Expanding the view on Complexity within the Architecture Trade-off Analysis Method

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Abstract

The following paper presents the learning outcomes from an investigation into the aspects of complexity involved in architecture-based analysis. Using a framework of situational complexity as provocation, the manifestations of complexity observed in the Architecture Tradeoff Analysis Method (ATAM) process are presented in terms of a people and systems dimension. These aspects of complexity are shown to impact upon some of the most important ATAM objectives. The change in ATAM complexity is also presented with respect to the design lifecycle. Some resolution to the complexity suffered by the process is suggested in terms of splitting out the analysis objectives and maintaining two types of analysis, as well as paying attention to the content aspects of the process that drive its direction from within.

Keywords
Software architecture, architecture analysis, situational complexity, ATAM

1. Introduction

Empirical [1] and theoretical [2] work both support the notion that the further along the system design and development path, the more committed stakeholders are to the solution and the more costly it becomes to change design decisions [3]. The tangible saving in terms of both effort and money has created a decisive need to reason about the finished systems properties using a baseline of only the earliest design artefacts. Software architecture (SA) is one such discipline that seeks to make use of abstract design representations, encouraging communication amongst stakeholders and providing a vehicle for reasoning about the design from the earliest system form onwards [4]. By establishing a relationship between the goals of a system, be they functional or non-functional and the underlying structure of the system, SA suggests the capability to design for desired properties.

The need to design for specific properties also requires a method by which these properties can be tested for in architectural designs, giving rise to architecture-based analysis techniques. Architecture-based analysis developed recently during two distinct epochs, the first marked by questioning techniques oriented towards candidate selection [5], the second marked by methods more focused on analysis throughout the design process [6]. Coincident with the change in analysis role was the expansion of the participating stakeholder group, showing a shift from expert-centric to stakeholder-centric analysis. The resulting group of participants can be considered, as they are in the broader design process, a human activity system, granting architecture-based analysis many of the attributes of a social or ‘soft’ process [7].

Expanding the stakeholder group heightens the situational complexity, which Flood suggests comprises a ‘classic/systems’ dimension and a ‘people’ dimension [8]. Until recently the focus has remained on the systems aspects of architecture-based analysis with only recent acknowledgement of the people dimension. “as architecture reviewers, we continually run into social, psychological, and managerial issues and must be prepared to deal with them.” [9]. The different world views (Weltanschauung) [10] of each participant will naturally effect how they view the task and participate therein. Until now the responsibility for handling this aspect of complexity has been placed in the hands of the facilitator. This is notably dismissive of the need to alter the process itself and the potential for the facilitator themselves to contribute to the complexity of the situation. The following paper presents an experience-based account of researching the complexity of architecture-based analysis within a combined industry-university design project.

Section 2 presents the importance of the research methodology and the research situation to the interpretation of the outcomes, as well as introducing the chosen architecture-based analysis method. The aspects of complexity identified within the Architecture Trade-off Analysis Method (ATAM) are then presented (Section 3) and their impact on the ATAM process discussed (Section...
4). Learning from applying the process at different stages in the design lifecycle is then discussed in Section 5 and a brief conclusion given in Section 6.

2. Research Background and Methodology

2.1 Research situation

The research was undertaken as part of a broader project whose aim was to develop a proof of concept design for a next generation network (NGN) management system. Traditionally telecommunications infrastructure has been strongly engineered for quality, meaning that a relatively static topology and offline configuration of the network by-in-large accounts for the quality perceptions of the user. However faced with a significant decline in the value of its traditional services, the telecommunications market has perceived the need to enable new value added user services. The desire to provide innovative new service sets to consumers has created a step-wise increase in the complexity of management systems and placed them in the critical path for service delivery. In many ways the business capability is now seen as being defined by the capability of the management systems [11]. This significantly augmented the quality expectations of a class of systems that were already considered in the domain of complex systems.

Consequently the quality focus of software architecture and the telecommunications problem seemed a natural fit, realising a linkage project between the university and an industrial partner who was a leading vendor of telecommunications equipment and services. The project group consisted of academics from within the university, senior technology consultants from the industry partner and several doctoral researchers. The academics were drawn from different telecommunications and software disciplines. Their roles included oversight of each of the key project discipline of Architecture, Policy, Networking and Service. Each discipline had at least one associated doctoral researcher.

