Non-skill Attributes of Information Systems Professionals in an Integrated CASE Environment

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Introduction

Computer Aided Software Engineering (CASE) and Integrated Computer Aided Software Engineering (I-CASE) tools have been touted as the solution to the high cost of software development. Such tools may provide drawing and diagramming support, data dictionary development and integrity checking, as well as final code generation from the analysis documents produced. While the potential benefits seem great, research on productivity using CASE tools has shown mixed results [Rupnik-Miklic and Zupancic; Norman and Nunamaker; Finlay and Mitchell; Aaen]. The use of CASE and I-CASE tools to effect software development can be modeled as an interaction of task, tool (or methodology), organization, and person (or group) [e.g. Chen and Norman; Orlikowski; Ryan and Bock]. Most of the research into CASE effectiveness has focused on the first four elements of this model. This study serves to further the research into the effect of the fifth element of the model, specifically the non-skill attributes of the software engineer in the use of CASE tools.

Motivation for the Study

Non-skill attributes of Information Systems (IS) professionals are personal attributes or characteristics which may impact IS development work but are not part of a specific skill set required to accomplish a task. These include the IS professional's interest in the task to be performed and the professional's personality. Previous studies have shown that success or failure with a systems development project can be partially attributed to these non-skill attributes [Forte and Norman, 1992; Corbitt and Norman, 1991].

The current study builds upon these previous studies. Specifically, two major expansions of the body of knowledge result from this study. They are as follows: 1) We studied IS professionals' use of an integrated development (I-CASE) environment over the entire life cycle of a systems development effort, 2) We studied the non-skill attributes of the professionals.

The first of the expansions of the body of knowledge is concerned with the changes in the IS professionals' work environments which have occurred in recent years. The previous studies generally examined only a few isolated tasks which IS professionals must perform during systems development. While these tasks were identified as very important to the general tasks of developing an information system, a study examining the entire Systems Development Life Cycle (SDLC) using an integrated environment more closely resembles the actual work environment for IS professionals. Integrated environments are becoming the norm in systems development [Baram and Steinberg, 1990]. It is, therefore, important to examine IS professionals in the environment in which they operate. The current study addresses this concern by examining the use of the I-CASE tool of Texas Instruments called IEF, which takes developers from the earliest stages of the SDLC (planning) to the final stage (construction.)

The second expansion of the body of knowledge is concerned with the tendency of previous studies to include non-skill attributes only in passing, while most of the focus was on technical or organizational aspects of CASE adoption. It was felt that these studies could only form an incomplete picture of the relationship between the non-skill attributes and use of a software development environment. This study specifically examines several non-skill attributes of personality, including task interest, extroversion, detail-orientation, mode of learning, and mode of decision making. We examined anticipated and actual enjoyment of SDLC tasks, relating those attitudes to personality characteristics. Greater understanding of these attributes of IS professionals would enable them and their supervisors to plan and assign work more effectively throughout the SDLC.

In summary, the current study makes a new contribution to the body of knowledge by studying many non-skill attributes of IS professionals in an integrated development environment throughout the entire systems development life cycle. A higher quality final product and more enthusiastic IS professionals will hopefully be the result of this

knowledge.

Review of the Literature

The CASE development environments and the systems development effort has been extensively studied. The use of CASE to effect software development can be modeled as an interaction of task, tool, organization, and person [e.g. Chen and Norman, 1992; Orlikowski, 1993; Ryan and Bock, 1992]. The interaction of the software engineer (the person) with a CASE tool can be influenced by skill or non-skill attributes. Skill attributes include analysis skills, development experience, and experience using the CASE tool for development [Kemerer, 1992; Finlay and Mitchell, 1994; Orlikowski, 1993]. Non-skill attributes can include age, sex, learning style, and personality traits.

Leitheiser [1992] examined IS skills required for success with the IS development effort. His focus was on the future needs of IS professionals. While IS skills, such as the ability to design a physical data base, were found to be important, other non-skill attributes were also seen as very important. Green [1989] and Watson et. al. [1990] also note the importance of non-skill attributes. Nord and Nord [1995] reported on the importance of non-skill attributes for success in the IS profession. Software engineer resistance to change has been a factor mentioned in unsuccessful CASE implementation and adoption [Orlikowski, 1993]. Additionally, developers' personal attributes (non-skill) was ranked more important than technical (skill) attributes [Finlay and Mitchell, 1994] in user satisfaction with a CASE developed system. Non-skill attributes are being increasingly recognized as important for this technology, and more study is necessary.

