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Competencies for Work Domains in Business Computer Science

WORC Paper 98.06.004/4

Peter T. van den Berg

Running head: COMPETENCIES IN BUSINESS COMPUTER SCIENCE

Competencies for Work Domains in Business Computer Science

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$R = .46$

r character traits
 t = job description
 t = computer science

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Abstract

In order to relate expertise in business computer science to multiple criteria, the importance of competencies, as elements of expertise, for the performance of tasks and roles were investigated. Seventy-five information technology professionals (9 women and 66 men) from 21 organizations rated the importance of 34 competencies for the performance of 86 tasks and 7 roles. In accordance with previous studies, knowledge of information technology, working methodically, and analytic ability were rated as important competencies for most types of tasks, and social skills were especially important for tasks related to interaction with the environment and leadership roles. By means of cluster analysis, four work domains were discerned: technique-oriented, organization-oriented, leadership-oriented, and user-support-oriented domains. It is argued that relating competencies to work domains has theoretical and practical relevance.

Competencies for Work Domains in Business Computer Science

More and more organizations realize that their most important competitive advantage is the knowledge, skills, and abilities of their employees. Because of the globalization of the world economy, everything can be produced nearly everywhere. The only things that are difficult to imitate or to transfer are the characteristics of the people who are important for organization's success. In this context, expertise is potentially an important concept for organizations.

As stated in the editorial of this issue, expertise is defined in terms of "what distinguishes outstanding individuals in a domain from less outstanding individuals in that domain, as well as from people in general" (Erickson & Smith, 1991, p. 2). This should be developed further to enhance scientific understanding and to make it more applicable to human resource management of modern organizations. Therefore, the work domain to which expertise is related should be defined more clearly. Several methods are used for identifying experts, as such length of experience, overall appraisal of performance, and peer nominations, but in all studies known to the author the expertise concept has been used to indicate a general level of job performance. This means that expertise has been linked to a composite criterion. As Schmidt and Kaplan (1971) noted, a composite criterion may represent an economic dimension, but for the scientific understanding of behavior multiple criteria should be used.

Developments in modern organizations make multiple criteria also more valuable for applied human resource management. Nowadays, employees often change tasks within the same job because they work on temporary projects. This is especially true in computer science (Bridges, 1994). This means that human resource management should focus on continuously matching the characteristics of the employees with the work activities to be done. This process may start in the personnel selection phase. In the case of a narrow labor

market, applicants do not need to have all the job requirements. However, they have to have some basic traits and be able to improve other characteristics by training. When contracted, they have to find their way in the organization by comparing the characteristics they have with the characteristics that will be required in the future and try to acquire what they are lacking. In this process, they should be helped to seek out tasks they like to perform and that will become more and more important for the organization in the future. This can make clear which competencies they will need to improve in order to perform well in a new composition of tasks, so that they increase their employability. To help employees in making career choices, it makes sense to describe the work domains in which they can be an expert.

In order to distinguish several expertise domains, the concept of competency will be used. Competency is a key concept in modern personnel management. Spencer and Spencer (1993, p. 9) defined competency as "an underlying characteristic of an individual that is causally related to criterion-referenced effective and/or superior performance in a job or situation." Several methods are available for establishing the characteristics of outstanding workers, e.g., critical incident interview, repertory grid method, and analysis of work activities. A competency consists of a definition and a description of the specific behaviors in which the competency is demonstrated. Competencies can be considered the basic elements of expertise. As a special characteristic of competencies, they can be used for assessing the individual as well as his or her performance on the job. Therefore, they are suited for distinguishing expertise or competency domains and for describing the characteristics of experts.

A growing occupational sector in which the trends described above are predominant is computer science. A lot of studies have been performed on the characteristics of experts in this field. Experienced programmers showed more abstract representation of problems (Weiser & Shertz, 1983) and more metacognitive knowledge of tasks and strategies

(Eteläpelto, 1993) than inexperienced subjects. High performers on experimental tasks spent more time evaluating problems and solutions (Vessey, 1986). Exceptional designers in software projects were able to integrate their thorough knowledge of the application domain with their computer knowledge and showed excellent communication skills and high motivation (Curtis, Krasner, & Iscoe, 1988). Sonnentag (1995) found that excellent software professionals have high technical knowledge and a high level of social skills, and use a method-oriented working style. They also spend more time on review meetings and consultations.

