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Experience as a Moderating Variable in a Task-Technology Fit Model

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Abstract

We test the addition of experience with maintenance tools and with the maintenance task to our previously tested task-technology fit model for software maintenance tool use. Tool experience is significant as both a main and moderating effect, but task experience adds little to the explanatory power of the model.

Introduction

Task-technology fit (TTF) is the matching of the capabilities of the technology to the demands of a task. A task, in the TTF literature, is an activity to be accomplished by a knowledge worker. Tasks can be of a problem-solving nature, e.g., auditing or software maintenance, or of a decision-making nature. Technology, also referred to as tools, includes a wide range of information technologies including hardware, software, data, user-support services or any combination of these (Goodhue and Thompson, 1995). A fundamental argument of a TTF model is that a software tool will be used if the functions available to the user support the activities of the user.

In previous research, we tested a TTF model for software maintenance tool usage (Dishaw and Strong, Forthcoming). The independent variables in our research model were software maintenance task characteristics, software maintenance tool characteristics, and the fit between the tool and task characteristics. The dependent variable was tool usage.

Our research model, shown in Figure 1 with the two new experience variables tested in this paper, was constructed from three models from the general MIS literature. The Task/Technology Fit Model (Goodhue, 1988b; Goodhue, 1992) provides the basic framework for examining tool usage. The TTF model, however, is general and does not address either a specific task or technology. To adapt the TTF model to our research context, we developed a general maintenance task model using the Software Maintenance Model (Vessey, 1986), augmented by software understanding literature (Letovsky, 1987; Letovsky & Soloway, 1986). A software maintenance tool functionality model was developed based on the problem solving literature and the Functional CASE Technology Model (FCTM) (Henderson & Cooprider, 1990). The integration of these models results in a more comprehensive framework relating maintenance task and technology characteristics to software tool usage.

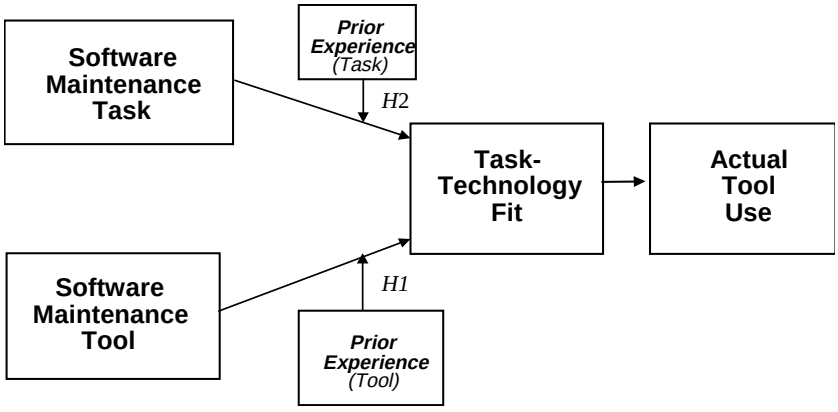

Figure 1. Research Model

Experience as a Moderator of Task-Technology Fit

In our revised model, fit is moderated by an individual maintainer's experience with the task and the technology. Fit between task and technology may differ by individuals. For example, fit may be moderated by prior experiences of maintainers. For this reason, some versions of the TTF model have included individual characteristics as a moderating variable (Goodhue, 1992). For this study, the relevant individual characteristic variables are prior experience with both tool and task.

On the tool side, this focus is suggested by studies showing that experience or familiarity with software tools has a positive correlation with usage (Davis, Bagozzi & Warshaw, 1989; Guinan, Hopkins, & Cooprider, 1992). The concept that past behavior is a good predictor of future behavior is well established in the psychology and organizational behavior literature, e.g., (Robbins, 1997; Schuler & Jackson, 1996). Tool use is a behavior. As such, it is likely to be repeated unless there are negative

consequences from doing so. As shown in Figure 1, experience with maintenance support tools is posited to moderate the fit relationship with technology characteristics, as follows:

Hypothesis 1) Greater experience with tools is associated with higher use of tools than explained by the TTF model alone.

On the task side, the argument for the effect of task experience is less clear. For this study the relevant maintenance task experience is experience with maintaining the particular system that is the focus of the maintenance project. Tool vendors and supporters argue that tools help compensate for lower task experience, e.g., tools can help with initial understanding of a software system. According to this argument, maintainers with less experience with the system they are maintaining would more likely benefit and expect positive benefits from using tools, while more experienced maintainers are less likely to turn to tools because they do not need them. There is, however, little solid empirical evidence to support such an argument.

A counter argument is that tools add a level of abstraction to the task, and less experienced maintainers need to more directly gain experience with the system by using manual methods or by talking with others who know the system. This argument is supported by a study of spreadsheet tools that found that users need to be experienced in the task as well as the tool to use the tool effectively (Mackey & Elam, 1992). Thus, while we expect task experience to moderate the relationship between task characteristics and fit, the direction of the effect has been argued in both directions. The following hypothesis, stated with the direction argued by tool vendors, should be considered as an exploratory test:

Hypothesis 2) Lower experience with the task is associated with higher use of tools than explained by the TTF model alone.

