Career Tracks and Job Requirements in Information Systems vs. ACM/AIS IS 2010 Curriculum Guidelines: An Empirical Study

Monica Vladoiu
UPG University of Ploiesti
Ploiesti, Romania *monica@unde.ro*

Zoran Constantinescu
UPG University of Ploiesti
Ploiesti, Romania *zoran@unde.ro*

Daniela Danciulescu
University of Craiova
Craiova, Romania *danadanciulescu@central.ucv.ro*

Abstract

There is always a gap between what the job market expects from both undergraduates and graduates and what academic education actually provides. Keeping this gap is important in our view, because universities have to put first the best interest of their students as persons, in the long run, i.e. to prepare them to live a fulfilled life, in all the aspects that count, by both empowering them with the best possible knowledge, skills, attitudes, and values and helping them discover their innate abilities. However, finding the right job is an important coordinate of the multifaceted life nowadays, and academia is ought to empower them in this direction too. Our main goal here is to determine what are the most sought after job types (in line with the career tracks of ACM/AIS IS 2010 Curriculum Guidelines for undergraduates) and job requirements (per job type), in Information Systems in our country. However, in our view, this research has more than local interest given that our IS job market is very dynamic due to the consistent presence of both major corporations and active firms in this field.

Keywords: Information Systems job market, ACM/AIS IS 2010: Curriculum Guidelines for Undergraduate Degree Programs in IS, IS career tracks, IS job requirements.

1. Introduction

Education, research and innovation play a fundamental role in supporting social cohesion, economic growth and global competiveness. As it is seen at European level, higher education has a multiple focus on equally important goals that are intrinsically connected, such as preparation for continuous, lifelong (1) development and maintenance of a broad, advanced knowledge base, (2) sustainable employment, (3) active citizenship in democratic societies, and for (4) personal development [11, 20]. Achieving these goals can contribute significantly to finding appropriate solutions to major systemic socio-economic, political, and environmental problems nowadays.

One of the major concerns that our society in general and academia in particular, has to carefully consider nowadays regards the right balance between what our students need in order to fully accomplish the four goals above and what the economy needs at a given point in time. There is always a gap between what the job market expects from university undergraduates and what academic education actually provides. Keeping this gap is important in our view, because universities have to put first the best interest of their students as persons, in the long run, i.e. to prepare them to live a fulfilled life, in all the aspects that count for them, by both empowering them with the best possible knowledge, skills, attitudes, and values and helping them discover their innate abilities. However,

finding the right job is an important coordinate of the multifaceted life nowadays, and academia is ought to empower them in this sense too. The research presented in this paper has to do with our constant concern of finding the right balance between these significant issues. We had focused our attention to undergraduates in Information Systems (IS) that make no exception in this sense. The main goal of this paper is to determine what are the most sought after (1) job types (in line with the career tracks of IS 2010 Curriculum Update: ACM/AIS Curriculum Guidelines for Undergraduate Degree Programs in Information Systems) and (2) job requirements (per job type), in Information Systems in our country, i.e. Romania [14]. However, we think the results of this research have more than local interest given that our job market, in IT&C in general and in IS in particular, is very dynamic due to the consistent presence of both major corporations (60% of the IT&C market) and small active firms in this fields. The industry involves more than 110,000 employees and more than 6 billion Euros each year as gross income [27]. It needs 12,000 new specialists each year, and the total number of both undergraduates and graduates is about 7,000 annually, some of which go to work abroad.

Our main research interests have been as follows: (1) discovering whether our Information Systems' job market is aligned with the ACM/AIS Information Systems Curriculum Guidelines with regard to the categories of IS career tracks and, for each job category, (2) determining the major requirements most frequently mentioned in the specific IS jobs ads, and (3) establishing how many jobs of that type are available.

The structure of the paper is as follows: the next section presents briefly our research methodology. In Section 3, the results of our research are shown, empirically analyzed, and discussed in light of both the ACM/AIS IS 2010 Curriculum Guidelines and the actual job market. One interesting finding is that new career tracks, not included in IS 2010, are available for IS undergraduates. The fourth section includes the related work and the fifth one includes the conclusions and future work ideas.

