TOWARDS A CAPABILITY PLANNING/DESIGN METHODOLOGY FOR ENTERPRISES HANDLING ANTHROPOGENIC HAZARDS

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ABSTRACT

Anthropogenic hazards can be defined as human intent, negligence or error leading to threatening situations or the failure of a man-made system. There are a range of challenges, such as under-development, unemployment and poverty as well as the threat of pandemics that leads to an increase in anthropogenic hazards. Due to this increased frequency, complexity and severity, the management of these hazards is becoming increasingly important.

This paper aims to provide a rationale and set a research agenda for the development of the capability to handle anthropogenic hazards. Existing capability development models are investigated that may contribute towards the research agenda. The complex nonlinear dynamic nature of capability development and the complexities involved in developing capabilities across organisational boundaries must be addressed.

1 INTRODUCTION

Anthropogenic hazards can be defined as human intent, negligence or error leading to threatening situations or the failure of a man-made system. Across the world millions of people are impacted by anthropogenic hazards. There are various factors that lead to these hazards such as poverty leading to crime or poor leadership leading to a revolution. There are a range of challenges, such as under-development, unemployment and poverty as well as the threat of pandemics that leads to an increase in anthropogenic hazards. Due to this increased frequency, complexity and severity, the management of these hazards is becoming increasingly important. In South Africa one of the largest threats to the community is the high levels of crime. During 2010/2011 a total of approximately 2,1 million serious crime cases were registered in the RSA [2]. "Every day, around 50 murders, 100 rapes, 700 burglaries and 500-plus violent assaults are officially recorded in a population of 50m"[1]. Although several factors contribute to the dire statistics, this paper aims to inquire about the role that capability planning and design could play to reduce the effects of anthropogenic hazards. More specifically, we would like to explore the development of a capability planning and design methodology for the South African Police Service to reduce crime or its effects. In defining capability, the Australian DOD states that: "Capability is the power to achieve a desired operational effect in a nominated environment, within a specified time, and to sustain that effect for a designated period. Capability is generated by fundamental inputs to capability comprising organisation, personnel, collective training, major systems, supplies, facilities, support, command and management."[10]

In section 2 we discuss the research agenda, followed by a literature study in section 3. We conclude in section 4.

2 SETTING A RESEARCH AGENDA

Although capability planning exists as a discipline, no methodology exists to address the coherent and consistent planning and design of the extended enterprise in attending to anthropogenic hazards. For reference purposes, we will refer to the *extended enterprise that attends to anthropogenic hazards*, as the enterprise of interest (EOI). The complex nonlinear dynamic nature of capability development and the complexities involved in developing capabilities across enterprise boundaries must be addressed for the EOI.
Capability based planning rooted in systems engineering, provides one input in developing defence capabilities. Therefore, we investigate systems engineering principles and its application on capability development in Section 3.1.2. Other existing capability development approaches may also contribute to the aim of this paper and are discussed in Section 3.1.3. This paper does not intend to cover all possible trends in literature, but highlights the initial focus of this study. Other disciplines, such as enterprise governance, enterprise engineering and organisation design could also contribute towards the development of a suitable methodology for the EOI and will be explored at a later stage

This paper attempts to answer the following questions by referring to existing literature:

1. How can existing capability development frameworks contribute to the capability planning/design methodology for the EOI?
2. How can systems engineering principles contribute to the development of capabilities for the EOI?
3. What are the inherit complexities associated with capability development?
4. What research approach should be followed to develop the capability planning/design methodology for the EOI?

3 LITERATURE STUDY

3.1 Capability development

3.1.1 Capability based planning

Capability based planning (CBP) replaced the traditional method of threat based planning in the military. CBP attempts to break down traditional organisational boundaries to provide transparency and unity [13].Walker [17] explains: “The concept of CBP recognises the interdependence of systems (including material and people), doctrine, organisation and support in delivering defence capability, and the need to be able to examine options and trade-offs among these capability elements in terms of performance, cost and risk so as to identify optimum force development investments. CBP relies on scenarios to provide the context against which to measure the level of capability.” Taylor [13] explains that CBP has several building blocks. It has high level capability objectives derived from government guidance. Secondly it considers the way in which the force will fight which is generally governed by some operational concept or top-level doctrine. The third building block consists of standard groupings, also called capability clusters to help manage the process. Fourthly, the rest of the capabilities are realised within available resources. Taylor [13] further explains that CBP is “concept led”. Capabilities are developed according to an operational concept which refers to how a force plans to operate in the future and includes strategic, operational and tactical level employment concepts. Figure 1 depicts the generic process chart of CBP.

