Evaluating IT Knowledge Requirements for Business Professionals

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Abstract. *Educational programs in information technology have to be continually re-evaluated and revised. A study was conducted to determine perceived IT knowledge requirements for business professionals. The study suggests that IT professionals in business have to be armed with a mix of knowledge in IT technology, management, and business operations. Also, it shows that practitioners perceive managerial and business issues as being more important than do students.*

Keywords. IT in business, IT professionals, knowledge requirement, curriculum, IT education

1. Introduction

Educational programs in information technology (IT) must be continually re-evaluated and revised. A way of supporting the process of re-modelling an IT curriculum is by asking involved respondents to rate the importance of each IT knowledge/skill [1].

The University of Zagreb, Graduate School of Business & Economy offers an Undergraduate Degree Programme in business administration specializing in *IT in Business*. The programme offers a mix of classical courses in business administration (such as accounting, finance, etc. …) and courses in IT (such as information systems, databases, software engineering, simulation, expert systems, decision support systems, data mining …).

The paper shows the results of a study conducted to determine perceptions regarding critical areas of knowledge and skills in IT. The aim of the study was to rank IT knowledge needed in business and to find possible groups of related knowledge clusters; and finally help to re-evaluate current programme, or to model new programme curriculum.

The study is based on the questionnaire described in Section 2. Results of the study are discussed in Section 3, and possible curriculum issues are presented in Section 4.

2. Questionnaire

Table 1. Questionnaire

1	Knowledge of enterprise and business functions
2	Detailed knowledge of specific business functions (e.g. finance, production, sales/marketing …)
3	Ability to understand/recognise business problems and find problem solution
4	Knowledge of team work
5	Knowledge of group decision methods and decision support systems
6	Knowledge of management executive support systems
7	Knowledge to plan, organize and write documentation and reports
8	Knowledge to plan, organize and lead projects
9	Knowledge of e-business methods and techniques
10	Knowledge of systems analysis
11	Knowledge of information systems planning and development
12	Knowledge of expert systems, simulation and AI methods
13	Knowledge/ability to train IT users
14	Knowledge of organizing helpdesk/ information centres
15	Knowledge of internet document publication/retrieval technology
16	Knowledge of data modelling and database design
17	Knowledge of analytical processing, data mining & knowledge discovery methods
18	Knowledge to apply security methods in information systems
19	Knowledge of quality assurance methods in information systems
20	Knowledge of design and development information systems methods
21	Knowledge of programming
22	Knowledge of hardware, networks and other technical aspects of IT
23	Knowledge of acquisition (evaluation and selection) of hardware/software

The Questionnaire (Table 1) was developed on the basis of an extensive review of current university undergraduate curricula and IT literature. It includes questions regarding IT knowledge (hardware/software, programming, systems analysis, information systems

development, databases, knowledge discovery, expert systems and simulation, user education, information retrieval …), business functions knowledge, and management skills.

The respondents were asked to rate the importance of each knowledge/skill item from 1 to 5, as shown in Table 2.

Table 2. Scale response anchors

1	Completely unimportant
2	Unimportant
3	Neither important nor unimportant
4	Important
5	Very important

The questionnaire was completed by 150 people: 64 of them were attendants of a Business Intelligence Conference held in Zagreb in February 2003, 43 were graduate students of Information Management and 43 were undergraduate students at the Graduate School of Business & Economy. The respondents were segmented into four groups according to their profession. The group frequencies are shown in Table 3.

(Note: Out of 150 responders only 133 answered to all 23 questions. All the results are shown for the 133 complete questionnaires, because multivariate techniques ignore the observations/ records where one or more responses are missing. Scale data were normalized prior to multivariate analysis).

Table 3. Profession categories

Category	N
1 - managers	32
2 - IT people	34
3 - other professions	25
4 - students	42
All	133

3. Results

Answers from the respondents were analyzed using statistical software SAS[1], site licensed to the University of Zagreb.