2. The Research Methodology

The starting point of our research has been a seminal document, namely *IS 2010 Curriculum Update: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems*, which is the result of the collaborative effort of both Association for Computing Machinery and Association for Information Systems [14, 23]. According to ACM/AIS IS 2010, the main career tracks for Information Systems undergraduates are the following ones: Application Developer, Business Analyst, Business Process Analyst, Database Administrator, Database Analyst, eBusiness Manager, ERP Specialist, Information Auditing & Compliance Specialist, IT Architect, IT Asset Manager, IT Consultant, IT Operation Manager, IT Security & Risk Manager, Network Administrator, Project Manager, User Interface Designer, and Web Content Manager.

Our first research question has been concerned with the degree of alignment between our IS job market and the IS career tracks included in the ACM/AIS IS 2010 Curriculum Update. Therefore, we started to analyze online job advertisements available on several specific websites. As solely Linkedin Jobs provided full descriptions of each job, we continued our search only there. Thus, each job description included the job name, the employer, the job location, the time of posting, and a detailed description of requirements (knowledge, skills, attitudes etc.), daily tasks, seniority level, employment type (full- or part-time), and so on.

The expression "Information Systems" has been searched on Linkedin JOBS for our country several times a week and, sometimes, several times a day (between January, 10 and April, 10 2019). During this time, the number of job ads has been relatively constant, at about 600 postings. The number of new job ads posted daily has varied from 5 to 27 postings. About 50 job offers were older than 6 months or duplicates at any given time.

After thoroughly examining each and every job advertisement available, we have come to the conclusion that no automatic or semi-automatic analysis of the text can be performed because, generally, these job offers are too verbose, mix elements pertaining to different types of requirements, are very different in length both as such and with

respect to their composing parts, have plenty of words glued together, sometimes with odd characters inside them, and so on. Even with human expertise in the field of information systems, it has been quite challenging to realize what each job was in fact and what the main requirements were, i.e. the ones that defined each particular job. The automatic built-in advanced filtering performed poorly as well, maybe for similar reasons. Therefore, the only option available for us has been an empirical analysis. For each job advertisement, several information have been retained for further evaluation:

- Job category, against the IS 2010 career tracks;
- Job name and requirements, in two categories required/must-have and desired/a-plus/nice-to-have. Per each category, three sub-categories have been used: hard skills, soft skills and other (attitudes, abilities, and values);
- Level of study required (BSc degree, MSc degree, only experience needed).

To respond to our second research question, each job advertisement has been thoroughly analyzed by human experts, each having more than 25 years experience in the field (both industry and academia). This way, the major requirements mentioned the most frequently in the IS jobs ads have been discerned, per each category of career track in IS 2010. We have considered as major requirements the ones without which the job cannot be properly done. In addition, the jobs have been counted per each category.

3. Job Requirements: Analysis and Discussion

3.1. Job Distribution per Career Track

The first outcome of our research consists of the distribution of job advertisements by job type (which addresses research question 1 and 3). Thus, In Table 1, in the first column, the IS 2010's career tracks are included. For each career track, the most frequent alternative job names are presented. For example, Application Developer can be found in the set of job ads available on Linkedin Jobs either as such or with quite a few alternative names, namely software engineer/developer, IT developer, software (development) team lead, or <some particular programming language> developer. We have assimilated the Team Lead position with a developer one, because this is generally the paradigm in software engineering. Some career tracks have been extended to include a wider palette of jobs, e.g. *IT Operations Manager* covers also IT Operations (Field) Engineer or Specialist, and IT Operations Team Leader, or *IT Security & Risk Manager* includes also similar names, as IT Security & Risk Administrator or Supervisor, but also covers IT Security Engineer, Professional, Consultant, Analyst, or Officer. For each career track in Table 1, more information is available, i.e. the total number of job ads per track, the number of jobs requiring either a BSc degree or a BSc/MSc degree, and the number of jobs that require no degree, but only various categories and levels of experience.

In Table 2, similar information is available, except that the career tracks are not present among ACM/AIS IS 2010 Career Tracks. These extra career tracks found in our search on Linkedin Jobs Romania are as follows: Quality Assurance (QA) and testing engineer, data analyst, data warehouse analyst, customer IT support, and other non IS specific career tracks (not requiring a IS degree). In the last lines of both Table 1 and Table 2, two kinds of percents are computed, one against the total number of IS specific jobs, and one against the total number of job ads found when searching on Linkedin Jobs for <Information Systems> near <Romania>. These values have been computed as it is shown further on. In our empirical analysis, a total of 550 job advertisements have been considered, i.e. the ones that were less than 6 months old, without including duplicates. From the total of about 600 job ads available on Linkedin Jobs during the time of our research, at any time, about 50 of them were older than 6 months or were duplicates. Therefore, from those 600 ads only 550 IS jobs were available indeed, from which 320 were covering the IS 2010 career tracks and 73 were in the extra areas of information systems mentioned above. So, a total of 393 IS specific jobs and a total of 550 jobs in information systems, retrieved from Linkedin Jobs, have been used to compute the rounded percentages in the last two lines of the both tables beneath.

