| 12. | Freeman, P. & Aspray, W. (1999). The Supply of Information Technology Workers in the United States, Computer Research Association, Washington, 25-41. | 4 | - |
| 13. | Green, G. I. (1989). Perceived Importance of Systems Analysts' Job Skills, Roles, and Non-Salary Incentives. MIS Quarterly, 13(2), 115-133. | 4 | 91 |
| 14. | Koh, S., Lee, S., Yen, D.C. and Havelka, D. (2001). 'Evolution of IS Professionals' Competency: An Exploratory Study,' Journal of Computer Information Systems, Summer 28, pp, 21-30 | 4 | - |
| 15. | Litecky, C.R., Prabhakar, B.K., and Arnett, K.P. (1996). MIS job market: Shaken, but not stirred. Journal of Systems Management, July/August, 50-54. | 4 | - |
| 16. | Litecky, C. R., Arnett, K. P., and Prabhakar, B. (2004). The Paradox of Soft Skills versus Technical Skills in IS Hiring, Journal of Computer Information Systems, 45(1), 69-76. | 4 | 41 |
| 17. | Niederman, F., Brancheau, J. and Wetherbe, J. (1991). 'Information Systems Management Issues for the 1990s,' MIS Quarterly, Vol. 15, No. 4, pp. 474-500. | 4 | 289 |
| 18. | Sukhoo, A., Barnard, A., Eloff, M., & Van der Poll, J.A. (2005). Accommodating Soft Skills in Software Project Management. The Journal of Issues in Informing Science and Information Technology, 2,691-703. | 4 | - |
| 19. | Watson, H.J., Young, D., Miranda, S., Robichaux, B. and Seerley, R. (1990). 'Requisite Skills for New MIS Hires,' Data Base, Vol. 21, No. 1, pp. 20-29. | 4 | - |
| 20. | Abraham, T., Beath, C., Bullen, C., Gallagher, K., Goles, T., Kaiser, K., and Simon, J. (2006). 'IT Workforce Trends: Implications for IS Programs.' *Communications of the Association for Information Systems*, 17, 1147-1170. | 3 | - |
| 21. | Ashenhurst (ed.) (1972). 'Curriculum Recommendations for Graduate Professional Programs in Information Systems: A Report of the ACM Curriculum Committee on Computer Education for Management', *Communications* of *the ACM,* 15: 5 (May, 1972) 363-398. | 3 | 32 |
| 22. | Bailey, J.L., & Stefaniak, G. (2000). Preparing the Information Technology Workforce For the New Millennium. ACM SIGCPR Computer Personnel, 20(4), 4-15. | 3 | 3 |
| 23. | Cash, E. et al. (2004). *The Impact of E-commerce on the Role of IS Professionals.* ACM SIGMIS Database, 35(3), 50-63. | 3 | 22 |
| 24. | Couger, J.D.,, Davis, G.B., Dologite, D.G., Feinstein D.L., Gorgone, J.T., Jenkins, A.M., Kasper, G.M., Little, J.C., Longenecker, H.E., Jr, and Valacich, J.S. (1995). 'IS'95: Guideline for Undergraduate IS | 3 | 68 |

| | | | |
|---|---|---|---|
| | Curriculum,' MIS Quarterly, 19:3, September 1995, pp, 341-359 | | |
| 25. | Gorgone, J., Davis, G., Valacich, J., Topi, H., Feinstein, D., Longenecker, H. (2002). Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems, Association for Computing Machinery. New York | 3 | 33 |
| 26. | Igbaria, M., Greenhaus, J.H., Parasuraman, S. (1991). Career Orientations of MIS Employees: An Empirical Analysis, MIS Quarterly, 15(2), 151-169. | 3 | 145 |
| 27. | Koh, S., Lee, S. and Tang, H.L. (2000/2001). 'Educational Gaps as Perceived by IS Educators: A Survey of Knowledge and Skill Requirements,' Journal of Computer Information Systems, 41:2, Winter 2000/2001, pp, 76-84 | 3 | - |
| 28. | Roark, M. L. (1976). Information Systems Education: What Industry Thinks, Data Management, 14(6), 24-28. | 3 | - |
| 29. | Wade M.R. and Parent, M. (2002). Relationships Between Job Skills and Performance: A Study of Webmasters, Journal of Management Information Systems, 18 (3) p. 71-96. | 3 | 53 |
| 30. | Young, D. and Lee S. (1996). „The Relative Importance of Technical and Interpersonal Skills for New Information Systems Personnel,', Journal of Computer Information Systems, Summer 1996, pp. 66-71. | 3 | - |

