Positive and Negative Learning by IT Professionals

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Abstract: *The paper summarises the main findings of a preliminary study of issues relating to the personal and professional development of IT professionals in Silicon Valley and in Dublin. It uses the concept of positive and negative learning to identify the amount to which they have enhanced or diminished their knowledge and skill base in IT topics since graduating from university. It identifies emerging topics in the area and analyses how professionals undergo re-skilling, in the context of life long learning.*

Key words: *Positive learning, negative learning*

INTRODUCTION

This paper analyses the results of a random survey of IT professionals in Ireland and Silicon Valley. The participants had graduated at least five years before the survey was undertaken. Using a notional score of 100% for modules taken in their year of graduation, they were asked to rate their current knowledge. A current score of 125% indicates that a participant has acquired 25% additional knowledge/proficiency in the area (positive learning), while a score of 75% indicates that he/she has forgotten previous knowledge/proficiency (negative learning).

The aim of the survey is to investigate the composition and level of computer skills by practicing IT professionals. In a broader context it will analyse issues relating to the personal and professional development of IT professionals in the two locations. The reference model for the research was the classification of modules for primary degrees in computing adopted by the Thematic Network in Computing [TN96]:

1. Algorithms and Data Structures	2. Architecture
3. Artificial Intelligence & Robotics	4. Database & Information Retrieval
5. Human Computer Interaction	6. Numerical & Symbolical Computing
7. Operating Systems	8. Programming Languages
9. Software Methodology/Engineering	10. Networks
11. Logic	12. Discrete Mathematics
13. Automata Theory	14. Cryptography
15. Physics	16. Electronics
17. Control Theory	18. Communications Hardware
19. Management Information Systems	20. Decision Support Systems
21. Business Subjects	22. Numerical Analysis
23. Statistics	24. Operations Research
25. Signal Processing	26. Computational Linguistics
27. Machine Translation	

Silicon Valley: Boundaries.

Silicon Valley occupies the area that is officially called Santa Clara Valley, in California. This area stretches from the Santa Cruz mountains and the San Francisco Bay, from Palo Alto, through Mountain View, Sunnyvale and Santa Clara, down to San Jose, and continues as far south as Gilroy. The main Californian counties that are included in the definition of Silicon Valley are Santa Clara County, San Mateo County, Alameda County, and San Francisco County. These four counties are defined as Silicon Valley here.

Silicon Valley County	No. of IT Companies (2002)	County Population 2002 (Estimated)
Alameda County	1708	1,486,600
San Francisco County	789	793,600
Santa Clara County	3860	1,719,600
San Mateo County	961	717,000
Total		

Dublin: Boundaries.

In this thesis Dublin refers to County Dublin, Ireland. According to the National Informatics Directorate in Ireland, at the end of 2002, it is estimated that the Irish software industry consisted of more than 900 companies, 140 of them foreign, employing 28,000 people and exporting over €12bn worth of products and services (http://www.nsd.ie/htm/ssii/stat.htm). The software industry is concentrated mainly in the Dublin area. The population of County Dublin in 2002 was 1,122,821.

IT Employees Definition.

Surveys were sent to randomly selected IT firms as per Dublin and Silicon Valley databases. For this survey IT firms surveyed are defined as firms involved in telecommunications, software or hardware development, semiconductor and networking. IT sales or manufacturing firms were not surveyed.

IT professionals surveyed can be grouped as per the following occupation definitions: Program manager, hardware/software engineer, developer/programmer, customer support/documentation.

IT Firms Database

The database used to extract a sample of IT firms in Dublin for survey purposes was supplied by the National Informatics Directorate, in Dublin (http://www.nsd.ie/htm/ssii/search_counties.php3?counties=Dublin).

There are 634 Dublin IT companies listed in the nsd website. The names of IT firms in Silicon Valley, California was taken from the Silicon Valley Web Directory of computer and semiconductor companies headquartered in Silicon Valley, website: http://mentorms.best.vwh.net/valley/s1_compi.htm. There are 1055 Silicon Valley IT companies listed in the Mentorms website.

SKILL BASE OF IT PROFESSIONALS

The numbering system of topics in the report of the Thematic Network on Computing is used in the following table. The category of scores 50+ includes all scores greater than or equal to 50 and less than the next category bound.