These studies mainly investigated the skill attributes of IS professionals using CASE tools. They surveyed personal attributes and quality work and discovered that some non-skill attributes are associated with quality. There are two limitations to these studies: 1) they study the older CASE technology, and 2) they mention the non-skill attributes only in passing. Due to the widespread and growing use of integrated CASE technology in the systems development model, we felt it was important to use an I-CASE tool to examine the entire SDLC. We also wanted to directly investigate the relationships between non-skill attributes and development work. The current research addresses these shortcomings in the body of literature.

In this study we have chosen to examine the personality traits of the IS professional. Analysis of personality traits has been applied in other areas of IS with some success. User satisfaction with group support software, for example, was found to relate highly to introversion or extroversion of the user [Yellen et. al., 1995]. It appears that the use of personality (non-skill attributes) profiles are on the rise in business [Bush and Schkade, 1985; Coe, 1992; Hollenbeck and Whitener, 1988; Sitton and Chemlir, 1984; Zemke, 1992], adding weight to the importance of non-skill attributes.

In this research, the instrument used to collect personality data was the Meyers-Briggs Type Indicator (MBTI). This instrument, although sometimes criticized, is widely used

both in research and business [Mason and Mitroff, 1973; Sitton and Chemlir, 1984; Coe, 1992; Britt, 1994]. Additionally, the National Research Council, a subgroup of the National Academy of Sciences, examined the MBTI in a special evaluation. The MBTI was found to have high face validity and high impact among respondents [Zemke, 1992]. In other words, the MBTI is a good vehicle to determine a person's personality type and it does have value in the working world. The MBTI measures an individual on four scales of personality:

extraversion/introversion (E/I);
sensing/intuitive (S/N);
thinking/feeling (T/F);
judging/ perceiving (J/P).

The E/I scale measures one's focus or interest: either on the external world of people and things, or on the internal world of concepts and ideas. The S/N scale indicates one's preference for learning: either from the five senses using concrete data, or by deducing from theories and hypotheses. The T/F scale shows one's approach toward decision making: either by using a rational and logical approach, or by an emphasis on feelings and personal relationships. Finally, the J/P scale measures one's decision modes: either decision oriented and preferring outcomes and closure, or process oriented and preferring information gathering and flexibility [Mason and Mitroff, 1973]. The score on any given scale is a reflection of one's preferred mode of operation-- the comfortable choice [Kettelhut and Schkade, 1991]. These four scales can be combined to produce sixteen different personality profiles, for example, an ESTJ (extraversion, sensing, thinking, judging) or an INFP (introversion, intuitive, feeling, perceiving).

In two surveys of computer professionals, an attempt was made to identify a common personality type. Sitton and Chemlir [1984] found a preponderance of ENTP while Bush and Schkade [1985] discovered a greater percentage of ISTJ. The only common trait was the Thinking trait over the Feeling trait. This could be expected, as working with computers requires a level of comfort with logical and rational thought processes. The fact that these two studies did not find agreement on the other traits is not surprising due to the many different tasks which a "computer professional" may do [Bishop-Clarke, 1995]. Different personality profiles may be drawn to different tasks. In the current study we examined how the MBTI attributes influence anticipated and actual enjoyment of technical and manual tasks using an I-CASE tool throughout the systems development life cycle.

The Methodology

This section has been organized to report 1) the experimental individuals and groups, 2) the I-CASE tool used, and 3) the task and the measures gathered.

The subjects in the study were senior IS undergraduates students at a large metropolitan university in the US Southwest. They were enrolled in the capstone course of the

information systems major. Some researchers criticize the use of students as subjects in studies concerning IS professionals. However, in order to enroll in the course a minimum of six prerequisite IS courses is required, with a grade of C or better, and an overall college gradepoint average of 2.5 out of a possible 4.0. At the start of the semester, 39 percent were already employed in the IS field. By the end of the semester, virtually all had secured employment in the field. The average age was 27 years. The subjects were awarded bonus points for good performance in the study and were, therefore, motivated to take their contributions seriously. Given these characteristics, we believe they are knowledgeable, mature and representative of IS professionals early in their careers. In short, they are good surrogates for IS professionals and appropriate subjects for this study. Other demographic information on the student subjects is presented in Table 1.