3.1 Descriptive Statistics

All 23 questions can be treated as criterion variables measured on an ordinal rating scale (see e.g., [5]). Mean values are shown in Fig. 1. Overall, knowledge is rated above 3.3, i.e. no knowledge is rated as unimportant. The most important knowledge in the opinion of the responders is captured in the following items: 1 (Knowledge of enterprise and business functions), 3 (Ability to understand business problems and choice of problem solution), 4 (Knowledge of working in team environments), 9 (Knowledge of e-business methods and techniques) and 15 (Knowledge of internet document publication/retrieval technology). The knowledge area rated as being least important is 21 (Programming skills). It appears that, overall, organizational issues are perceived as being more important than are the technical considerations.

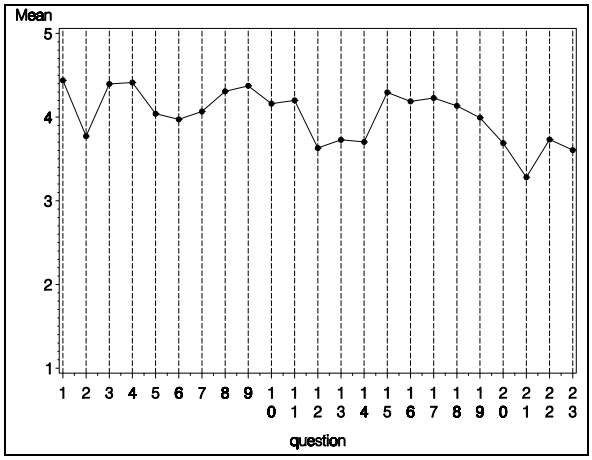

Figure 1. Response Means ("snake plot")

3.2 Factor / Principal Components Analysis

Principal Component Analysis (PCA) with Varimax Rotation, and Maximum Likelihood (ML) Factor Analysis with Quartimin rotation were applied. We present here only the results of the PC analysis.

Guttman-Kaiser criterion yielded 7 factors (63% of total variance), of which first three had a simple and meaningful interpretation. In addition, to obtain a "benchmarking" measure, eigenvalues of the correlation matrix were compared to those obtained from a randomized version of the data matrix. The randomized matrix was obtained by randomly scrambling each column of the data matrix. As seen in Fig. 2, this approach yielded only two "important" components (accounting for 37% of the total variance).

[1] SAS is a registered trademark of SAS Institute Inc. in the USA and other countries.

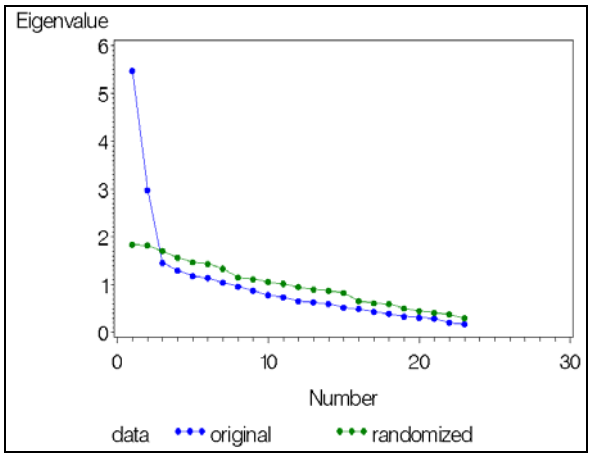

Figure 2. Eigenvalues of the original matrix as compared with the eigenvalues of the "scrambled" matrix

Interpretation of the factors was based on the variables with factor loadings greater than 0.40. The cutoff value was determined by taking into account the sample size and the test for the squared correlation coefficient (see eg., [3]).

Thirteen items (knowledge), shown in Table 4, were combined in Factor1 and labelled *IT Knowledge*. IT Knowledge consists of various knowledge areas typically possessed by *IT technologists*.