Some studies on competencies relate to information technology professionals. For example, Spencer and Spencer (1993) found that the following competencies, in descending order of importance, contribute to superior performance of technicians and professionals: achievement orientation, impact and influence, conceptual thinking, analytical thinking, initiative, self-confidence, interpersonal understanding, concern for order, information-seeking, teamwork and cooperation, expertise, and customer service orientation. Interestingly, communicative and motivational factors turned out to be more important than cognitive factors.

The studies cited make only a general distinction between high-flyers and other people without referring to the specific contents of their work. However, people who are experts in some domain of work may be non-experts in another domain. As noted before, it would be better to define the work domains to which expertise might be related. This is done in the present study.

Besides the content of the job, contextual variables may contribute to the validity of competencies. Many studies show that in some types of situations, so-called weak situations, behavioral characteristics are more important than in other types of situations, so-called strong situations. This distinction is related to the concept of autonomy. For example,

Barrick and Mount (1993) found that, in management jobs with a high level of autonomy, high scores on conscientiousness and extraversion and low scores on agreeableness are more strongly related to high performance than in low-autonomy jobs. Therefore, work autonomy was considered an important contextual variable.

The Present Study

The aim of the present study is to investigate the importance of competencies for the performance of work activities in business computer science and to discern work domains consisting of tasks and roles requiring similar competencies, i.e. expertise domains. For this purpose, the work activities in this sector were divided into a number of tasks and roles. Next, information technology professionals rated the importance of some frequently used competencies for their own tasks and roles. This method is similar to Guion's (1965) synthetic validity method. To investigate the validity of a test battery in small sample sizes, Guion divided the activities and responsibilities in an organization into some elements and related the test scores to the performance of the employees on the elements composing their job. In the present study, the actual levels of competencies and performances were not measured, but the relationships were rated subjectively. This was done for the following reasons. Many measures of competencies and performance lack the necessary reliability. The actual performance of knowledge workers is mostly invisible for their managers. In their meta-analysis, Mabe and West (1982) found that self-ratings show high differentiation between dimensions, suggesting that job incumbents have the best knowledge of their job contents. Besides, the purpose of the study was not to validate the competencies, but to explore the expertise domains in business computer science.

Although the present study is mainly descriptive, some general hypotheses were formulated on the basis of the studies cited. The following competencies were assumed to be important for the performance of many tasks and roles: knowledge of information

technology, cognitive ability, working methodically, and motivation. Social skills were hypothesized to be important for the execution of tasks requiring interaction with the environment and for the performance of leadership roles. This expectation follows from the meta-analysis by Barrick and Mount (1991) showing that extraversion predicts performance in occupations requiring interaction with other people. This is in accordance with the fact that, in the study by Sonnentag (1995) on the social skills of experts, 51.3% of them were team or subteam leaders.

Method

Sample and Procedure

A pilot study was performed to test whether the administration of the instrument of the main study caused any trouble and whether any improvements were needed. The sample consisted of 11 information technology professionals from a Belgian firm. They filled in the questionnaire and made suggestions for improvement.

The sample in the main study consisted of 75 professionals in business computer science from 21 organizations. The organizations were approached by phone and by letter for participation in the study. When an organization agreed to cooperate, a questionnaire was distributed to the employees working in business computer science. The completed questionnaires were sent to the investigator in a postage-paid envelope. Anonymity of the participants was guaranteed. They held the following jobs: 12 informatics consultants, 9 applications programmers, 10 systems programmers, 9 network/data managers, 9 system designers, 2 information analysts, 14 information managers/coordinators, and 5 project leaders. Four jobs could not be classified. The mean number of years in the current job was 4.9 (Sd. = 5.1). Their mean age ranged from 24 to 59 with a mean age of 36 (Sd. = 8,9). There were 9 women and 66 men.