At the start of the semester the subjects took the Meyers Briggs Type Indicator (MBTI) test. Next, the subjects voluntarily formed teams to complete the class project. Each team was required to perform a semester-long information system development task in a case study developed by one of the researchers. Using an I-CASE tool, the work took the teams from requirements gathering through implementation, with a demonstration of the on-line system during the last sessions of the semester.

Many of the factors which limit experimental research on teams were eliminated in this study. Since small teams have been shown to be more productive than large teams [Gallupe, Dennis, Cooper, Valacich, Nunamaker, & Bastianutti, 1992; Shaw, 1981] team size was limited by the instructor to between four and six members. Groups are more successful when the task is well defined and limited in scope [Niederman & DeSanctis, 1995] so the work requirements for each milestone in this study were carefully spelled out in advance. Since groups have poor success records when the measure of success is time to accomplish a task [Telem, 1988], time pressure was not a factor in the study (however, the final presentation of the on-line system was to be completed before the end of the semester). No one was aware of their individual nor their team members' personality types when the teams were formed. Therefore, the subjects could make no formal attempt to "balance" their teams so that all relevant personality types were represented on a team. The team members could collectively fire a member and individuals could, with the consent of the instructor, quit one team to join another. The teams thus resemble work teams in a real development environment.

The I-CASE tool IEF from Texas Instruments played an important role in the tasks to be performed in the preparation of the project, including the milestone reports which are discussed later. The subjects had been trained in a previous semester class on the use of the tool and felt comfortable with the technology. This eliminates the learning curve associated with a complex tool [Kemerer, 1992]. Some tasks on the milestone reports require the use of IEF while others do not. These are classified as technical or manual tasks. Regardless, all the tasks are within the discipline imposed by the IEF I-CASE tool.

Four team milestone reports were required to be submitted during the semester, with the syllabus describing the specific features needed on each report. (An abbreviated reproduction of the specific requirements of each report is shown in the appendix.) The

four reports corresponded to the systems development stages of Analysis, Design, Development, and Implementation. For each milestone report there were several specific requirements or tasks to be performed. The team members could assign tasks to individuals or work together on any task. A total of 42 tasks on four milestones were completed by each team. Work on each milestone report was evaluated, each task receiving a rating between 100 and 0.

We collected data on the students' perceptions of their enjoyment of the tasks. These were collected both as prior perceptions and as after-the-fact statements. For each task, the students indicated their anticipated and actual enjoyment, as described in the following paragraphs.

Prior to the submission of each of the four reports, the subjects were required to fill out a form which listed the tasks to be performed for that report. The subjects indicated how enjoyable they thought each task would be. A 7-point Likert scale, in which "7" indicates greatly enjoyable and "1" indicates unenjoyable, was used. If the subject did not plan to work on a task no number would be written next to it. In this way, we recorded the subjects' anticipated enjoyment of each task.

After turning in a milestone report, the subjects were presented with a second copy of the form which again listed all the specific requirements or tasks which were performed for the milestone report. This form asked the subject to indicate how enjoyable or unenjoyable each task actually was. The 7-point Likert scale used on this part of the form was identical to the one which was used on the form filled out prior to preparing the report. In this way we collected the subjects' actual enjoyment of each task that they worked on.

The first form (asking about expected enjoyment) was handed in two weeks prior to the submission of each milestone report. The second form (asking about actual enjoyment) was handed in concurrently with the milestone report. Thus the two forms were filled out sufficiently far apart in time so that a subject's responses on the actual enjoyment survey would not be contaminated by preconceived perceptions of enjoyment.

Research Assertions

We were interested in discovering if relationships exist between the following pieces of data. These relationships form the basis of our assertions. These assertions are not treated as formal hypothesis due to the limitations imposed by the sample size used in this analysis.