The research focus of this paper is a subset of the work undertaken as part of the Architecture practice of the team. While the issues addressed in this research are pertinent to the broader practice of architecture-based design as they are the specific area of architecture-based analysis, the focus was chosen due to reasons of involvement and clarity. The researchers were heavily involved in the Architecture practice of the design team. The issue of clarity refers to the ability to clearly identify the research area. Architecture-based analysis is a contained event that occurs within architecture-based design practice with a clearly defined method. Whereas the design team were consciously not following a structured design approach due to the nature of the research challenge.

2.2 The Architecture Trade-off Analysis Method (ATAM)

Architecture-based analysis techniques fall into one of two categories, questioning and measuring according to whether they offer qualitative or quantitative results. In complex design situations the effort required to develop models suitable for quantitative analysis and the concentration on one quality at the expense of others tend to dissipate the use of measuring techniques. While many of the subsequent questioning techniques provide the ability to evaluate multiple quality aspects of a system and don’t require quantitative models, they still tend to only find application as candidate selection methods once a design has reached maturity [5].

The adoption of an iterative incremental development process required a method which could be used throughout the systems lifecycle, as well as provide insight into the design issues and how they relate to the customer objectives. Consequently the methods suited to such an approach are those oriented towards application from an early point in the design life-cycle as well as providing the ability to analyse the relationship between multiple quality concerns and design decisions. The only methods found to satisfy these conditions included Software Architecture Assessment using Bayesian Networks (SAABNet) [12] and the Architecture Tradeoff Analysis Method (ATAM) [13]. Although it is viewed as qualitative in nature, SaabNet requires the numeric coding of relationships between design aspects as conditional probabilities and as such requires determinism in the relationship between design moves and system properties that is not known.

The Architecture-based Trade-off Analysis Method (ATAM) was selected as the most appropriate for the research project as it could be used throughout the design lifecycle, achieved design analysis rather than candidate selection and had a strong lineage of development backed by case reporting. The method itself is broken into two overlapping phases of 9 steps as shown in Figure 1.
quality goals into concrete scenarios representative of the goals. The final steps identify architectural sensitivity (architectural decision key to a specific quality) points, trade-offs (architectural decision key multiple qualities) and risks (important decisions not made) [13]. (need to potentially add a diagram to this).

2.3 Action Research and Interpreting the Research Outcomes

As discussed in Colquitt [6], the original research interest in the “social” dimension of complexity promoted the idea there are difficulties the process has to overcome which are only attributable to the people within a situation. That is the problems arise from the intersection between the technical and non-technical [14], the interaction of the perspective of the stakeholders with the task of architecture-based analysis. The human dimension of which urges the use of qualitative methods to capture the complexity of the phenomena [14].

The need to act as a researcher in the telecommunications research project and simultaneously research the architecture-based analysis of systems promoted the use of a methodology that would accommodate both roles. Action Research (AR) as a methodology for situated inquiry is sympathetic of the need to perform both roles and is also accepting of change as a mechanism of developing further understanding. The need for both action and learning is revealed in the structure of the methodology which in its most abstract form consists of stages of planning action, taking action and reflecting upon action. The phases form a natural cycle, in which the reflection and learning from the previous cycle influences the planning and action to be taken in the next phase, as theory and practice both inform one another [15]. The particular method adopted for applying Action Research is that of Susman [16] Figure 2.

While Action Research reports on experience it needs to be understood as a more structured approach to inquiry than recollections of past experience. The research was undertaken with a specific aim to understand the complexity of ATAM; a specific method of inquiry (Action Research) and a defined framework of ideas representing the outcomes of background research. However the structure and discipline does not grant generality of the findings, and although the issues can be extrapolated out to large systems design the outcomes would be specifically different. The research should be understood in the spirit of Schon’s “science before the fact” [2]. With the outcomes providing the basis for more controlled experimentation in the future.