Measures

Tasks. A typology of tasks in business computer science was used that was developed by the Dutch Computer Society (1993) and is presented in the Appendix. It consists of descriptions of 86 tasks comprising the whole field of business computer science. A task was defined as a group of activities that yield an intended result and cannot reasonably be split up. On the basis of the main concerns of the tasks, they were divided into nine groups as shown in the Appendix. These groups of tasks represent aspects of information management. The aspects of data, functions, facilities, organization, and coordination were derived from Zachman's (1987) architecture model, and the aspect of coordination consists of tasks coordinating these four aspects. The aspects of quality control, project control, business management, and interaction with the environment were added by the Dutch Computer Society (1993) to describe tasks regulating the relationships between the organization of information management and other business functions. The subjects were asked to indicate the tasks they performed.

Roles. In business computer science, many tasks can be done within the scope of different roles, and this scope may yield additional required competencies. For example, the task "Composition of project report" may be done in the role of a person who has to propose new solutions (creative role) or in the role of an assistant who has to describe the ideas of others. In the present study, the following roles were used: the decision-making role, the consultative role, the creative role, the reconnaissance role, the stimulating-leadership role, the directive-leadership role, and the assisting role. Descriptions of these roles were presented, and the subjects were asked to indicate the roles they performed in their job.

Importance of competencies. The job requirements mentioned in 100 advertisements for information technology professionals were categorized in 30 groups. Four additional requirements were formulated by experienced IT professionals who participated in the research team. Behavioral descriptions of the 34 competencies were derived from

competency models described in the research literature. On the basis of consensus in the research team, a distinction was made between competencies that are assumed to be trainable and competencies that are assumed difficult to change. Trainable competencies are not necessarily required in personnel selection, but may be acquired to some degree later on. Stable competencies, on the other hand, should be present beforehand. Cognitive competencies were also distinguished from behavioral competencies, as they are usually measured with other methods. This resulted in the following groups of competencies: (a) knowledge (trainable, cognitive): knowledge of IT, knowledge of other disciplines, knowledge of the environment, and commercial insight; (b) behavioral style (trainable, behavioral): planning and organizing, group leadership, individual leadership, conflict handling, resoluteness, convincingness, didactic skills, initiative, independence, communicative skills, oral fluency, writing skills, teamwork, negotiating skills, customer orientedness, working methodically, accuracy, and listening; (c) cognitive capacity (stable, cognitive): abstraction ability, problem analysis, judgement, creativity, and analytic ability; and (d) personality (stable, behavioral): perseverance, flexibility, emotional stability, immunity to stress, sensitivity, need for achievement, and integrity.

The competencies were presented in a random order. Descriptions of these competencies were also provided. The subjects were asked to rate the importance of the competencies for high performance on the tasks and roles they accomplished on a scale ranging from 0 (not important) to 3 (very important).

Autonomy. The level of autonomy was measured with the following three items: (a) you have to work following the prescriptions of supervisors, (b) you can independently take decisions about your own work activities, and (c) there is ample scope for the contribution of your own ideas. These items were rated on vertical bars with, on the lefthand side, the numbers 1 to 9 and, on the righthand side eight job names that indicated the levels on the

bars. The levels of the eight jobs were derived from the ratings of seven experts (see Van den Berg, 1993). In order to obtain a reliable score on autonomy, the item scores were added up. The Cronbach's alpha of the composite autonomy scale in the present study was .67.

Results

Because the number of tasks and roles of each subject was limited, not all the subjects rated all the tasks and roles. The mean number of subjects per task was 16.5 (Sd. = 6.8), and the mean number of subjects per role was 35.9 (Sd. = 14.2). Although some tasks were rated by a small number of subjects, the standard error of the mean of nearly all the tasks fell within the limits of a half point on the 4-point scales and the 95%-confidence intervals were smaller than 1.

The Cronbach's alpha was used as an indication of agreement among raters. The data matrix with the importance scores of the competencies for each task and role was transposed, resulting in 93 matrices with subjects as variables and competencies as cases. The mean of the 93 Cronbach's alphas was .85. This result shows that the profiles of the scores among the raters are very similar, although the absolute scores may differ.