## References

[1] European Commission, "The EU ICT Sector and its R&D performance," 2014.

[2] OECD, "OECD Science, Technology and Industry Scoreboard 2015: Innovation for growth and society". OECD Publishing, Paris, 2015.

[3] Eurostat, "Almost 8 million ICT specialists employed in the EU in 2014," 2016.

[4] OECD, "Key ICT Indicators, Employment of ICT specialists across the economy, as share of total employment - Last updated July 2015," 2016. [Online]. Available: http://www.oecd.org/internet/broadband/oecdkeyictindicators.htm. [Accessed: 21-Feb-2016].

[5] European Commission, "Employability and social inclusion," 2016. [Online]. Available: https://ec.europa.eu/jrc/en/research-topic/employability-and-social-inclusion. [Accessed: 21-Feb-2016].

[6] K. Gareis, T. Hüsing, S. Birov, I. Bludova, C. Schulz, and W. B. Korte, "E-skills for jobs in Europe: Measuring progress and moving ahead". Empirica

Gesellschaft für Kommunikations- und Technologieforschung mbH, Bonn, Germany, Final Report, 2014.

[7]  M. S. Lynn, "Computer science education - The need for interaction," in International Workshop on Managing Requirements Knowledge, 1972, pp. 847–848.

[8]  C. B. Archer, "What does business and industry expect from computer science graduates today?," in Proceedings of the fourteenth SIGCSE technical symposium on Computer science education, 1983, pp. 82–84.

[9]  W. L. Ziegler, "Computer science education and industry: Preventing Educational Misalignment," in The Proceedings of the Twentieth Annual Computer Personnel on Research Conference, 1983, pp. 108–112.

[10] J. A. Archibald and M. Katzper, "On the preparation of computer science professionals in academic institutions," in Proceedings of the national computer conference and exposition - AFIPS '74, 1974, pp. 313–319.

[11] A. R. Goddard, "Relating Computer Science programs to the needs of industry through internships and cooperative programs," ACM SIGCSE Bull., vol. 6, no. 1, pp. 165–168, Feb. 1974.

[12] C. V. Ramamoorthy, "Computer Science and Engineering Education," IEEE Trans. Comput., vol. C–25, no. 12, pp. 1200–1206, Dec. 1976.

[13] M. C. Mulder, "A Recommended Curriculum in Computer Science and Engineering," Computer, vol. 10, no. 12, pp. 72–75, Dec. 1977.

[14] M. E. Sloan, "Evaluation of the Model Curriculum in Computer Science and Engineering," Computer, vol. 10, no. 12, pp. 114–120, Dec. 1977.

[15] G. L. Engel and O. N. Garcia, "Curricula Development in Computer Science and Engineering," IEEE Trans. Educ., vol. E-21, no. 4, pp. 226–229, 1978.

[16] C. V. Ramamoorthy, "Trends and perspectives in computer science and engineering education," Proc. IEEE, vol. 66, no. 8, pp. 872–879, 1978.

[17] R. M. Aiken, "Computer Science Education in the 1980's," Computer, vol. 13, no. 1, pp. 41–46, Jan. 1980.

[18] P. H. Cheney, D. P. Hale, and G. M. Kasper, "Knowledge, skills and abilities of information systems professionals: past, present, and future," Inf. Manag., vol. 19, no. 4, pp. 237–247, Nov. 1990.