From the figures in Table 1, one can see that more than 80% of the actual IS jobs available are on the career tracks considered in *ACM/AIS IS 2010 Curriculum Guidelines for Undergraduate Degree Programs in Information Systems*. More than 50% of these jobs require a Bachelor of Science degree in Information Systems or a related field (Computer Science, Information Technology, Software Engineering, etc.). However, less than 10% mention in their requirements list, with "OR" the Master of Science degree. In fact, only a very few number of jobs consider a MSc degree as compulsory, as follows: 3/80 Application Developers, 1/12 Business Process Analysts, 3/27 Project Managers, 1/14 IT Risk Managers, and 1/21 Network Engineers, so 9 out of 154 jobs. This is to be researched further, especially taken into account that the jobs included in this analysis have had a very diverse seniority level, from entry to VP level, and that more than half of them were in the mid-senior and senior class. Also, it is interesting to notice that more than 20% of the IS jobs do not explicitly require a degree. The majority of these job ads mention as necessary just various experience levels and expertise categories.

Table 1. Job types against ACM/AIS IS 2010 career tracks.

IS 2010 Career Tracks		Job Education Req.			
	Job Name	**Job Ads No.**	**BSc.**	**BSc or MSc**	**No deg.**
A. Application Developer	Application / IT Developer Software Engineer / Developer Software Team Lead / Architect Software Development Team Lead <Programming Language> Developer	80	46	8	26
B. Business Analyst	Business Analyst Business Intelligence Analyst	24	24	0	0
C. Business Process Analyst	Business Process Analyst Business Systems Analyst	12	9	2	1
D. Database Administrator	Database Admin DB Performance Support Engineer	1	1	0	0
E. Database Analyst	Database Analyst Database Developer	7	7	0	0
F. e Business Manager	eBusiness Manager eBusiness Specialist/Engineer	0	-	-	-
G. ERP Specialist	ERP Specialist / NetSuite Expert SAP Specialist / Consultant / Team Lead ABAP Developer	21	18	2	1
H. Information Auditing & Compliance Specialist	Information Auditing & Compliance IT Audit, Governance & Advisory	8	5	0	3
I. IT Architect	IT Architect / ICT Production Head	1	0	1	0
J. IT Asset Manager	IT Asset Manager IT Asset Librarian / Administrator	2	1	0	1
K. IT Consultant	IT Consultant	2	2	0	0
L. IT Operation Manager	IT Operations Manager / Team Leader IT Operations (Field) Engineer / Specialist	42	21	1	20
M. IT Security & Risk Manager	IT Security & Risk Manager / Officer Administrator / Supervisor IT Security Engineer / Professional / Consultant / Analyst	49	28	4	17
N. Network Administrator	Network/Systems Administrator Operating Systems/Storage/Servers Administrator Cloud Administrator Infrastructure Solution Architect Network Engineer/Analyst/Consultant/Specialist	35	20	5	10
O. Project Manager	Project Manager / Solution Architect Product Owner / Manager	27	18	5	4
P. User Interface Designer	User Interface Designer/Analyst/Specialist User Experience Designer/Analyst/ Developer	4	1	0	3
Q. Web Content Manager	Web Manager / Strategist / Developer	5	1	1	3
	Total number of IS job ads/IS 2010	**320**	**202**	**29**	**89**
	Percent of 320+73 actual IS job ads	81.40	51.40	7.40	22.65
	Percent of 550 retrieved IS job ads	58.20	36.70	5.30	16.18

As mentioned before, Table 2 includes similar information on job ads regarding other extra career tracks that are not included in ACM/AIS IS 2010. They have been retrieved from Linkedin Jobs when searching with <Information Systems> near <Romania>. Some of them are very close to the Information Systems field, such as IS Quality Assurance, data analyst, data warehouse analyst, or customer IT support, while other are quite far apart. The latter category includes (1) jobs that only require a university degree, which can be performed by IS undergraduates as well, (2) jobs in IT&C that require a specific university degree, e.g. Computer Engineering, Automatics, Electronics, Electrical or Mechatronic Engineering, and, finally, and (3) jobs for which other university degrees are necessary such as Law (e.g. for Privacy Assurance/GDPR), Psychology (e.g. for Human Resources), Accounting and Financial (e.g. for Financial Analyst, Billing Officer etc.), and so on. The job ads of this last category seem to have been retrieved because those employees-to-be need specific IS knowledge to perform their responsibilities.