1) Is there a relationship between anticipated enjoyment from performing a task and actual enjoyment? We hypothesized a positive relationship. Experiences shows us what was enjoyed in the past, and it is should be easy to project this past enjoyment into the future. Our subjects had used the I-CASE tool IEF before and should have developed some expectations of what they liked and didn't like. By hypothesizing a

positive relationship between anticipated and actual enjoyment, we are also hypothesizing a similarity between past and current work. Knowing this information will provide insights into how standardized is the rigor enforced by CASE tools throughout the entire SDLC, an important selling point for CASE tools [Adelson and Soloway, 1985]. Perceptions of future enjoyment are important to have if the management goal is to have enthusiastic workers. Actual enjoyment is important to have if the goal is to have contented workers.

2) Is there a relationship between personality type and the correlation of anticipated to actual enjoyment from performing a certain type of task? This relationship will provide insights into whether a person is a good predictor of his or her enjoyment with performing a task. We predict that the people with the MBTI personality categories of Introversion and Feeling will be better in tune with themselves and their likes and dislikes, as they are more internally focused(Introverts) and more oriented toward feelings in general (Feeling). Identifying such a relationship would help IS to better manage their workers to increase their work satisfaction.

3) Is there a relationship between personality type and actual enjoyment of a manual task? We hypothesized a positive relationship between the MBTI personality categories of extraversion, intuitive, feeling, and perceiving (E,N,F,P) and actual enjoyment from performing a manual task. Manual tasks may require discussions with other people, empathy, and a great deal of interest in the process of arriving at a decision. These are attributes of E, N, F, and P personalities [Sitton and Chemir, 1984].

4) Is there a relationship between personality type and actual enjoyment of a technical task? We additionally hypothesized that there is a positive relationship between the MBTI personality categories of introversion, sensing, thinking, and judging (I,S,T,J) and anticipated enjoyment from performing a technical task. Technical, computerized tasks require focus upon ideas and concepts, concrete data, a logical approach, and an orientation toward the product rather than the process of the SDLC [2610 and 3610 text book]. These are attributes of I, S, T, and J personalities [Sitton and Chemir, 1984]. These two assertions 3 and 4 have already entered the popular culture as established facts, we hope to establish them more scientifically. This would be useful for determining job assignments from among the many tasks found in the typical system creation. They would also be useful for steering future IS professionals into meaningful careers.

Results

The researchers collected and coded each subject's demographic data, MBTI personality profile, and anticipated and actual enjoyment of performing specific tasks on each of the four milestone reports. Thirty-eight usable survey instruments were completed and used as the basis for this study. As mentioned in our discussion of the subjects, the demographic data (Figure 1) shows that our students are a very experienced and mature group.

In examining the data for our assertions we found that our data was very sparse. Given the number of tasks (42) and the group size (4), each person may only need to execute ten or eleven tasks. Thus, on average, only 35% of the subjects recorded enjoyment information for a task before they completed a milestone (anticipated enjoyment), and a still lower percentage (32%) recorded enjoyment information on the response forms after they had completed a milestone (actual enjoyment). Therefore, we used a .10 level of significance to indicate trends in our data, rather than attempt a more rigorous test.

Assertion One:

We averaged the responses for all the subjects for each of the 42 tasks. We compared the 42 pairs of "anticipated enjoyment" and "actual enjoyment" average responses using paired "t-tests". We found only 13% of these tests showed a difference between the mean of the anticipated enjoyment ratings and actual enjoyment ratings. In other words, our assertion was confirmed that generally subjects were able to predict how much they would enjoy completing a particular task before completing each of the four milestones.

Assertion 2:

Is there a relationship between personality type and the correlation of anticipated to actual enjoyment from performing a certain type of task?

Assertions 3 and 4:

The tasks on all the milestone reports were divided into two classifications: manual and technical. Since the study used the integrated CASE tool IEF as its foundation, which is a rather technical tool, tasks which required the exclusive use of IEF were classed as technical. Those tasks which were not IEF-based or which required extrapolation beyond the boundaries of IEF were classed as manual. Typical technical tasks included developing an entity relationship diagram and running a completeness check; typical manual tasks included writing an executive summary and specification of a training program.