Research Method

Three organizations participated in this study. All had large MIS applications groups who expend a large proportion of their annual budgets on software maintenance. Their information systems environments are all based on IBM 390 mainframes running MVS COBOL/CICS applications. All three organizations used commercially available tools such as the Viasoft tool suite or the Microfocus COBOL workbench and its related tools, as well as additional tools for debugging, tracing, and abend analysis. The subjects for the study were working programmer analysts completing their normal maintenance projects from their organization's existing maintenance backlog. The forty-seven subjects completed a questionnaire about the characteristics of their maintenance tools and their experience before starting their project, and a questionnaire about task characteristics and their actual use of maintenance tools after the project.

The hypotheses were tested using linear regression models, as done in previous studies using TTF models. The hypotheses, which propose additional moderating effects in the model, were tested by comparing the regression with the moderating variable, which is an interaction of two main effects, to one without the interaction term (Baron and Kenny, 1986). The addition was assessed using an F test of the significance of the change in R^2 resulting from the addition of the new interaction variable. Thus, we tested the two sets of regression models, below. Models 1b and 2b tested the significance of adding the moderating effects of tool experience and task experience, respectively. Models 1a and 2a were the models to which they are compared.

(1a) $ToolUse = \alpha + \beta_1 TaskChar + \beta_2 ToolChar + \beta_3 Fit + \beta_t ToolExp + \varepsilon$

(1b) $ToolUse = \alpha + \beta_1 TaskChar + \beta_2 ToolChar + \beta_3 Fit + \beta_t ToolExp + \beta_5 ToolChar*ToolExp + \varepsilon$

(2a) $ToolUse = \alpha + \beta_1 TaskChar + \beta_2 ToolChar + \beta_3 Fit + \beta_4 TaskExp + \varepsilon$

(2b) $ToolUse = \alpha + \beta_1 TaskChar + \beta_2 ToolChar + \beta_3 Fit + \beta_4 TaskExp + \beta_5 TaskChar*TaskExp + \varepsilon$

Results

With hypothesis 1 we posit that experience with tools has a moderating effect on the relationship between tool characteristics and fit. The results in Table 1 present our test of this hypothesis. The addition of the interaction term to the base model produces a highly significant improvement in the model indicating that there is a significant moderating effect. The direction of the sign of the beta for the added term, however, is negative. The significant moderating effect supports hypothesis 1, but the direction of the effect fails.

Hypothesis 2 is similar to hypothesis 1 in that it posits a moderating effect for task experience. The results are presented in Table 2. Although the base model produced a significant regression, we do not see a significant improvement in the hypothesized model over the base model. We cannot conclude that task experience produces a moderating effect. Thus, hypothesis 2 is not supported.

Discussion and Conclusion

The fit model with tool experience included as main and interaction variables (Model 1b) provides the best overall adjusted R^2 produced from our hypotheses tests ($R^2 = 0.63$). This R^2 value is excellent for MIS models measured with field data.

Table 1. Test of Hypothesis 1 Experience with Maintenance Tools

Model	Adj. R^2	F	Sig. F	Change R^2	Change F	Change F Sig	Variables	Beta	Sig
1a. Base Model	.456	8.349	.000	-	-	-	Task Characteristics	-.463	.003
							Tool Characteristics	-.099	.540
							TTF	.270	.098
							Tool Experience (TE)	.269	.060
1b. Hypothesized Model	**.633**	13.071	.000	**.167**	**15.905**	**.000**	Task Characteristics	-.433	.001
							Tool Characteristics	-.300	.004
							TTF	.567	.105
							Tool Experience (TE)	.534	.000
							TE* Tool Char.	**-.231**	**.000**

Table 2. Test of Hypothesis 2 Experience with the Maintenance Task

Model	Adj. R^2	F	Sig. F	Change R^2	Change F	Change F Sig	Variables	Beta	Sig
2a. Base Model	.351	6.808	.000	-	-	-	Task Characteristics	-.523	.003
							Tool Characteristics	-.017	.896
							TTF	.062	.715
							Task Experience (TskE)	.194	.157
2b. Hypothesized Model	.357	5.87	.001	.021	1.413	.242	Task Characteristics	-1.109	.039
							Tool Characteristics	-.061	.647
							TTF	.013	.940
							Task Experience (TskE)	-.344	.471
							TskE* Task Char.	.710	.242

According to Model 1b, more tool characteristics (more functionality) reduces tool usage. This negative effect is compensated for when these characteristics are needed for the task, i.e., high fit (TTF), or when the programmer is highly experienced with the tool, both of which increase usage. We conclude that fit between a tool's functions and the needs of task activities adjusted for the maintainer's prior experience with the tool are excellent predictors of a maintainer's use of that tool for a particular maintenance project.

Tool experience is clearly an important contributor in our TTF model. As a main effect, tool experience is significant and has a positive effect on utilization. This is consistent with behavioral research. It also moderates the relationship between tool characteristics and fit as hypothesized, although not in the expected direction.

Further investigation of the moderating effect of tool experience on the relationship between tool characteristics and fit should be explored in a laboratory setting that can provide more control over the values of tool experience. A different subject group with different tools could also be helpful in further exploring the effect of tool experience.

Experience with the task adds nothing to the fit models either as a main effect or as a moderator. The claim of tool vendors that programmers would employ a tool in an attempt to initially understand a system is not supported by our findings. The opposite claim that a programmer must have sufficient understanding of the system being maintained to use a tool is also not supported. Further research is needed to determine whether and under what circumstances prior task experience affects tool utilization.

References

References available on request from the first author (dishaw@uwosh.edu).