Looking at the numbers, one can see that analysts are necessary also for data analytics and warehousing, these being two categories that have not been taken into account in IS 2010 as possible career tracks for IS undergraduates. Another field of interest for them is IS Quality Assurance. In our analysis, however, we have found that more than half of these jobs are for testing engineers and that they do not require a degree, but only experience in using some frameworks. Customer IT Support for various information systems is another area of interest for IS undergraduates, and more than 75% of these positions ask for a BSc degree. The last percent worth looking at is the retrieval precision, i.e. the total number of truly IS jobs available (320+73) against the total number of jobs retrieved on Linkedin Jobs as IS related (550), which is 71.45%.

Table 2. Job categories not present among ACM/AIS IS 2010 Career Tracks.

Extra Career Tracks		Job Education Req.			
	Job Name	**Job Ads No.**	**BSc.**	**BSc or MSc**	**No deg.**
Quality Assurance & Testing Engineer	QA Manager QA Engineer / Verification Specialist Testing Lead / Engineer	26	9	3	14
Data Analyst	Data Analyst / Research Analyst / Scientist Data Architect / Advisor Data Engineer / Processor	9	4	0	5
Data Warehouse Analyst	Data Warehouse Analyst / Expert Data Warehouse Specialist / Developer	5	3	0	2
Customer IT Support	Customer IT Support Engineer Customer IT Support Specialist	33	25	1	7
	Total number of IS job ads/extra IS2010	**73**	**41**	**4**	**28**
	Percent of the 320+73 actual IS job ads	**18.60**	**10.45**	**1.00**	**7.15**
	Percent of the 550 retrieved IS job ads	**13.30**	**7.45**	**<1.00**	**5.10**
Other Career Tracks	Jobs req. just a university degree (yes-IS)	62	62	0	0
	Jobs req. specifically a non-IS degree				
	• IT&C	39	34	5	0
	• Other	56	53	3	0

3.2. Job Requirements per IS Career Track

Further on, the main categories of IS jobs available in the last six months are shown, along with their major requirements (the most frequently mentioned in the specific IS jobs advertisements on Linkedin Jobs). Based on the data presented in the previous sub-section, the IS experts are mostly sought after for the next types of jobs (335 positions from the 393 actual IS jobs advertised, i.e. more than 85% of the IS jobs available):

- Application Developer, 80 positions;
- IT Security and Risk Professional, 49 positions;
- IS Analyst (Business, Business Process, Database, Data Warehouse), 48 positions;

- IT Operation Specialist, 42 positions;
- Network/System Administrator, 35 positions;
- Customer IT Support Specialist, 33 positions;
- Project Manager, 27 positions;
- ERP Specialist, 21 positions.

Further on, for each career track, the core requirements (hard and soft skills) will be summarized based on the very detailed job descriptions available on Linkedin Jobs.

The Application Developer Career Track includes the IS 2010's Application Developer, but also other positions such as Software Engineer/Developer, Software Team Lead, Software Architect, IT Developer, Software Development Team Lead, and <Programming Language> Developer. The exact job requirements are shown in Table 3. The most important hard skills required are knowledge of and experience with object oriented programming, Java, SQL, relational database management systems, C#, JavaScript, software engineering, analytical thinking, data structures and algorithms, development tools, and so on. The most wanted soft skills are good communication, problem-solving, teamwork abilities, working well under pressure, customer oriented, able to work independently, flexibility, adaptability and ability to learn.

Table 3. Application Developer (AppD): Job Requirements.