![Figure 2 – Susman Action Research Model [16]](image)

Importantly the content of the rest of this paper only seeks to present the outcomes of the research, not the processes whereby AR assisted in formulating the outcomes. Similarly for reasons of brevity some supporting material has been omitted in terms of design artefacts and quotes.

3. Complexity in the ATAM

3.1 An Expanded View of Complexity within the ATAM

The motivation for a specific focus on architecture-based analysis arose from an early project need to perform analysis on existing system designs. The research team exhibited strong diversity from the outset, and matters of design often became side-tracked by clarifying interpretations and viewpoints amongst the design group. Discussions indicated the role of the stakeholder in the project, their experience and areas of interest all contributed to the ways in which they participated. The importance of personal viewpoints, beliefs and interests aligns closely with what has been termed a ‘people’ dimension to complexity [8]. Importantly this aspect of complexity will increase as the perceptions and beliefs of the participants diverge.

The chosen method of ATAM promoted stakeholder participation, yet didn’t openly tackle how to address the impact of stakeholder diversity. Instead the ATAM literature suggests these issues can be resolved by properly setting the expectations of the participating parties, ensuring documentation is made available and that the facilitator is sufficiently skilled [9]. The focus on the facilitation is dismissive of the need to adapt the process itself to handle such diversity. It also re-enforces the view that traditional systems engineering is focused on the ‘systems’ aspects of complexity at the expense of the ‘people’ dimension [17]. Complexity within a situation arises from both the number of parts and relationships of...
the system at hand, as well as the people within the design situation. Consequently the following sections present the aspects of both ‘people’ and ‘systems’ complexity encountered within the ATAM. Section 4 will discuss how this complexity impacted what the method was trying to achieve.

3.2 People dimension to complexity

People complexity suggests each individual’s capabilities, beliefs and interests will influence how they participate in design situations. These aspects of complexity formulate the perspective from which a participant views the design situation. This perspective influences the way design artefacts are interpreted and communicated amongst the group. The term Weltanschauungen (W) [10], meaning world view is commonly used in Information Systems (IS) literature to express the idea that artefacts and actions can be interpreted in different ways according to each individual’s perspective. Significant evidence for differing world views was found throughout the ATAM exercises.

3.2.1 Differing world views. The second and third steps of the ATAM are designed to present the business case for the system and the system architecture. These presentations are given by the industry partner (client) and the design team respectively. The difference in language and concepts used within these presentations provided the first insight into the perspectives at work within the analysis. The business drivers presented by the client emphasised the needs of cost management, including both operational and capital measures, as well as customer choice and satisfaction. These drivers are all contingent on the way in which the system is designed but are nonetheless, quite distant from the quality attributes such as performance and security commonly put forward when talking about system architectures.

The difference in language and concepts exhibited in the presentation activities of the ATAM also carried through into the quality attribute workshops. These workshops are designed to elicit the key quality attributes of the system that form the first tier of the utility tree. The quality responses of the industry partner used telecommunications business concepts such as “network optimised” and “customer aware”. Alternatively the broader group tended to re-enforce the systems quality perspective adopted by the software architecture community, offering qualities like “performance” and “availability”. However rather than simply re-enforcing the dichotomy of business and systems quality, the quality responses also indicated a more personal value-based view of the quality needs for the system. Vocal advocates of standards offered qualities like “standards-based”, similarly those with broader experience in billing and mobile aspects to networks raised notions like “roaming” and “billing accuracy”.

The language used to define the attributes themselves also reflected the personal notions of the participants. Those with backgrounds in telecommunications management used terms such as “protocols”, “managed data”, “5 9’s” and “Frame Loss Rate”. Participants with more hands on networking experience referred to “rack space”, “moves/adds/changes (MACS)”. Whereas the architecture-minded amongst the group used well known architectural constructs such as “connections” and “components” [18], the extreme of which was a systems architect who clearly defined 3 qualities then offered the view that these three were defined/contributed to by the remaining qualities.

3.2.2 Influence of Roles and Beliefs on Participation.

The impact of personal beliefs on how individuals exercised their roles within the analysis also became quite evident through the project. In developing group artefacts there is an inherent aim to accommodate the views of all participants present. This accommodation creates a natural tension between group consensus and personal opinion. Participation in these social situations is based upon appreciative acts. Appreciative acts concern both judgements of reality (what is the case?) and judgements of value (is this acceptable or unacceptable?) [19]. These judgements cannot be ego-less and are intrinsically linked to the participant’s view of their role in the situation. There were several instances of roles and judgement shaping individual participation.