For each of the 86 tasks, the mean importance of the competencies was calculated. These results are too extensive to be presented here. First, in order to reduce the number of competencies without losing relevant information, a cluster analysis was performed on the mean importance scores. Four pairs of competencies were clustered because they were conceptually similar and had nearly the same ratings: group leadership and individual leadership; methodical work and accuracy; abstraction ability and problem analysis; and emotional stability and immunity to stress. Second, within the nine groups of tasks (see Appendix), the mean importance scores were averaged. In order to investigate the agreement of the task ratings within groups, the Cronbach's alphas were calculated using tasks as

variables and competencies as cases. The mean alpha was .88 (Sd. = .09) and the lowest was .72 for the Business management group. These results show that aggregation of the scores within the groups was allowed. Because the tasks were not rated by the same subjects, the importance scores within these groups were based on variable groups of subjects. The results are presented in Table 1.

(Insert Table 1 about here)

In accordance with the hypotheses, knowledge of information technology and working methodically/accuracy were considered to be important competencies for the performance of nearly all the groups of tasks. The cognitive capacities of analytic ability and, to a lesser degree, abstraction ability/problem analysis were also rated as important in most groups. Judgement and creativity reached the importance score of 2 or higher in fewer groups, but it may be argued that these competencies are less central aspects of general cognitive capacity. Also in accordance with the expectations was the finding that, in the group of interaction with the environment, most competencies involving social skills were rated as important or very important. However, the results with respect to the importance of need for achievement were less confirmative. An additional striking result was that the importance scores of the personality traits were not high in most groups of tasks.

The importance of the competencies for performing the roles is presented in Table 2. With regard to the roles, the competencies that might be expected to be important were rated as such. For example, it might be supposed that resoluteness is an important competency for the decision-making role, that creativity is important for the creative role, that group and individual leadership is important for the stimulating-leadership role, that perseverance is important for the directive-leadership role, and that teamwork is important for the assisting role. In accordance with the hypotheses, the stimulative- and directive-leadership roles require competencies related to social skills. All the personality traits were rated as important

for performing these roles. This finding suggests that the leadership roles require some competencies that are difficult to train. Interestingly, knowledge was found to be relatively unimportant for these roles.

(Insert Table 2 about here)

In order to distinguish work domains where the importance of the competencies differs as much as possible, a series of cluster analyses was performed. Because we wanted to join together the tasks and roles with similar importance profiles, the scores were first standardized within tasks and roles. These standardized scores represent the relative importance of the competencies within each task or role. Next, cluster analyses using the K-means method with Euclidean distances were performed. The analysis with four clusters led to the best interpretable results. Analysis of variance showed that the clusters differed significantly with respect to the importance scores of all the competencies (see Table 3). The cluster membership of the tasks is indicated in the Appendix. The assisting role belongs to the first cluster, the creative role and the reconnaissance roles to the second cluster, the decision-making role, the stimulating-leadership role, and the directive-leadership role to the third cluster, and the advising role to the fourth cluster.

(Insert Table 3 about here)

The first cluster is characterized by tasks with a very technical orientation. The inclusion of the assisting role shows that this role requires competencies that are similar to the technical tasks. The cluster centers of this cluster are presented in the second column of Table 3. As might be expected, the competencies of knowledge of information technology and working methodically/accuracy are very important. Analytic ability and independence are also rather important.

The tasks of the second cluster are related to the organization analysis or the adaptation of the system to the specific organization. The reconnaissance role and the creative

role are also included in the second cluster. The second cluster may be called the organization-oriented work domain. The most important competencies required in this domain are in descending order: analytic ability, writing skills, judgement, knowledge of the environment, independence, knowledge of information technology, commercial skills, and abstraction ability/problem analysis.

The third cluster consists of three management roles: the decision-making role, the stimulating-leadership role, and the directive-leadership role. This cluster was conceived as the leadership-oriented work domain. In the leadership-oriented work domain, the following competencies are important: resoluteness, convincingness, planning and organizing, communicative skills, oral fluency, independence, initiative, and team work.

The tasks in the fourth cluster are related to the support of end users by means of writing instructions or rendering direct assistance. Because the advisory role was defined as supporting and advising in decision making, it is no surprise that this role also belongs to the fourth cluster. The cluster comprises the user-support oriented work domain. This domain requires the competencies of writing skills, communicative skills, customer orientedness, oral fluency, and listening.