Table 4. Factor1 = IT Knowledge

9	Knowledge of e-business methods and techniques	0.51218
11	Knowledge of information systems planning and development	0,66887
12	Knowledge of expert systems, simulation and AI methods	0,56436
13	Knowledge/ability to train IT users	0,67763
14	Knowledge of organizing help desk/information centres	0,58773
16	Knowledge of data modelling and database design	0,73109
17	Knowledge of analytical processing, data mining & knowledge discovery methods	0,52721
18	Knowledge to apply security methods in information systems	0,65192
19	Knowledge of quality assurance methods in information systems	0,52078
20	Knowledge of design and development information systems methods	0,71172
21	Knowledge of programming	0,71624
22	Knowledge of hardware, networks and other technical aspects of IT	0,68528
23	Knowledge of acquisition (evaluation and selection) of hardware/software	0,43537

Eight items (knowledge), shown in Table 5, were combined in Factor2 and labelled *Management Knowledge*. Management Knowledge consists of various knowledge bases possessed by *managers*.

Table 5. Factor2 = Management Knowledge

1	Knowledge of enterprise and business functions	0,45271
2	Detailed knowledge of specific business functions (e.g. finance, production, sales/marketing …)	0,41304
3	Ability to understand business problems and choice of problem solution	0,44086
4	Knowledge of working in team environments	0,59628
5	Knowledge of group decision methods and decision support systems	0,69484
6	Knowledge of management executive support systems	0,61893
7	Knowledge to plan, organize and write documentation and reports	0,57187
8	Knowledge to plan, organize and lead projects	0,57366

Three items (knowledge), shown in Table 6, were combined in Factor3 and labelled *Expert Knowledge*. Expert Knowledge consists of various knowledge performed by an *expert* or *business analyst*.

Table 6. Factor3 = Expert Knowledge

1	Knowledge of enterprise and business functions	0,59052
2	Detailed knowledge of specific business functions (e.g. finance, production, sales/marketing …)	0,42523
23	Knowledge of acquisition (evaluation and selection) of hardware/software	0.50664

The factors reveal three groups of desirable knowledge IT professionals doing business must master: IT knowledge, management knowledge, and expert knowledge. IT knowledge is needed to implement IT solutions, expert knowledge to know the business area in which IT solutions will be implemented, and management knowledge is needed to successfully complete an IT project. Depending on the size and type of the IT project, all knowledge may be exercised by a generalist individual or by more than one specialist.

Rotated factors exhibit decomposition of Factor2 into Factor2a, Factor2b and Factor2c.

Factor2a, shown in Table 7, consists of three knowledge items related to team work, group decision making, and executive management and is labelled *Cooperative Knowledge*.

Table 7. Factor2a = Cooperative Knowledge

4	Knowledge of working in team environments	0,64544
5	Knowledge of group decision methods and decision support systems	0,82060
6	Knowledge of management executive support systems	0,69848

Factor2b, shown in Table 8, consists of four knowledge items related to business functions, business reporting, and project management and is labelled *Business Project Management Knowledge*.

Table 8. Factor2b = Business Project Management Knowledge

1	Knowledge of enterprise and business functions	0,64532
2	Detailed knowledge of specific business functions (e.g. finance, production, sales/marketing …)	0,63459
7	Knowledge to plan, organize and write documentation and reports	0,63145
8	Knowledge to plan, organize and lead projects	0,56738

Factor2c, shown in Table 9, is related to the knowledge of problem recognition and is labelled *Problem Recognition Knowledge*.

Table 9. Factor2c = Problem Recognition Knowledge

3	Ability to understand business problems and choice of problem solution	0,72137

Respondents are grouped into four categories (Table 3). Concerning Factor1 (IT Knowledge) there exist significant differences in responses of managers and IT people vs. students. Students consider IT knowledge more important than do Managers and IT people. Students belong to a younger population and have little or no work experience. They are probably not acquainted with the importance of managerial skills to the same degree that managers and IT people are.