Table1. Scores (per cent) of IT Professionals by Domain

Topic	**0+**	**50+**	**75+**	**100+**	**150+**	**200+**	**Mean**	**St. Dev.**
1	27	11	11	32	5	14	92	91
2	24	14	11	24	11	16	94	78
3	54	16	5	22	3	0	40	54
4	19	11	8	30	14	19	114	91
5	38	11	8	22	14	8	75	79
6	41	14	11	27	8	0	57	57
7	16	3	14	32	19	16	118	81
8	19	8	8	27	22	16	128	95
9	30	8	3	22	16	22	106	92
10	14	3	5	30	16	32	133	81
11	24	5	3	38	22	8	95	75
12	46	14	8	32	0	0	47	52
13	65	8	5	22	0	0	31	50
14	43	14	8	27	0	8	57	67
15	51	11	8	24	3	3	53	91
16	38	14	11	27	8	3	65	59
17	62	11	5	22	0	0	32	49
18	27	8	3	38	14	11	91	77
19	27	3	8	41	14	8	98	65
20	46	8	5	27	8	5	65	69
21	41	3	5	19	19	14	90	114
22	43	11	8	27	5	5	62	73
23	38	11	11	35	0	5	61	62
24	46	14	8	32	0	0	48	55
25	59	16	0	22	3	0	35	53
26	59	16	22	3	0	0	35	47
27	54	19	3	24	0	0	39	43

The mean scores indicate that when we average across the industry, many of the academic domain areas are not used in an ongoing basis by the respondents. However, there are no zero entries in the 100+ column, so that each topic in the list is being used in a specialist capacity in the industry.

The respondents were also asked to identify new and emerging academic topics, to extend the scoring mechanism to them and to indicate their proficiency levels. On average, 10% of the respondents indicated that they had developed new skills since graduating.

Table 2. New Skills Areas

New Skill Area	**% Skill Level**	
	Dublin	**Silicon Valley**
Emerging Architectures	130	
Hardware Interfaces	100	
Strategic Analysis	400	
Requirements Analysis	130	
Finance	150	150
Video Editing/Compression		100
Intelligent Networks	180	
Mobile Networks	200	
Fixed Networks	180	
Distributed Systems	100	
Transmissions Systems	150	
Routing		150
New Programming Languages		150
Web Design	130	
Project Management	150	
Messaging	200	200
Technical Documentation	200	
Help Systems	200	
Telecoms	150	

As one would anticipate, the respondents are all working at an advanced level in the specified domains. However, they had great difficulty in specifying the academic content for the areas identified.

ACQUISITION OF NEW SKILLS

The professionals surveyed were asked to identify the primary form by which they acquired new IT skills.

Table 3. Acquisition of New Skills

Acquisition of New Skills			
	On the Job Training	**Night Courses**	**Personal Research**
Silicon Valley	46%	7%	47%
Dublin	64%	--	36%

In the following table, 3+ indicates the period from 3 months to less than 6 months prior to the survey.

Table 4. Recent Training

Most Recent Training for New Skills								
	0+	**3+**	**6+**	**9+**	**12+**	**15+**	**18+**	**21+**
Silicon Valley	32%	--	47%	7%	7%	--	--	7%
Dublin	15%	28%	19%	--	5%	14%	5%	14%

The table indicates that in Silicon Valley retraining happens on a more regular basis than in Dublin.

In Table 5, external courses include part-time undergraduate and postgraduate academic programmes as well as professionally certified programmes. The activities covered in the last two columns relate mostly to training and re-skilling. The entries in the table relate to the per cent of companies with formal systems in place.

Table 5. Support from Employers

Dominant Form of Re-skilling			
	Funding of External Courses by Employer	**On the Job Training**	**Mentoring by Fellow Staff**
Silicon Valley	27%	27%	46%
Dublin	33%	27%	40%

CONCLUDING COMMENTS

The data in Table 1 indicates that all the academic modules typically found on an undergraduate computing syllabus have a direct relevance to individual sectors of the IT industry. However, the demand for individual skills varies considerably when we average across the whole industry, with some topics being in general demand and others being seen as of specialist use. This is reflected in the bi-modal nature of many of the statistical distributions.

The emerging topics identified by the respondents should be of interest to academics designing new IT programmes. The amount of added knowledge that the professionals have had to acquire since graduation in many of the modules may also present new opportunities to universities.

REFERENCES

[TN96] Evaluation Conference on Inter University Cooperation in Europe in the Field of Computing. (July, 1996) DG XXII.

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Quantum Computing - An Overview

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Abstract: This paper gives an overview of quantum computing from the particle approach. It reports on progress in algorithm design in this important area and records progress in the development of quantum circuits.

The Neighbourhood Structure of Heuristic Algorithms

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Abstract: We review a spectrum of heuristic algorithms for combinatorial optimization problems. The concept of polynomial time exponential local search (PLS) algorithms is introduced and the performance of the *r*-swap heuristic is compared to a heuristic in PLS .

These papers will be available in the CD version of the Proceeding.