The belief that qualities can be hierarchically organised influenced the way in which the lead architect, then facilitator went about utilising the quality responses. Instead of tallying the votes, the facilitator decided to use the quality relationships to group responses in a bid to include a broader range of quality attributes rather than simply selecting the most popular. Quality attributes are a key concern of software architecture and the groupings attracted the attention of a member of the architecture team, who sought to change the end result of the exercise.

Similarly in building the utility tree, the lead designer raised issue with assumptions about the system creeping into scenarios. Being the designer, any aspects of design that crept into the development of artefacts would directly impact their work and potentially force decisions that they themselves were unwilling to make at that stage. On each of these occasions, the impact of group processes on personal roles prompted remedial action by a participant.

3.2.3 Negotiating of Meaning as Critical. Given the diversity of language and concepts discussed in section 3.2.1 it is not surprising that the negotiation of meaning was an important theme throughout the research. Open dialogue helped surface assumptions and grow each
3.3 ‘Systems dimension’ to complexity

Whilst the initial focus of the research was the effect of the people dimension on complexity, there was commonly found to be contributing factors from the systems dimension. Be it due to the intractable nature of design, the conceptual nature of the system at such an early stage of design or the various ways a system can be decomposed, it became apparent that behind most people problems, complex systems aspects could be seen to be co-incident.

3.3.1 Concomitant nature of the problem and solution. One of the most prominent aspects of systems complexity in the ATAM proved to be the relationship between the business-strategic and system requirements perspectives. Exploration of either perspective seemed to require knowledge from the other in order to understand it. For example considerations of the impact of specific quality requirements on a system commonly reverberated back to considerations at the business strategic level.

Similarly in attempting to resolve answers to questions at a business strategic level, knowledge of the capability of the system was often sought. The problem and solution appear to evolve together and become concomitant. In software design the learning loop is perceived as taking place between the requirements and the design artefacts [20]. While this is indeed necessary and true, experience here has shown that the requirements embody an approach that attempts to resolve a business need for the client. Therefore the loop of learning between the original motivating problem and the approach lies as much between the aspirations of the client and the driving requirements of the system as it does between requirements and design activities. Potentially it is even more critical at this stage since the loop of learning bridges world views as well as from problem to solution (as section 3.2.1 attests).

3.3.2 Divergent nature of understanding. The difficulty in reconciling these viewpoints lies in developing a complete understanding of them. The search for solutions cannot be exhaustive due to sheer number of permutations in complex systems [21]. Experience from a goal-based requirements (GBR) workshop to bridge the business strategic perspective and systems quality perspectives helped highlight this aspect of complexity. Several graphs of up to eighty nodes were produced, which only represented the higher level considerations.

3.3.3 Difficulty developing usage aspects. Another of the consistent difficulties in attempting to communicate aspects of the solution or problem was the elusive nature of use, or how the system would be used. Early on in the design lifecycle the system architecture is incomplete, hindering attempts at understanding the potential usage aspects of the system [22]. Even in the event that a complete functional structure was to be available there is still some doubt as to whether this adequately reveals the context of use [23].

Additionally no real precedent for such a telecommunications system existed. Therefore notions of use which would develop from detailed system knowledge were unclear. In their place abstractions of use, in this case the operational aspects, or operational specifications, were put forward. The problem with operational specifications like those so commonly used in telecommunications is that they are solution agnostic. They specify what has to be done but don’t give clarity on how it should be achieved. A task like the ATAM really requires the structural detail behind how things are achieved to understand the quality ramifications. Two systems could quite readily exhibit the same operational characteristics but have two entirely different systems (structurally, architecturally) implementing them.

Further obstructing the understanding of usage was an expectation of innovation. The project has been conceived with the intention that the NGN management framework would supersede existing management practises. As such traditions and experience became largely invalid because they were perceived as coming encumbered with the past mistakes.