[19] R. R. Nelson, "Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements," MIS Q., vol. 15, no. 4, pp. 503–525, Dec. 1991.

[20] D. M. S. Lee, E. M. Trauth, and D. Farwell, "Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation," MIS Q., vol. 19, no. 3, p. 313, Sep. 1995.

[21] P. A. Todd, J. D. McKeen, and R. B. Gallupe, "The evolution of IS job skills: A content analysis of IS job advertisements from 1970 to 1990," MIS Q. Manag. Inf. Syst., vol. 19, no. 1, pp. 1–27, 1995.

[22] The Joint Task Force on Computing Curricula. IEEE Computer Society and Association for Computing Machinery, "Computing Curricula 2001 Computer Science," Final Report, 2001.

[23] Lisbon European Council, "Lisbon convention," 2000. [Online]. Available: http://www.europarl.europa.eu/summits/lis1_en.htm.

[24] J. C. Knight, J. C. Prey, and W. A. Wulf, "A look back: undergraduate computer science education: a new curriculum philosophy and overview," in Proceedings Frontiers in Education 27th Annual Conference. Teaching and Learning in an Era of Change, 1997, pp. 722–727.

[25] S. Fincher and M. Petre, "Project-based learning practices in computer science education," in Proceedings of 28th Annual Frontiers in Education Conference (FIE '98). Moving from "Teacher-Centered" to "Learner-Centered" Education., 1998, pp. 1185–1191.

[26] W. R. Rice, Y. Beg, C. Waters, M. K. Bokreta, and J. J. Santiago-Aviles, "New pedagogical approaches to computer science education: a case study in peer learning," in Proceedings of 29th Annual Frontiers in Education Conference (FIE'99). Designing the Future of Science and Engineering Education, 1999.

[27] D. V. Pigford, "Designing and implementing active learning in the computer science curriculum: an interactive tutorial," J. Comput. Sci. Coll., vol. 17, no. 2, pp. 199–204, Dec. 2001.

[28] B. Timmerman and R. Lingard, "Assessment of active learning with upper division computer science students," in 33rd Annual Frontiers in Education Conference (FIE), 2003, pp. S1D–7 – S1D–12.

[29] D. J. Neufeld and N. Haggerty, "Collaborative team learning in information systems: A pedagogy for developing team skills and high performance," J. Comput. Inf. Syst., vol. 42, no. 1, pp. 37–43, 2001.

[30] A. Carbone and J. Sheard, "A studio-based teaching and learning model in IT: What do First Year Students Think?," in Proceedings of the 7th annual conference on Innovation and technology in computer science education ITiCSE'02, 2002, pp. 213–217.

[31] M. Simpson, J. Burmeister, A. Boykiw, and J. Zhu, "Successful studio-based real-world projects in IT education," in Proceedings of the fifth Australasian conference on Computing education ACE, 2003, pp. 41–5.

[32] A. Green, M. De Hoyos, S. Barnes, D. Owen, B. Baldauf, and H. Behle, "Literature Review on Employability, Inclusion and ICT, Report 1: The Concept of Employability with a Specific Focus on Young People, Older Workers and Migrants", C. Centeno and J. Stewart (Eds.), JRC Technical Report Series, EUR 25794 EN. Institute for Prospective Technological Studies, Joint Research Centre, European Commission, 2013. Available at: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=6059

[33] M. Fugate, A. J. Kinicki, and B. E. Ashforth, "Employability: A psycho-social construct, its dimensions, and applications," J. Vocat. Behav., vol. 65, no. 1, pp. 14–38, Aug. 2004.

[34] Y. Cai, "Graduate employability: a conceptual framework for understanding employers' perceptions," High. Educ., vol. 65, no. 4, pp. 457–469, Jul. 2013.

[35] S. Lee, D. Yen, D. Havelka, and S. Koh, "Evolution of is professionals' competency: An exploratory study," J. Comput. Inf. Syst., vol. 41, no. 4, pp. 21–28, 2001.