According to Oosthuizen and Smith [9] capability attributes and capability elements were defined as two dimensions to military capabilities by the South African National Defence Force. The attributes are defined in functional terms and relates to what the capability must be able to do. The elements are the essential components of the capability and describe what the capability consists of [9]. These elements are known as the POSTEDFIT capability elements and are listed by Oosthuizen and Smith [9] as:

- Personnel: The required characteristics of the necessary human resources
- Organisation: Related command and control characteristics of mission task forces
- Sustainment: The required characteristics of the logistics, personnel and financial support
- Training: The required characteristics of the training to prepare human resources
- Equipment: The type, quantity and the required characteristics of the defence equipment
- Doctrine: The required characteristics of the doctrine, aids, operating procedures etc.
- Facilities: The required characteristics of the military facilities
- Information: The required characteristics defence intelligence, information and data
- Technology: The required characteristics of commercial and/or military technologies

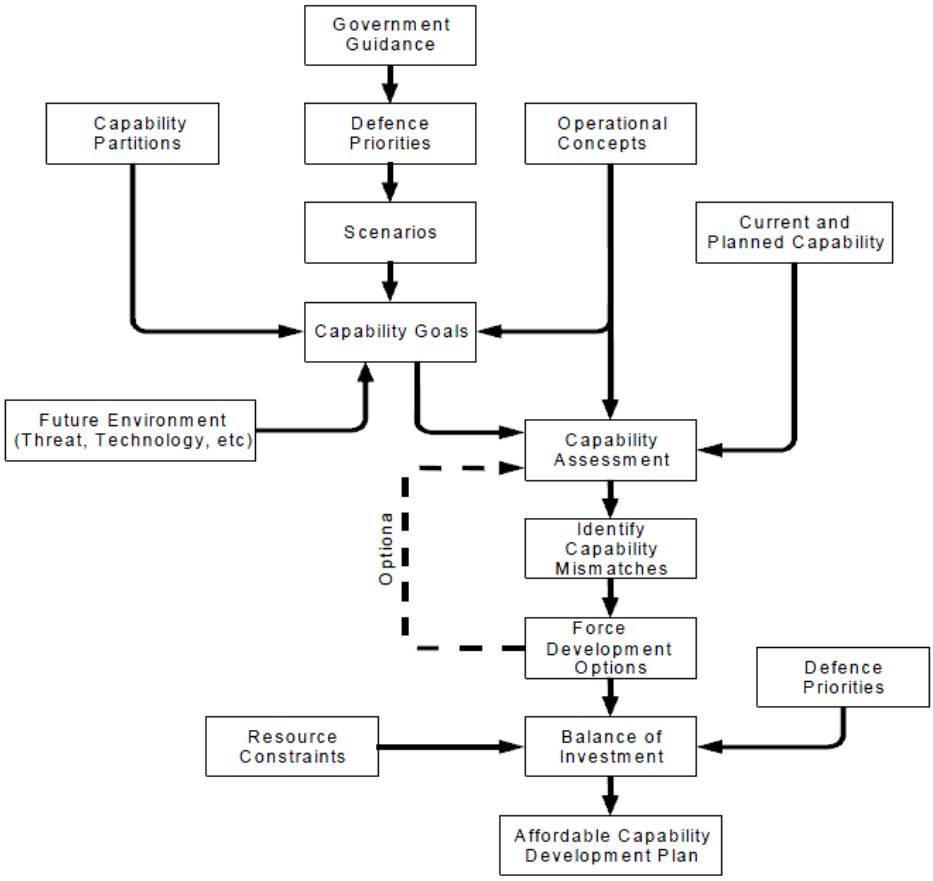


Figure 1: Generic Process Chart of Capability-Based Planning [13]