3.3.4 Environmental Turmoil. Complicating matters was the speed with which important environmental influences could change. Telecommunications is an rapidly evolving industry where technology and carrier behaviour is constantly changing. From within the organisation there were multiple company acquisitions and new patents brought to the design situation. The social, political and technological forces influencing the project made it
difficult to stabilise the linkage partner’s position, exacerbating the difficulty understanding the strategic and system quality associations.

4. Impact of situational complexity for the ATAM process

4.1 Disconnect between the business strategic and systems quality perspectives

Where aspects of systems and people complexity discussed in section 3 are coincident upon a process it is understandable they would affect the conduct and outcomes. Perhaps the most enduring of these affects was the difficulty to associate and understand the business strategic and systems quality perspectives. The relationship and understanding between these perspectives is fundamental to the aims of what the ATAM is designed to achieve. [4].

The ATAM literature offers a fairly close relationship between these two informational elements, in many instances proposing what are more commonly recognised as quality attributes, as business drivers. “For example, in an e-commerce system two of the business drivers might be stated as: “security is central….and modifiability is central to the success of the system...”” [13]. Contrary to these examples, the earlier discussion of the ‘people dimension’ to complexity established these as two different perspectives (world views). Importantly the actors aligned with these perspectives are likely to use significantly different language and concepts to express the driving system need. The diversity of these viewpoints caused difficulty for the ATAM in two main ways. The first was in understanding and utilising the responses. The second was building the business goal to system quality relationships necessary for constructing the utility tree.

4.2 Common understanding of quality viewpoint

The ATAM literature states the potential mismatch in communications resulting from the business owner and designers having to communicate through an intermediary in the form of a facilitator [9]. When confronted by the relatively unique quality terms of the linkage (industry) partner the facilitator sought to interpret them in more popular systems quality terms. The perspective was an important one, yet was unlikely to receive much representation in the process while it differed so significantly from the broader group. The experience affirmed the legitimacy of the systems quality perspective and the alignment of the facilitator’s world view with it. Furthermore, as participants showed significant interest in each other’s qualities when they were tabled.

4.3 Disjoint between systems quality and business drivers

4.3.1 Assumptions in bridging perspectives exemplified by Quality of Experience. While the systems quality and business strategic perspectives proved to be
quite different, the utility tree requires causal attributes be made between them in order to focus the analysis. Characterisations could be attempted in order to draw relationships between the business and quality viewpoints. However assumptions generally have to be made in order to do so. For example in the NGN solution space, systems commonly refer to the need for high levels of throughput and performance to ensure customer satisfaction [25]. Yet there are no guarantees that a performing system will be the determining factor in the customer’s view of the service. The customer may be happier with a low performing cheaper service, or a service delivery method that does not have any real-time implications. The concept of Quality of Experience (QoE) acknowledges that the customer does not just use technology but lives with it [26]. Consequently quality aspects associated with the usage perspective partially influence, but aren’t solely responsible for the customer perception [27]. Care needs to be taken in testing the assumptions behind framing the problem in a particular way [2], which is effectively what these characterisations are inviting participants to do. Viewing the customer satisfaction as largely a network performance issue narrows out of view other contributing factors to customer experience like ubiquity, cost, cultural appeal, etc [28].

4.3.2 Exhaustive Understanding of Requirements is Infeasible. Attempts at understanding the relationship between the systems quality perspective and business strategic perspective are complicated by the concomitant nature of understanding between them. Section 3.3.1 outlined how understanding of the business and technical solutions were dependant upon one another. Seeking to resolve the problem by reaching an exhaustive understanding of either perspective is likely to be infeasible given the combinatorically explosive nature of search through the solution space [21], exemplifying the divergent nature of real world situations [2]. Modelling the customer goals highlighted this divergence showing that quality attributes were implicit in some of the goals but their subsequent refinement provided no guarantees of yielding explicit quality attributes akin to those commonly found in software architecture literature. Furthermore the depth of reasoning (some 6-8 layers of hierarchy) highlighted how much refinement logic was internalised by the goal to quality associations.