In order to investigate the relationships between the level of work autonomy and the importance of the competencies, the importance scores for the tasks of each subject were averaged. These mean scores were correlated with the level of autonomy as measured with the 3-item scale. It was found that autonomy correlated with the importance of the following competencies: convincingness ($r = .36$; $p < .01$), oral fluency ($r = .30$; $p < .01$), communicative skills ($r = .30$; $p < .01$), writing skills ($r = .24$; $p < .05$), and knowledge of other disciplines ($r = .23$; $p < .05$). In accordance with previous studies, the results show that the level of autonomy is positively related to the importance of some behavioral characteristics, besides knowledge of other disciplines. Interestingly, all these competencies

are related to communication with other people.

Discussion

The results show that four competency domains can be distinguished in business computer science. These competency domains may be described as technique-oriented, organization-oriented, leadership-oriented, and user-support-oriented. These results are useful in the further development of the concept of expertise because they define the domain in which people can be an expert. Usually the domain is the whole job and expertise is based on a composite criterion. However, most jobs consist of several elements that require different competencies. This means that experts in some elements of the job are not necessarily experts in other elements. The necessity for distinguishing work domains is growing because jobs as stable groups of tasks are fading away. As noted before, this is especially true in computer science.

A seemingly contradictory finding is that the agreement of the ratings within groups of tasks was high, while tasks from different groups were grouped in the cluster analysis. This may partly be explained by the standardization of the scores before cluster analysis. Also, the high level of agreement within groups of tasks may result from the fact that some competencies were rated as very important for the performance of most tasks (e.g., knowledge of information technology) and others competencies were mostly rated as not important (e.g., commercial insight). Nevertheless, this result shows that aggregation within the groups was allowed.

Although the present study is based on subjective ratings of the importance of competencies, the results are mainly in accordance with studies using a more objective approach (e.g., Sonnentag, 1995). Nevertheless, the results may have been affected by the fact that the views of other people are not reflected in the data. For example, customers may emphasize the importance of social skills and employees may require more stimulating

leadership from their managers.

By relating competencies to tasks and roles and discerning stable and trainable competencies, the results of the study can have an added value for applied human resource management. Organizations may use these results to improve personnel selection through a better specification of the competencies required for the tasks and roles to be accomplished. The competency model for a specific combination of tasks and roles can be derived by simply taking the highest importance of the competencies belonging to these tasks and roles.¹ In addition, the importance of competencies for combinations of tasks and roles may be weighed with the time spent on these tasks and roles. Srinivasan, Shocker, and Weinstein (1973) described a method for performing this type of weighing. In personnel selection, the stable competencies of applicants should have the level required for the job, but trainable competencies may be somewhat lower, if the person has the opportunity and the ability to improve them.

The results may also be helpful in career counseling. Employees should rate their own competencies on behaviorally anchored rating scales.² On the basis of the profile of scores and the wishes of the employee, the competency domain or domains are chosen in which he or she can make a career. In cooperation with the counselor, the tasks and roles are selected that match the needs of the individual and the organization. If a person lacks some trainable competencies, these should be trained. However, if a person does not have the stable competencies required, a change to the new composition of tasks is not advisable.

Finally, organizations may use the findings for designing a performance appraisal system. On the basis of the tasks and roles performed, the competencies can be selected that are important for high performance. These competencies can be rated on the behaviorally anchored rating scales mentioned above. Such an approach to performance appraisal may be used in a competency-based organization as described by Lawler (1994).

A limitation of this study is that some tasks were rated by only a small number of subjects. This may cast some doubt on the reliability and representativeness of the importance scores on individual tasks. However, the reliability of the task ratings was quite high. Besides, the main results presented in Table 1 and Table 3 are based on the importance of the competencies for several tasks and roles involving the ratings of a larger group of subjects.

Future studies should investigate the predictive validity of competencies for the performance of tasks and roles in business computer science. For the assessment of multiple criteria, different raters should be used depending on the type of tasks and roles. For example, in the technique-oriented work domain, performance may be rated by the supervisor, in the organization-oriented domain by the client organization, in the leadership-oriented domain by team members and a supervisor, and in the user-support-oriented domain by end users. The practicality of a method based on the assessment of competencies for tasks and roles should also be studied in the context of career counseling, personnel selection, and performance appraisal.

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Footnotes

¹The necessary data for doing so can be obtained from the author.

²Such scales are available from the author.

