The Impact of Background and Experience on Software Inspections

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This work was an initial investigation into the relationship of an inspector's characteristics and his or her effectiveness in a software inspection. Prior research indicates that the overall effectiveness of an inspection team depends largely on the effectiveness of the individual inspectors who make up that team. But, the effectiveness of those inspectors varied widely, even when they were using the same inspection technique. Much of this variation was attributed to the inherent differences among the inspectors. Therefore, in order to better understand these differences, this work focused on the variations in background and experience, to understand the variation in their effectiveness. In addition to gaining a better understanding of the inspection process, the results of this work also provides guidance to inspection planners in selection and training of inspection team members.

Most of the existing software inspection research has focused on improving the methods and techniques used for inspections. There has been little research specifically focused on identifying and understanding the important variations among inspectors. To identify the prior research work on software inspections and take advantage of it to the greatest extent possible for research in a different context, e.g. variables related to the individual inspectors, a methodology using the concepts of the literature search, grounded theory and empirical studies was configured.

First, a literature search methodology is used to take advantage of existing research. This existing research does not specifically have to be focused on the variables of interest. It is used to frame the space within which the researcher will work. Second, in order to combat the lack of existing focused research, a tailored version of techniques from the *Grounded Theory* research method, used often in Sociology and Psychology, is included in the methodology. The grounded theory approach uses existing data collected in studies on process of interest. In addition to forming theories and hypotheses top-down based on a researchers' *a priori* assumptions, theories and hypotheses are formed systematically, bottom-up from the data. Finally, empirical studies are used both as a source of empirical data for hypotheses building and as a method for testing the generated hypotheses. By combining these three concepts, the methodology allows a research framework to be built top-down, from exiting theory in the literature, while specific hypotheses are built bottom-up, using empirical data, and mapped into the framework. It also allows those hypotheses to be tested using empirical studies.

These activities have been configured into a three-step methodology. Step 1 is to develop an initial list of variables and associated high-level hypotheses based on a thorough search of the literature. These variables will provide a framework for the more specific hypotheses. When there is little or no prior research focused on the process of interest, this step contains a methodology for analyzing published studies, both from software engineering and from other fields, to propose a set of variables and related hypotheses. While these studies often have goals that are minimally related to the current work, useful for variables and hypotheses can often be extracted. In this work, the output of Step 1 was a proposed list of variables characterizing the differences among the inspectors' background and experience and the associated high-level hypotheses about the effect of those variables on inspection performance.

Step 2 uses concepts from grounded theory to refine the variables and hypotheses bottom-up from existing empirical data. The goal of this step is to build specific hypotheses, "grounded" in data, that can be mapped back to the high-level hypotheses and variables from Step 1. This step assumes the presence of

data from empirical studies conducted on the process of interest. These studies may have different goals, but can be used as long as they collected the necessary data to be reanalyzed for the current work. Hypotheses are generated and refined iteratively using multiple data sets, where possible. In this work, data from a series of inspection studies was used to define concrete metrics for each variable identified in Step 1. Additionally, a set of hypotheses was generated and then mapped back to the high-level hypotheses from Step 1.

Step 3 is to design and run new studies to test one or more hypotheses from Step 2. The methodology provides guidance on choosing the right set of hypotheses for testing. In this case, two studies were conducted. After examining the set of hypotheses from Step 2, a sub-set was chosen for further study based on the level of support found in the existing data and the interest of the researchers. The two studies were focused around these hypotheses. The data from these studies was used not only for hypothesis testing, but also to refine the existing hypotheses by iterating Step 2.

The hypothesis tested in the first study was that inspectors who have more experience with the inspection process would find more defects than those who have less experience. The analysis of the historical data in Step 2 had shown that process experience was an important variable, but it was still unclear what type or how much experience was necessary to see a benefit. This study examined observation of an inspection as a method for gaining inspection experience. The results of this study showed that based on qualitative data, the subjects believed that the observation was beneficial both to their understanding of the process as well as to their effectiveness in using the process. The quantitative data showed this improvement in only some cases. Furthermore, it appeared that for less experienced inspectors to gain any benefit from observing an inspection, that inspection must be focused on a requirements document from a domain in which the inspector has high domain knowledge.

The second study was run to test the hypothesis that the amount of detail required in an effective inspection technique should be tailored to the experience of the inspector using that technique, e.g. more experienced inspectors need less detail while less experienced inspectors need more detail. Again the historical data had shown some indications that for experienced inspectors too much detail reduced the number of defects they found, while for less experienced inspectors more detail was necessary to overcome the lack of experience and help them find more defects. The results of this study showed that the level of detail in the technique and the inspector's experience seemed to have little impact on the effectiveness of the inspector. There was an indication in the subject feedback that this result was likely due to the set of defects present in the artifact. Some subjects believed that with a "more complex artifact" or "more difficult defects", the amount of detail in the process would have shown a greater effect. Further study is required to understand these complexity issues.

This work contributes a three-step methodology that can be used when researching previously unstudied variables that affect a well-studied process. This dissertation also presents complete list of the hypotheses about the relationship between the background and experience of an inspector and his or her performance during an inspection that were generated in Steps 1 and 2. The complete designs and results of the two studies run in Step 3 of the methodology are also discussed. Finally, some specific suggestions for both researchers and practitioners are provided.

Publications from Thesis:

Carver, J., Van Voorhis, J., and Basili, V.R. "Understanding the Impact of Assumptions on Experimental Validity." To appear in *Proceedings of the 2004 ACM-IEEE International Symposium on Empirical Software Engineering (ISESE 2004)*. August 2004.

Carver, J, Shull, F., and Basili, V.R. “Observational Studies to Accelerate Process Experience in Classroom Studies: An Evaluation.” In *Proceedings of the 2003 ACM-IEEE International Symposium on Empirical Software Engineering (ISESE 2003)*. September 2003. p. 72-79.

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