Hard Skills	% total AppD job ads	Soft Skills	% total AppD job ads
object oriented programming	50	communication	39
Java	47	problem-solving	33
SQL	44	teamwork	28
.NET	36	work under pressure	11
relational DBMS, C#, JavaScript	33	customer-oriented	11
software engineering	17	work independently	8
analytical thinking	17	flexible	8
REST, data structures and algorithms	14	learning	8
development tools, versioning tools	14	adaptable	8
Computer Science, C/C++, SOAP	11		

The Information System Analyst Career Track includes the IS 2010's Business Analyst, Business Process Analyst, and Database Analyst, with similar positions such as Business Intelligence Analyst, Business Systems Analyst, respectively Database Developer. However, this track has been extended to include the Data Warehouse Analyst career track, with some alternative positions as Data Warehouse Specialist, Expert, or Developer. The specific job requirements are shown in Table 4. The core hard skills required are knowledge of and experience with database management systems, analytical thinking, working in medium or large software systems' projects, through the full development lifecycle, and with integrated data and systems' approach. The most required soft skills are good English, interpersonal communication and other skills, time management and organization (self and others), quality oriented work, self-learning new technologies and relating them to current business needs, and a problem-solving attitude.

Table 4. Information System Analyst (ISAn): Job Requirements.

Hard Skills	% total ISAn job ads	Soft Skills	% total ISAn job ads
database management systems	72	English (written, oral)	83
analytical thinking	61	inter-personal communication	78
medium or large software systems	44	organized, time management	72
full software development lifecycle, best practices, project management	44	quality oriented, systematic work	61
systematic vision, integrated data and systems' approach	39	self-learning new technologies & relating them to business demands	50
data analysis, modeling, manipulation, management, quality	33	problem-solving attitude	44

understand complex information & see the essential	33	communication (written, oral) creative solutions work independently / teamwork integrity & loyalty / responsibility adaptability / flexibility	22
documenting and reporting precisely	28		
several projects at once, multiple systems	28		
ERP systems (e.g. SAP, Oracle EBS)	22		

The IT Security and Risk Professional Career Track includes the IS 2010's IT Security & Risk Manager, with alternative names Administrator or Supervisor, along with other positions, such as IT Security Engineer/Professional/Consultant/Analyst, and IT Security & Risk Officer. The job requirements for this track are shown in Table 5. The most important hard skills required are knowledge of and experience with security, networking, security information and event manager, risk analysis, databases, security architectures, forensics, scripting, intrusion detection system, Linux, security audit, and GDPR. The most sought after soft skills are good communication, teamwork abilities, problem-solving, customer oriented, organizational skills, strong work ethics, and working well under pressure. Moreover, some jobs in this field require knowledge about industrial, business, or other domain's processes or operations.

Table 5. IT Security and Risk Professional (ITSR): Job Requirements.

Hard Skills	% total ITSR job ads	Soft Skills	% total ITSR job ads
security	84	communication	80
networking	48	teamwork	56
SIEM (security information & event manager)	32	problem-solving	36
risk analysis	20	customer-oriented	20
databases, security architectures, forensics	16	organized	16
scripting, Linux, security audit, GDPR	12	work ethics	8
IDS (Intrusion Detection System)	12	work under pressure	8
programming	8		
Cisco, cloud, privacy, application security, Net/Sys admin, Microsoft technologies, Regex, Pentest, IDAM, SABSA	4		

The IT Operation Specialist Career Track includes the IS 2010's IT Operations Manager, but also other positions such as IT Operations (Field) Engineer/Specialist, or IT Operations Team Leader. The specific job requirements are presented in Table 6. The most required hard skills are knowledge of and experience with SQL, Windows, Linux, databases, networking, and scripting. The most sought after soft skills are good communication, working well under pressure, teamwork abilities, problem-solving, organizational skills, and customer-orientation.

Table 6. IT Operation Specialist (ITOp): Job Requirements.

Hard Skills	% total ITOp job ads	Soft Skills	% total ITOp job ads
SQL	70	communication	70
Windows	50	work under pressure	50
Linux	40	teamwork	50
databases, networking, scripting	30	problem-solving	45
DevOps, server admin, programming	20	organized	30
MS Office, MS Excell	20	customer-oriented	20
cloud	10		

The Network/System Administrator Career Track includes the IS 2010's Network Administrator, but also other similar positions such as (Operating) Systems Administrator, Storage/Servers Administrator, Cloud Administrator, or Infrastructure Solution Architect. Moreover, this track has been expanded to include also the Network Engineer career track, with some alternative names as Network Analyst, Consultant, or Specialist. The specific job requirements are presented in Table 7. The most required hard skills are knowledge of and experience with networking, administration, Linux, Windows, virtualization, databases, scripting, security, cloud, and Web. The most sought

after soft skills are good communication, teamwork abilities, problem-solving, customer-orientation, organizational skills, and good time management.