[36] J. Cappel, "Entry-level IS job skills: A survey of employers," J. Comput. Inf. Syst., vol. 42, no. 2, pp. 76–82, 2001.

[37] M. J. Gallivan, D. P. Truex III, and L. Kvasny, "Changing patterns in IT skill sets 1988-2003: A content analysis of classified advertising," Data Base Adv. Inf. Syst., vol. 35, no. 3, pp. 64–87, 2004.

[38] H. J. Nelson, A. Ahmad, N. L. Martin, and C. R. Litecky, "A comparative study of IT/IS job skills and job definitions," in Proceedings of the 2007 ACM SIGMIS CPR conference on 2007 computer personnel research:The global information technology workforce - SIGMIS-CPR '07, 2007, pp. 168–170.

[39] C. R. Litecky, K. P. Arnett, and B. Prabhakar, "The paradox of soft skills versus technical skills in is hiring," J. Comput. Inf. Syst., vol. 45, no. 1, pp. 69–76, 2004.

[40] R. K. Plice and B. A. Reinig, "Aligning the information systems curriculum with the needs of industry and graduates," J. Comput. Inf. Syst., vol. 48, no. 1, pp. 22–30, 2007.

[41] T. E. Blum and M. M. McCoey, "Incorporating business concepts into a computer science curriculum: a multi-tiered approach," J. Comput. Sci. Coll., vol. 22, no. 3, pp. 175–182, Jan. 2007.

[42] D. C. Yen, H.-G. Chen, S. Lee, and S. Koh, "Differences in perception of IS knowledge and skills between academia and industry: findings from Taiwan," Int. J. Inf. Manage., vol. 23, no. 6, pp. 507–522, Dec. 2003.

[43]  D. Hagan, "Employer satisfaction with ICT graduates," in Proceedings of the Sixth Australasian Conference on Computing Education ACE '04, 2004, pp. 119–123.

[44]  Z. Jamaludin and A. A. Mutalib, "IT-graduate abilities: performance gap as an input for curriculum improvement," in ITRE 2005. 3rd International Conference on Information Technology: Research and Education, 2005., 2005, pp. 348–351.

[45]  C. Litecky, B. Prabhakar, and K. Arnett, "The IT/IS job market: A Longitudinal Perspective," in Proceedings of the 2006 ACM SIGMIS CPR conference on computer personnel research Forty four years of computer personnel research: achievements, challenges & the future - SIGMIS CPR '06, 2006, pp. 50–52.

[46]  C. E. Moe and M. K. Sein, "Meeting the IT-skill shortage in Europe head-on: Approaching in Unison from Practice and Academia," in Proceedings of the 2001 ACM SIGCPR conference on Computer personnel research - SIGCPR '01, 2001, pp. 29–36.

[47]  M. Humburg, R. van der Velden, and A. Verhagen, "The Employability of Higher Education Graduates: The Employers' Perspective," Maastricht University, Research Centre for Education and the Labour Market, 2013.

[48]  "Findings from the European Project "Higher Education as a Generator of Strategic Competences" (HEGESCO)" 2007. [Online]. Available: http://www.hegesco.org/. [Accessed: 03-Oct-2016].

[49]  M. Melink and S. Pavlin, "Employability of Graduates and Higher Education Management Systems (Final report of DEHEMS project)," University of Ljubljana, Faculty of Social Sciences, 2011.

[50]  J. T. Gorgone, G. B. Davis, J. S. Valacich, H. Toppi, D. L. Feinstein, and H. E. Longenecker Jr., "IS 2002: Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems,", Association for Computing Machinery (ACM) Association for Information Systems (AIS) Association of Information Technology Professionals (AITP), 2002.

[51]  T. L. Lenox and C. R. Woratschek, "Too Many Labels, Not Enough Agreement: Defining Sub-Disciplines in Computer Science-Related Fields," Inf. Syst. Educ. J., vol. 1, no. 45, 2003.

[52]  C. R. Woratschek and T. L. Lenox, "Defining CS , IS , and IT : Are We There Yet ?," in The Proceedings of ISECON 2006, 2006.