Table 1
Importance of Competencies Within Groups of Tasks

Competency	Group of tasks								
	Data	Func	Faci	Org	Coor	Qual	Proj	Bu	Int
Knowledge									
Knowledge of IT	■	+	■		■	+		■	
Knowledge of other disciplines				+					+
Knowledge of the environment		+		+	+		+	+	■
Commercial insight									■
Behavioral style									
Planning and organizing					+		+	+	
Group / individual leadership									
Conflict handling									+
Resoluteness					+	+	+	+	
Convincingness							+		+
Didactic skills									
Initiative					+			+	+
Independence	+	+	+	+	+	+	+	+	+
Communicative skills	+			+	+		+		+
Oral fluency				+	+		+		■
Writing skills				■	+		+		+
Teamwork							+		

(table continues)

Competency	Data	Func	Faci	Org	Coor	Qual	Proj	Bu	Int
Negotiating skills							+		■
Customer orientedness				+			+		■
Working methodically / accuracy	+	+	+	+	+	+	+	+	+
Listening	+				+	+	+		■
Cognitive capacity									
Abstraction ability / problem analysis	+	+			+		+	+	
Judgement					+		+	+	+
Creativity	+						+	+	
Analytic ability	■	+	+	+	+		+	+	+
Personality									
Perseverance							+		+
Flexibility									
Emotional stabil. / immunity to stress									
Sensitivity									
Need for achievement		+				+	+		
Integrity						+			+
Mean N per group	16.9	21.3	12.2	15.8	14	21.6	21.6	12.7	17.7

Note. Func = functions, Faci = facilities, Org = organization, Coor = coordination, Qual = quality control, Proj = project control, Bu = business management, Int = interaction with environment.

■ = mean score higher than 2.5. (very important), + = mean score between 2 and 2.5 (at least important), no sign = mean score lower than 2 (less important).

Table 2

Importance of Competencies for the Performance of Roles

Competency	Roles						
	Deci	Cons	Crea	Reco	StimL	DirL	Assis
Knowledge							
Knowledge of IT	+	■	+	+		+	+
Knowledge of other disciplines		+	+	+			
Knowledge of the environment	+	+	+	+			
Commercial insight							
Behavioral style							
Planning and organizing	+				■	+	
Group / individual leadership					■	+	
Conflict handling	+				■	■	
Resoluteness	■				+	■	
Convincingness	■	■	+		■	■	
Didactic skills		+			+	+	
Initiative	+	+	■	■	+	+	+
Independence	+	+	+	+	+	+	+
Communicative skills	■	■	+	+	■	■	+
Oral fluency	+	■	+	+	■	■	+
Writing skills	+	■	+	+	+	+	+
Teamwork					■	+	■

(table continues)

Competency	Deci	Cons	Crea	Reco	StimL	DirL	Assis
Negotiating skills	+	+			+	+	
Customer orientedness	+	■	+	+	+		
Working methodically / accuracy		+	+		+	+	+
Listening	+	+	+	+	■	■	+
Cognitive capacity							
Abstraction ability / problem analysis	+	+	+		+		+
Judgement	■	+	+	+	■	■	
Creativity		+	■	+	+		+
Analytic ability	+		■	+	+	+	+
Personality							
Perseverance	+	+	+		■	■	+
Flexibility		+	+		■	+	+
Emotional stabil. / immunity to stress	+				■	■	
Sensitivity	+	+			+	+	
Need for achievement					■	■	+
Integrity	+	+			■	■	
N	23	61	44	34	25	18	46

Note. Deci = decision-making role, Cons = consultancy role, Crea = creative role, Reco = reconnaissance role, StimL = stimulating-leadership role, DirL = directive-leadership role, Assis = assisting role.

■ = mean score higher than 2.5. (very important), + = mean score between 2 and 2.5 (at least important), no sign = mean score lower than 2 (less important).