Table 7. IT Network/System Engineer (NetSys): Job Requirements.

Hard Skills	% total NetSys job ads	Soft Skills	% total NetSys job ads
networking	90	communication	90
admin	70	teamwork	60
Linux, Windows	50	problem-solving	50
virtualization, databases	30	customer-oriented	20
scripting, security	20	organized	20
cloud, Web	10	time management	10

The Customer IT Support Specialist Career Track is not included in the ACM/AIS IS 2010 Curriculum Guidelines. However, in our country, this career track offers a number of positions similar with the Network/System Administrator Career Track. Its job requirements are shown in Table 8. The most required hard skills are knowledge of and experience with SQL, Oracle BI Tools, ERP, Microsoft Cloud, Windows Server, and Linux. The most sought after soft skills are good communication, ability of learning new things, problem-solving, customer-orientation, teamwork skills, and organizational skills.

Table 8. Customer IT Support Specialist (ITCS): Job Requirements.

Hard Skills	% total ITCS job ads	Soft Skills	% total ITCS job ads
SQL	38	communication	88
Oracle BI Tools	38	learning new things	38
ERP	38	problem-solving	38
Microsoft Cloud	38	customer-oriented	38
Windows Server	25	teamwork	25
Linux	13	organized	13

The Project Manager Career Track includes the IS 2010's Project Manager, but also other similar such as Solution Architect, Product Owner/Manager. The Project Manager job requirements are shown in Table 9. The most important hard skills required are concerned with knowledge of and experience with project management, agile paradigm, and SCRUM methodology. The most wanted soft skills are good communication, problem-solving, teamwork abilities, leadership and analytical thinking.

Table 9. Project Manager (PRJM): Job Requirements.

Hard Skills	% total PRJM job ads	Soft Skills	% total PRJM job ads
project management	69	communication	71
Agile	47	problem-solving	47
SCRUM	24	teamwork	35
management of teams	24	leadership	12
management of products	12		
software engineering	12		
business intelligence	12		
analytical thinking	12		

The ERP Specialist Career Track includes the IS 2010's ERP Specialist, but also other similar such as SAP Specialist/Consultant, SAP Team Lead, NetSuite Expert, and ABAP Developer. The ERP Specialist job requirements are shown in Table 10. The most important hard skills required are concerned with knowledge of and experience with SAP, databases, operating systems, Java, SQL, Web technologies, business intelligence, ABAP and HANA. The most wanted soft skills are good communication, analytical thinking, customer orientation, teamwork abilities, work well under pressure, problem-solving, and learning.

Table 10. ERP Specialist (ERPS): Job Requirements.

Hard Skills	% total ERPS job ads	Soft Skills	% total ERPS job ads
SAP	95	communication	68
analytical thinking	42	customer oriented	37
databases	37	teamwork	37
Linux, Windows	32	problem-solving	21
Java	21	work under pressure	16
SQL, Web, BI, ABAP, HANA	16	learning new things	16
EDI, PM, performance tuning, MS Office	11		

3.3. Expectations from the IS Professionals

The research undertaken here shows that IS professionals are needed in a broad variety of domains (business, industry, healthcare, government, non-profit organizations etc.), organizations, and jobs (at various levels). They need to deeply understand both the domain in which they work and the technology (both hardware and software) that helps them fulfill their organizational role. They are ought to have a systemic view on their work context, which includes people, policies and procedures, technologies, and information. IS professionals are also expected to have strong analytical and critical thinking skills.

They must be capable of using what they know and to learn new things constantly, in order to solve problems, and to build (integrated) solutions that enhance performance across organizations. Moreover, IS professionals have to be able to communicate properly with various categories of IS stakeholders (both orally and in writing, in several languages), to be customer-oriented, to work independently or as part of a team, to have organizational skills, to be adaptable and flexible, and to work well under pressure. Many of the job advertisements analyzed required from the employee-to-be to help their peers to learn and grow as professionals. They also stress out the importance of a strong work ethics, IS professionals being expected to be able to properly assess and act upon ethical issues in their line of work.

All these findings are in line with IS 2010, which sees Information Systems professionals as being focused on application of information and communication technology in *helping individuals, groups, and organizations achieve their goals within a competitive global environment* [14].

