Understanding Complexity in Architecture-based Analysis

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CERTIFICATE

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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List of Acronyms

ABD	Architecture-Based Design
ADL	Architecture Description Language
AQA	Architecture-based Quality Assessment
AR	Action Research
ASD	Architecturally Significant Decision
ASR	Architecturally Significant Requirement
ATAM	Architecture Tradeoff Analysis Method
GBR	Goal Based Requirements
HAS	Human Activity System
IS	Information Systems
MEEN	Management of Enriched Experience Networks
NGN	Next-Generation Network
OSS	Operational Support Systems
QDS	Quantified Design Space
QOE	Quality of Experience
RMA	Rank Matrix Analysis
SA	Software Architecture
SAABNET	Software Architecture Assessment using Bayesian Networks
SAAM	Software Architecture Assessment Method
SARA	Software Architecture Review Assessment
TMF	Telecommunications Management Forum
TMN	Telecommunications Management Network
UTS	University of Technology Sydney

ABSTRACT

As computer-based systems become more embedded in organisations and integrated into organisational activity, they also become proportionately more complex. Telecommunications networks in particular are facing significant challenges as their infrastructure combines to form one of the largest, most heterogenous systems around. The increase in complexity, coupled with the cost of late changes to system designs, elevates the importance of being able to reason about system designs from the earliest artefacts onwards. Software architecture is a discipline designed to address the increase in complexity by facilitating early design reasoning and providing a complimentary focus on system quality as well as function.

The following thesis reports on a research project aimed at addressing the complexity of the telecommunications design task with the techniques of software architecture. A particular focus is given to architecture-based analysis, the motivation for which arose from reconciling experience in design meetings against the focus of the analysis methods. Combining this experience with a diverse examination of systems literature realised the 'hypothesis' that the existing analysis literature did not address the true complexity of the task. Using a collaborative design project as a platform, the research made use of the situated method of inquiry called action research to explore the complexity of the analysis task.

The learning outcomes present the manifestations of complexity observed in the ATAM process in terms of a people and systems dimension. These aspects of complexity are shown to affect some of the most important ATAM objectives. Insight is also offered on the use of the method with respect to the design lifecycle, discussing how the elements of the design situation and situational complexity conspire to diffuse the efficacy of the ATAM. Some future resolution to this is suggested in terms of splitting out the analysis objectives and maintaining two streams of analysis, as well as paying attention to the content aspects of the process that drive its direction from within. While all the individual learning outcomes are important, the most enduring outcome stems from the rich understanding obtained by entertaining a 'soft' perspective of the analysis task. This is perhaps no better summed up than by Bucciarelli.

"attempts to improve the engineering design process by critics and assessors of that process have been, for the most part, couched wholly in instrumental terms... these instrumental approaches are deficient when applied to design process considered as a social process awash in uncertainty and ambiguity. They miss many of the trees in the forest." (Bucciarelli, 2002, pp 221)