4.3.3 Analysing against systems quality does not necessarily ensure customer satisfaction. The extent and complexity of the strategic viewpoint and the problematic nature of characterising goals as system qualities calls into question whether the system as judged from the quality viewpoint, satisfies the business strategic goals. From the experience of this research, this is largely not the case. Although the ATAM addresses important quality concerns there is no certainty these concerns ensure the satisfaction of the customer’s business objectives or allays their greatest worries. The lack of certainty affect’s the confidence of the group when deriving the attribute utility tree, which is effectively the centrepiece of the analysis. When faced with a utility tree devoid of business context, the participants sought to elaborate the utility tree with aspects of the business drivers. On reconciling the business and systems quality aspects, apprehensions were expressed as to the rigour of the relationship. The associations were re-analysed and changed according to the new consensus. The ready acceptance of change highlighted how unconvincing the original relationship was in that the group was comfortably able to reason through many changes.

5. ATAM and the design lifecycle

5.1 Design stages and their affect on the ATAM process

The previous sections presented the elements of situational complexity found to affect the ATAM and discussed the consequences for the process. The exercises that contributed to this learning all occurred across a significant time frame of the project. This granted insight into the use of ATAM both early on and throughout the design lifecycle. The following reflects learning on the relationship between ATAM and the design lifecycle.

Early in the design lifecycle quality requirements generally represented broader issues within the business drivers. The dependency of the system qualities on the business objectives saw a strong focus on clarifying the customer goals. The rationale for these goals appeared to be most strongly influenced by the external environment of the business. The constant pace of technological change and the ability for systems to define market capability continuously challenge the business to redefine itself in line with its environment[29]. These environmental factors, as well as scarring past experience are largely what the customer brings to the design situation [21]. Additionally the personal perspectives of the stakeholders ensure there is any number of views of the situation early on. At this stage in design the stakeholders are largely conceptually isolated and the focus of early activity is on negotiating meaning.

Once meaning has been negotiated the group can meaningfully discuss the quality aspects of the system in a bid to move from the business strategic to more systems design considerations. Personal meaning starts to become associated with group beliefs as negotiated artefacts are developed in group situations. Although in this design situation showed these beliefs were still confused by the lack of clarity surrounding the shape of the system design and its usage context. Importantly this experience only braces the early conceptual stage of design and successful ATAMs recounted within existing case reporting indicate
that once the design is of sufficient maturity, usage concepts become embodied along with detailed behavioural understanding of the system [30]. The detail of the design helps reveal usage aspects and focuses the group on technical challenges, testing against what are considered to be fixed notions of strategic direction.

Figure 3 attempts to depict the progression of the design and the associated characteristics of analysis situation. Boehm’s spiral model [31] is used as its overlay to indicate the early stages of design close to the origin and the later stages of design towards to the outer layers.

![Figure 3 - Stages of design and its influence on group process](image)

Evidenced by the experiences throughout this project as depicted in Figure 3, the use of ATAM early on is problematic for several reasons. The first is that the ATAM does not focus on making sense of the business strategic viewpoint. Rather it is more focused on using it to develop a list of business drivers. However there are business problems to be solved as much as there are technical ones. Secondly it seeks to move quickly from the business strategic viewpoint into the systems quality one, which is actually a significant evolution in design terms. Lastly emanating from the quick progression from the business perspective to the quality one, there is an assumption of group understanding. The difficulty is that this has neither been given the open forums in which it needs to develop, nor the structure of detailed artefacts upon which it is commonly built.

The ATAM relies on well reasoned and stable understanding of the business strategic needs. Problematically these needs are exposed to the constant turmoil of the external environment and tend to develop in concert with, rather than well ahead of the system design. Ideally the concomitant nature of the problem and the solution supports the need to deal with both at the same time. An approach that could potentially permit analysis at an early stage is to tailor the process according to the stage of the design. Figure 3 conveys the idea there are different needs at different times in the design lifecycle. Initially the problem focus is strategic; the strongest influences are previous system failures and changes in the business environment; meaning within the group is largely experience/belief-based and personal; and the system is represented by abstract artefacts such as goals and broad operational concepts.