[53]  The Joint Task Force for Computing Curricula 2005 - Association for Computing Machinery (ACM), Association for Information Systems (AIS) and Computer Society (IEEE-CS), "Computing curricula 2005 - The Overview report," 2005.

[54] G. K. Gupta, "Computer Science Curriculum Developments in the 1960s," IEEE Ann. Hist. Comput., vol. 29, no. 2, pp. 40–54, Apr. 2007.

[55] G. E. Forsythe, "A university's educational program in computer science," Commun. ACM, vol. 10, no. 1, pp. 3–11, Jan. 1967.

[56] S. Amarel, "A set of goals and approaches for education in computer science," in International Workshop on Managing Requirements Knowledge, 1972, pp. 841–846.

[57] B. M. Lunt, J. J. Ekstrom, S. Gorka, G. Hislop, R. Kamali, E. Lawson, R. LeBlanc, J. Miller, and H. Reichgelt, "Information Technology 2008: Curriculum Guidelines for Undergraduate Degree Programs in Information Technology," Association for Computing Machinery (ACM) and IEEE Computer Society, 2008.

[58] K. Pažur Aničić, B. Divjak and K. Arbanas, " Preparing ICT Graduates for Real-World Challenges: Results of a Meta-Analysis", IEEE Transactions on Education, vol. 60, no. 3, pp. 191-197, 2017.

[59] B. Kitchenham, "Procedures for Performing Systematic Reviews,", Department of Computer Science, Keele University, Technical Report TR/SE-0401 and Empirical Software Engineering National ICT Australia Ltd., NICTA Technical Report 0400011T.1, 2004.

[60] J. Webster and R. T. Watson, "Analyzing the past to prepare for the future: writing a literature review," MIS Q., vol. 26, no. 2, pp. 13–23, 2002.

[61] M. A. Köseoglu, Y. Sehitoglu, and J. Craft, "Academic foundations of hospitality management research with an emerging country focus: A citation and co-citation analysis," Int. J. Hosp. Manag., vol. 45, pp. 130–144, 2015.

[62] S. Westin, M. Roy, and C. K. Kim, "Cross-fertilization of knowledge: The case of MIS and its reference disciplines," Inf. Resour. Manag. J., vol. 7, no. 2, pp. 24–34, 1994.

[63] S. Waserman and K. Faust, Social Network Analysis: Methods and Application. Cambridge University Press, 1995.

[64] D. M. S. Lee, E. M. Trauth, and D. Farwell, "Critical skills and knowledge requirements of IS professionals: A joint academic/industry investigation," MIS Q. Manag. Inf. Syst., vol. 19, no. 3, pp. 313–340, 1995.

[65] K. P. Gallagher, T. Goles, S. Hawk, J. C. Simon, K. M. Kaiser, C. M. Beath, and W. B. Martz Jr., "A Typology of Requisite Skills for Information Technology Professionals," in 2011 44th Hawaii International Conference on System Sciences, 2011, pp. 1–10.

[66] T. Goles, S. Hawk, and K. M. Kaiser, "Information technology workforce skills: The software and IT services provider perspective," Inf. Syst. Front., vol. 10, no. 2, pp. 179–194, Feb. 2008.

[67] P. Donohue and N. Power, "Legacy job titles in IT: The Search for Clarity," in Proceedings of the 50th annual conference on Computers and People Research - SIGMIS-CPR '12, 2012, pp. 5–10.

[68] E. J. Sobiesk, J. R. S. Blair, J. D. Cook, J. C. Giordano, B. S. Goda, and C. W. Reynolds, "Designing an interdisciplinary information technology program," in Proceedings of the 7th conference on Information technology education - SIGITE '06, 2006, pp. 71–76.

[69] B. Prabhakar, C. R. Litecky, and K. Arnett, "IT skills in a tough job market," Commun. ACM, vol. 48, no. 10, pp. 91–94, Oct. 2005.