The difference between managers and IT people vs. students and other professions is particularly significant (p-value < 0.001) for variables 18 (Knowledge to apply security methods in information systems) and 22 (Knowledge of hardware, networks and other technical aspects of IT). This can be explained by the previous observation that students are more familiar with IT technology than they are with "management". (A note on methodology: The p-values in the tests for differences between managers and IT people vs. students and other professions were adjusted for multiple testing using a randomization technique [4].)

3.3 Canonical Discriminant Analysis

Canonical discriminant analysis (for differences in responses among four profession categories) generated three canonical variables. Only the first canonical correlation (sample canonical correlation = 0.62). was significantly different from zero (p-value < 0.001).

The first canonical variable was correlated (>0.40) with variable 18 (knowledge to apply security methods in information systems, correlation 0.63), 22 (knowledge of hardware, networks and other technical aspects of IT, correlation 0.61), 9 (knowledge of e-business methods and techniques, correlation 0.47) and 12 (knowledge of expert systems, simulation and AI methods, correlation 0.41).

These questions also yield the largest separation among (univariate) response means by profession categories, as shown in Fig. 3 (scale 1 – 5) and Fig. 4 (enlarged scale). Figure 3/4 demonstrates in visual form that although the four groups are essentially identical in their perceptions of importance on, for example, items 3,4, and 14, they differ somewhat on, say items 6, 9, 12, 18, 21, 22, and 23.

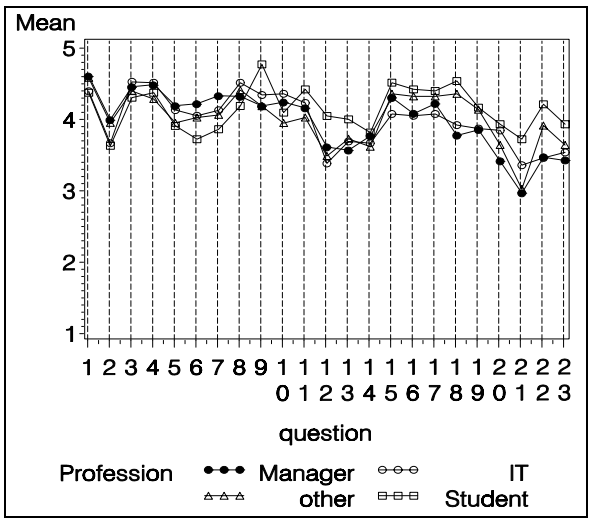

Figure 3. Response Means by profession categories (scale 1-5)

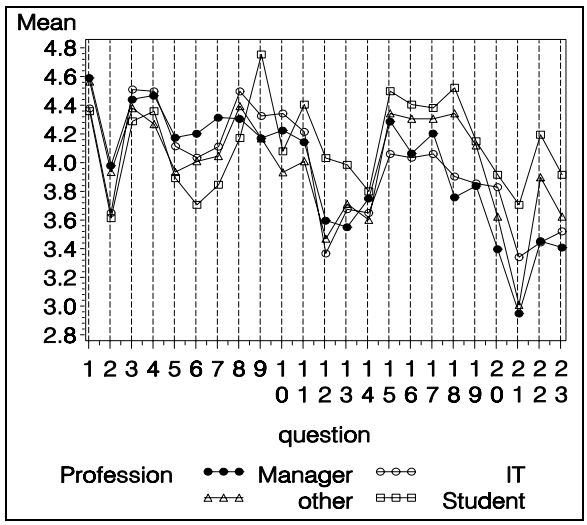

Figure 4. Response Means by profession categories (enlarged scale)

The first canonical variable separates students and other professions (having positive mean values) from managers and IT people (having negative mean values). Again, students consider

knowledge of items 18, 22, 9 and 12 as more important than what managers and IT people do (Table 10).