Table 3

Standardized Importance of Competencies Within Competency Domains and F-values

	Cluster				
Competency	1	2	3	4	F
Knowledge					
Knowledge of IT	1.91	.77	-1.18	.31	27.6***
Knowledge of other disciplines	-.46	.48	-1.50	.03	27.5***
Knowledge of the environment	-.04	.79	-1.06	.44	25.2***
Commercial insight	-1.65	-1.10	-1.59	-.73	6.5**
Behavioral style					
Planning and organizing	.46	.07	1.08	-.83	6.1**
Group / individual leadership	-1.31	-1.44	.53	-1.71	24.7***
Conflict handling	-1.23	-1.28	.19	-1.10	14.1***
Resoluteness	.36	.08	1.32	-.88	17.6***
Convincingness	-.52	-.14	1.21	.08	17.2***
Didactic skills	-1.02	-1.39	-1.21	.50	22.1***
Initiative	.34	.50	.72	.02	2.9*
Independence	.98	.79	.70	.43	3.9*
Communicative skills	.33	.76	.90	1.39	15.5***
Oral fluency	-.26	.29	.74	1.25	24.3***
Writing skills	.00	.91	-.06	1.46	16.4***
Teamwork	.35	-.25	.67	-.45	11.4***

(table continues)

Competency	1	2	3	4	F
Negotiating skills	-.63	-.25	.61	-.30	7.7***
Customer orientedness	.00	.06	-.53	1.30	16.6***
Working methodically / accuracy	1.56	.60	-.30	.33	46.4***
Listening	.15	.54	.15	.84	4.3**
Cognitive capacity					
Abstraction ability / problem analysis	.29	.68	-.89	-.33	15.4***
Judgement	.15	.80	.55	-.39	12.0***
Creativity	-.02	.22	-.91	.08	5.0**
Analytic ability	1.23	1.34	-.54	.22	26.4***
Personality					
Perseverance	-.06	-.12	.58	-.47	8.2***
Flexibility	-.14	-.45	-.03	.07	3.7*
Emotional stabil. / immunity to stress	-.05	-1.10	.22	-.57	29.5***
Sensitivity	-.99	-.97	-.59	-.04	9.2***
Need for achievement	.25	-.55	.32	-.37	10.7***
Integrity	.02	-.62	-.12	-.55	7.9***

* $p < .05$, ** $p < .01$, *** $p < .001$

Appendix. Cluster Membership of Tasks in Business Computer Science

<u>Cluster</u>		<u>Cluster</u>	
	<u>Data</u>		<u>Coordination</u>
2	compose object model	2	compose information policy
2	compose data model	2	determine decision criteria
1	manage meta-data	2	determine information architecture
1	compose implementation data model	2	analyse information services
1	perform data conversion	2	determine the desired situation
4	provide ad hoc information	2	determine alternative solutions
1	manage data	2	specify implementation strategy
	<u>Functions</u>	2	determine projects for information services
2	compose business process model	2	specify transition step
2	compose information process model	2	specify internal audit / security measures
2	select applications packages	2	monitor information system
2	design functional specifications	2	determine information system architecture
1	manage parameters	1	specify conversion strategy
1	design application structure	1	draw up system test plan
2	design manual information processes	1	draw up acceptance test plan
1	design program specifications	1	determine systems maintenance
1	make program	1	perform system test
1	install applications software	1	carry out acceptance test
1	manage program libraries	1	protect data processing systems
	<u>Facilities</u>	2	evaluate information system
1	specify technical infrastructure blueprint	4	provide front line support
1	quantify information system capacity	4	support personal computing
1	design computer system configurations	1	supervise usage
1	design network		<u>Quality control</u>
1	manage technical infrastructure capacity	1	determine development standards
1	manage data processing components	1	support development standards
1	manage data storage components	1	determine standards for systems operations
1	manage network		and control
2	select technical infrastructure components	1	determine operations standards
1	configure technical infrastructure components	1	assure quality
1	install technical infrastructure components		<u>Project control</u>
1	recover from system breakdowns	2	explore problems
1	plan operations	2	define project assignment
1	operate equipment	3	formalise project organization
1	manage computer usage	3	start assignment
1	manage network usage	2	draw up schedule
	<u>Organization</u>	3	control performance
2	investigate organizational aspects	2	compile report
2	analyse ability to change	2	evaluate assignment
2	organise information management function	4	organise transfer of knowledge
4	compile instructions for use	2	define area of investigation
4	compile user manual	2	perform risk analysis
4	compile operations manual		<u>Business management</u>
1	administer user authorisation	2	investigate data processing developments
		1	manage changes to technical infrastructure
		1	manage problems
			<u>Interaction with the environment</u>
		2	manage contracts
		4	manage customer relations
		4	undertake commercial tasks

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