Dealing with modelling the system goals exhibited very similar traits to system qualities, in that they were generally abstract, needed refinement to be properly understood and exhibited interdependencies, akin to design trade-offs. These similarities imply the potential for an early ATAM exercise focused on the use of goal-level artefacts to establish the consequences between different strategic approaches. This would yield significant knowledge on business strategic issues permitting the customer stakeholder sufficient, rather than partial representation in the process. It also helps model the customer problems that tend to consistently upset the technical design process. The knowledge in this area could then be used to feed into the more technically focused ATAMs once the system has developed significant maturity, which sees the design stakeholders as receiving sufficient representation. Separating these two types of analysis allows the customer to analyse business issues with the same rigour that systems analysis covers design issues. The outcomes of the business focused analysis would help provide a firm basis upon which to build the quality requirements for the systems analysis. The business analysis also provides a rigorous mechanism to confront the constant change in the external environment, rather than continuously exposing the system design to the business uncertainty.

5.2 The importance of ‘content’ versus ‘process’

In addition to the need to consider two different but inter-related types of analysis during the design lifecycle, there also needs to be a greater consideration for what analysis activities are achieving. In looking at design methodology Dorst noted that although most methodologies were specified in terms of processes, it was largely the “content” of the design situation that dictated the designer’s actions. “In most cases, considerations linked to the content of the design situation (the perceived design problem, the designer's goals and the perceived possibilities for the next step) will determine the 'kind of action' (process-component)” [32].

It is therefore not surprising that the reality of systematic design conflicts with the way in which it is prescribed [21]. Similarly the ATAM concentrates heavily on the process itself at the expense of the content issues, which can significantly affect an analysis. For example is the goal of the presentation of the business context just that? Or is it to reach agreement and understanding within the group of the
strategic issues influencing the system development and to carefully derive a set of system characteristics that can be seen to satisfy the strategic needs. Not forgetting of course there are multiple perspectives here. Do the designers have few expectations of the business context presentation and participate simply as a passive audience? Or do they expect a comprehensive presentation of issues availed to them through their interaction with the client, which they can rigorously question and seek to understand in a detailed way?

Where the reality of the activities does not fulfil the expectations of a stakeholder, there is little guidance for how resolution may occur. In this project improvisation took the form of glossaries, elicitation of meaning where it was not required, goal-quality matrixes and extensive elicitation of goal artefacts, amongst other things. Although explicit methods were used here to explore the improvisation there is a distinct danger that in commercial settings, with greater time pressures, where the facilitator would feel pressured to maintain in “control” of the exercise, the improvisation may well take the form of internal judgement and assumption. The danger of which is a self-sealing process [33], whereby the internal assumptions of the participants are not tested and any incidents that lurch towards difficulties in understanding are avoided lest they hamstring the entire process. However it must be acknowledged that this research can only point to the potential for this to occur due to the experience in the linkage project.

6. Conclusion

The ATAM represents a significant evolution for architecture-based analysis techniques. In place of masking the analysis process in the problematic scoring and manipulation of figures with a perceived end of candidate selection, the ATAM has taken responsibility for assisting understanding throughout design. The inclusive nature of the process also ensures that communication amongst the stakeholder community is enhanced. However as discussed in this paper the inclusive nature of the process and the conceptual nature of architectures challenges the evolved methods, particularly early on in the conceptual stages of design. The resultant situational complexity impedes some of the key objectives that the ATAM seeks to achieve, such as improved communication and a relationship between systems quality and stakeholder goals.

The impacts on the process can be seen to arise from the structure and perspective of the ATAM and notably extend well beyond the scope of facilitation. The process itself needs to adapt in order to provide the social framework in which the negotiation of meaning and objectives takes place. Currently the diversity of viewpoints are more likely to smooth over diversity than to openly encourage it into the process. However the uncertainty the richness of such diversity was found to impact on the design task which struggles to progress when exposed to constant change.

Consequently two streams of analysis have been proposed as a means of isolating the design perspective from the constant change of the business strategic environment. Further enhancement is also proposed through a greater focus on the content aspects of the system, which will drive participation from within the analysis aside from the external structure of the process imposed from outside it.

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8. References

6. Colquitt, D. The case for understanding social complexity in the architecture-based analysis process. in Qualitative Research in IT & IT in Qualitative Research. 2004, Griffith University: Griffiths University.