4. Related Work

Up to our knowledge, no similar research has been done yet in our country. However, internationally, several works address the same issues. The most similar with ours are two, which will be presented in more detail further on. The first one brings an Australian perspective on the understanding of the knowledge, skills, and competencies demanded of early career IS graduates [15]. The authors have used content analysis on 400 online job ads (from several websites) collected during a 10 weeks period of time in 2006. Their analysis revealed a dominant cluster of core IS knowledge and competency skills concerned with IS development, which was the most frequently required category of knowledge (78% of ads) and has been strongly associated with hard skills such as business analysis, systems analysis, data and information management, Internet, intranet, Web applications; and software packages, management, operations, maintenance and support, and computer languages, and soft skills such as communication skills and other personal characteristics. Specific terms as tools, environments, technologies, programming, object oriented, testing, and re-engineering were very frequent in connection with IS Development. As for personal characteristics, “learn” was the most frequent term, appearing in expressions like “ability to learn” or “eager to learn”. The second cluster formed included knowledge and skills at a more technical side of IS, such as architecture and infrastructure, operating systems, networks, and security. The main limitation of their study, as authors themselves point out, is that they focused on entry

level jobs addressing recent graduates. They had this approach to have a more detailed perspective on these jobs, instead of trying to analyze jobs on all seniority levels.

The second one has a similar approach with regard with content analysis of a set of job advertisements available online. However, their set is huge, with 244,460 unique job advertisements [1]. They have obtained that set by daily automatic searching of websites as Monster.com, HotJobs.com, and SimplyHired.com between July 2007 and April 2008. Their focus has been on jobs requiring Computer Science, Information Systems, Computer Information Systems, Management Information Systems, and other similar terms. After that, they have parsed the ad text to identify and extract the job skills terms. Their findings showed that the most frequently mentioned skills in computing job ads are as follows: security (33%), C/C++ (29%), SQL (28%), Programming (26%),.., Java (21%), leadership (20), project management (18%), Oracle databases (17%), Unix (17%), business strategy (17%), certification (15%), finance (14%), XML (14%), generic databases (13%), …, open source operating systems (12.50%), marketing (12%), JavaScript (12%), MS databases (11%), object oriented programming (11%), and .NET (10%). The job distribution per job type has also been done in this work. Thus, they have identified that the most wanted are IT Managers, security specialists, project analysts or managers, system administrators, database developers, C/C++ programmers, Java developers, open source developers, database administrators, network administrator, Java DB or Web application developers, Microsoft developers, system level C++ programmers, Web programmers and developers, and Web analysts and developers. The authors have also performed an analysis of hard skills requirements per job type, their findings being similar with ours in this respect.

There are other studies concerned on job requirements for IS undergraduates, but the focus for the most cited that we have analyzed is on establishing the skills gap between what the job market expects and what the university education offers [2-10, 12, 13, 15-19, 21-26].

5. Conclusions and Future Work

Our today society has to find solutions to a diversity of major systemic problems (economical, environmental, political, and social) and education, research, and innovation can play a pivotal role in empowering people to tackle these global challenges, providing this way for our society's evolution towards more cohesiveness, fairness, sustainability, respectfulness of both environment and people, in fact, towards more proper equilibria in all relevant life facets. As educators, we must always keep this desideratum in mind, to facilitate our students' journey towards being able to engage in such challenges and to proactively construct solutions that alleviates them. During this journey, they need to learn, to learn to learn, to grow as persons and as professionals, to find jobs that make them feel they contribute to the society's good, to be active citizens in democratic societies, while allowing and helping others to do the same. Their natural abilities together with knowledge, skills, attitudes, and values they achieve by education both in formal in informal environments will be a solid foundation for this process.

The research presented in this paper is rooted in the above beliefs and concerns, being meant as a guide for undergraduates in Information Systems and related fields, which can help them to find a suitable job at a given point in their personal and professional evolution. Both undergraduates and graduates in these fields are more and more involved in various domains of our society, and, consequently, will have a growing impact on various relevant contexts. This research can be useful also for educators and other stakeholders in education.

Future work includes establishing whether there is a skills gap between what the job market requires from IS undergraduates and the outcomes of the main IS university study programs, researching what is, comparatively, the current situation on major IS job markets with regard with these issues, and, consequently, whether both ACM/AIS Curriculum Guidelines and university curriculum need to be updated to better correlate with the international job market evolution in Information Systems.

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