We found a significant relationship ($p = .10$) between the personality type extroversion/ introversion and these tasks. Extroverts enjoyed the manual tasks more, introverts enjoyed the technical tasks more. For all other personality types no significant relationships were found.

Conclusions

While knowing the technical skills of information systems professionals is important to creating good systems, the personalities of these people is also important. In this study

we measured the Meyers-Briggs personality profile characteristics of extraversion/ introversion, sensing/intuitive, thinking/feeling and judging/perceiving. We examined these personality characteristics in relation to the enjoyment of typical tasks involved in the systems analysis and design process.

We found that people are good judges of what they will like. This is not a surprising result, but it could not be taken for granted. The past is not always a good indicator of the future. This consistency also points up how standardized is the rigor enforced by the IEF I-CASE tools. If other I-CAES tools are not as standardized, and then each system developed could be a completely new task which does not live up to one's expectations.

The correlation between anticipated and actual enjoyment [did/ did not] correlate with the four dimensions ...

We categorized the tasks undertaken during the systems analysis and design process as either manual or technical. We found a relationship only between the extrovert/introvert dimension of personality. Extroversion implies an interest in social relationships and human interaction, creating a match with the tasks which require more group work, or issues concerning personnel. Introversion implies an interest in ideas and a preference for working alone, creating a match for the technical tasks. Given the small data set in our research, we cannot state that there is no relationship between the other dimensions of personality and enjoyment of the task group. Given more data we would still expect to see the relationships we originally hypothesized.

More work needs to be done in this research on the individual in systems design, specifically in the use of I-CASE tools. Other studies might examine enjoyment of other I-CASE tools, or other personality characteristics. Information systems managers are working hard to retain employees as well as make good systems efficiently. By looking at employees as individuals with needs, likes and dislikes, we can assist in this goal.

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Appendix

TABLE 1
Demographics

Number completing study = 38
Average age 27.5 (range 21-53)

Average GPA	3.30 (range 2.5-3.9)
Gender:	Male (60%) Female (40%)

Average years experience in IS
3.2

Table 2
Summary of MBTI Personality Profiles
Extraversion/ Introversion (E/I);

CODE_EI

	Value	Valid Frequency	Cum Percent	Percent	Percent
Extraversion	1.0	17	44.7	44.7	44.7
Introversion	2.0	21	55.3	55.3	100.0
Total		38	100.0	100.0	

Sensing/Intuitive(S/N)

CODE_SI

	Value	Valid Frequency	Cum Percent	Percent	Percent
Intuitive	1.0	9	23.7	23.7	23.7
Sensing	2.0	29	76.3	76.3	100.0
Total		38	100.0	100.0	

CODE_PJ

Judging/ Perceiving (J/P).

Value Label	Value	Valid Frequency	Cum Percent	Percent	Percent
Perceiving	1.0	10	26.3	26.3	26.3
Judging	2.0	28	73.7	73.7	100.0
Total		38	100.0	100.0	

Thinking/ Feeling person (T/F)

Value Label	Value	Valid Frequency	Cum Percent	Percent	Percent
Thinking	1.0	31	81.6	81.6	81.6
Feeling	2.0	7	18.4	18.4	100.0
Total		38	100.0	100.0	

For each milestone report an overall grade was assigned using the rating scale of many North American university professors in which 100 to 90 indicates excellent, 89 to 80 indicates very good, 79 to 70 indicates good, 69 to 60 indicates poor, and below 60 is

considered not acceptable or a failure. The quality of the reports was evaluated as a team effort, although team members could award more or less points to very productive or unproductive members.

Additionally, on this second form, each subject indicated what percent of the total time spent working on the report he or she spent performing each task. In other words, if a subject spent half the time working on Task D and the other half on Task E, this subject would write 50% next to Task D and 50% next to Task E. All other tasks would have no number recorded next to them. In this way we collected data on how each team member spent their time.

Is there a relationship between personality and actual enjoyment of a task? We hypothesize a weaker relationship between personality type and actual enjoyment. This is due to people's inclination to overstate their strengths and weaknesses. The tasks which they anticipated they will enjoy will indeed be enjoyable but not as much as was originally thought. There will be, in other words, a halo effect surrounding tasks which an IS professional thinks will be enjoyable.