Table 10. Profession means on the first canonical variable

profession	Can1
IT people	-.86
Managers	-.60
Students	1.00
others	0.26

3.4 Correlation Analysis

Correlation analysis (based on Spearman correlation coefficients) shows that many variables are highly correlated. Especially large correlations are found among IT variables (belonging to Factor1 - IT Knowledge) and among managerial variables (belonging to Factor2 - Management Knowledge). Some of the larger correlations are among the following variables:

1 and 2,3
2 and 1,6,7,10
3 and 1,4,5,8,13,18,22
4 and 3,5,6,7,8,11
5 and 3,4,6,7,8,11,12
6 and 2,4,5,7,8,11,17
7 and 1,2,4,5,6,8,10,19
8 and 1,3,4,5,6,7
9 and 10,11,12,13,15,16,17,18,19,20,21,22
10 and 2,5,7,9,11,12,15,16,17,19,20,21
12 and 5,9,10,11,13,14,15,16,17,18,19,20,21,22
etc.

4. Curriculum model considerations based on the results of this pilot study

Three factors – IT Knowledge, Management Knowledge and Expert Knowledge – could be used to develop a curriculum model for the *IT in Business* degree programme. Besides classical courses in business administration, courses in the *IT in Business* degree programme may be composed of three IT concentrations: IT Knowledge, Management Knowledge and Expert Knowledge. They were named using the factors from which they were derived. Each concentration consists of courses that teach knowledge incorporated in their factor. Variables, i.e. knowledge items, more correlated with the factor could be attached to the mandatory course; and knowledge less correlated with the factor could be attached to the elective course. A variant of the programme is depicted in Table 11, where suggested mandatory courses are shown in grey and electives in white.

Table 11. A variant of *IT in business* curriculum

IT Knowledge

Knowledge of data modelling and database design	0,73109
Knowledge of programming	0,71624
Knowledge of design and development information systems methods	0,71172
Knowledge of hardware, networks and other technical aspects of IT	0,68528
Knowledge of information systems planning and development	0,66887
Knowledge/ability to train IT users	0,67763
Knowledge to apply security methods in information systems	0,65192
Knowledge of organizing help desk/information centres	0,58773
Knowledge of expert systems, simulation and AI methods	0,56436
Knowledge of analytical processing, data mining & knowledge discovery methods	0,52721
Knowledge of quality assurance methods in information systems	0,52078
Knowledge of e-business methods and techniques	0.51218
Knowledge of acquisition (evaluation and selection) of hardware/software	0,43537

Management Knowledge

Knowledge of group decision methods and decision support systems	0,69484
Knowledge of management executive support systems	0,61893
Knowledge of working in team environments	0,59628
Knowledge to plan, organize and lead projects	0,57366
Knowledge to plan, organize and write documentation and reports	0,57187
Knowledge of enterprise and business functions	0,45271
Ability to understand business problems and choice of problem solution	0,44086
Detailed knowledge of specific business functions (e.g. finance, production, sales/marketing …)	0,41304

Expert Knowledge

Knowledge of enterprise and business functions	0,59052
Knowledge of acquisition (evaluation and selection) of hardware/software	0.50664
Detailed knowledge of specific business functions (e.g. finance, production, sales/marketing …)	0,42523

A new undergraduate *IT in business* curriculum programme, for example, may consist of courses from all three concentrations. Some courses would be mandatory, with the rest being electives.

In the senior year, a "cap-stone" course (or two) could be offered which would be designed to integrate the three areas of knowledge using a case study format.

5. Conclusion

The study suggests that professionals for *IT in business* have to be armed with knowledge and skills in IT technology, management, and business operations. It verifies the conclusion [2] that the IT professional's job has become diversified and that curricula could consist of separate concentrations covering diverse knowledge areas.

Multivariate statistical analysis discovered three factors showing that IT in business knowledge could be separated into IT knowledge, management knowledge, and expert knowledge.

The other major finding of the study shows that practitioners perceive managerial and business issues as being more important than do students.

Finally, a University sponsored, practitioner focused research program is suggested as a way for educators to continuously evaluate the evolving knowledge requirements in the rapidly developing areas of the IT business profession, and to adopt University curricula accordingly.

6. References

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