3.1.2 Current systems engineering practices used for capabilities based planning

Although rarely applied systems thinking certainly addresses the product of systems engineering [5]. Systems thinking considers the cause, effect and behaviour of systems, the models and simulations attempt to represent the behaviour of the system instead of the complex system itself [4]. Systems impact each other, and the behaviour or the response of the systems to this impact, is the effect or stimulus-response. So behaviour is a cause and effect phenomenon. According to Hitchins [5] behaviour will be conditional for nonlinear dynamic systems and it may not be repeatable. He further argues that one is able to address complex issues using minimalist models when working with system behaviour instead of attempting to represent complete, complex systems. Hitchins [5] states that systems thinking addresses the nonlinear dynamic systems of the world around us. According to him systems engineering is a set of processes conducted largely by people, who form a sociotechnical group together with their facilities. Due the non linear dynamic state of this sociotechnical group and the inevitable feedback and constraints, the systems engineering process can be considered to be non linear dynamic too. An eight-layered systems hierarchy depicted in Figure 2 is used by the Department of Defence to facilitate the definition of system requirements and the acquisition of systems [9]. As can be seen from Figure 2, the system hierarchy is a combination of technical and social elements; level 6 in the hierarchy represents the instance where the technical system is converted into a user system where processes are conducted largely by people. Level 6 is also the first instance where the POSTEDFIT view exists [9]

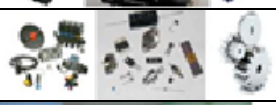
System	Level	Explanation
Operational Force	8	
Combat Grouping	7	
User System	6	
Products System	5	
Product	4	
Product Sub System	3	
Components	2	
Materials/Processes	1	

Figure 2: SANDF System Hierarchy [9]

CBP may be a useful framework and may provide some insight towards the development of a capability planning/design methodology for the EOI, but the implementation of CBP is not without challenges. According to Taylor [13] pluralism among defence interests and the number of stakeholders increases the complexity of implementing CBP. Oosthuizen and Smith [9] also accentuate the difficulty to implement CBP due to a *lack of directives and guidance*. Other challenges include [9]:

- Departmental interactions are not clearly defined
- Areas such as jointness, interoperability and flexibility lack focus
- Capability Based Planning is difficult to understand and overly complex

These challenges may also manifest when attempting to use the framework to derive a capability planning/design methodology for the EOI. The application of systems engineering to CBP also provides some insight on how systems engineering can be used for the purpose of developing a capability planning/design methodology for the EOI. CBP may not be the only framework to provide insight and due to the overall complexity associated with it, it may be useful to investigate other methods for capability development as well. The next section will elaborate on how enterprises develop capabilities for a competitive advantage.

3.1.3 Other capability development approaches

Montealegre [8] defines capability as the firm's ability to integrate, build and reconfigure internal and external assets and competencies to perform distinctive activities. According to him, enterprises traditionally take two approaches to capability development namely the resource-based approach and, more recently, the dynamic capabilities approach. The resource-based approach focuses on what resources are selected and how these resources are selected and deployed to develop and implement the strategies of the firm [12]. Montealegre [8] argues that the resource based approach lacks the ability to look beyond the properties of resources and resource markets and it is unable to explain enduring firm heterogeneity. It is also limited to relatively stable environments [7]. The dynamic

capabilities approach however explains how capabilities can be developed to adapt and even capitalize on rapidly changing technological environments and is an extension of the resource-based approach [13]. According to Montealegre [8], the dynamic capabilities approach accentuates the role of strategic management in adapting, integrating, and reconfiguring the organisational skills, resources and functional competencies both internally and externally within a changing environment. Various models have been proposed that assist in building resources and capability over time, but they all follow a factor-oriented, or variance theory approach [8]. Process theories are however necessary to explain the sequence of activities and to aid in successful implementation. Montealegre [8] developed the first process model for capability development and he validated the model by implementing it in the electronic commerce industry. Figure 3 illustrates the process model for capability development.

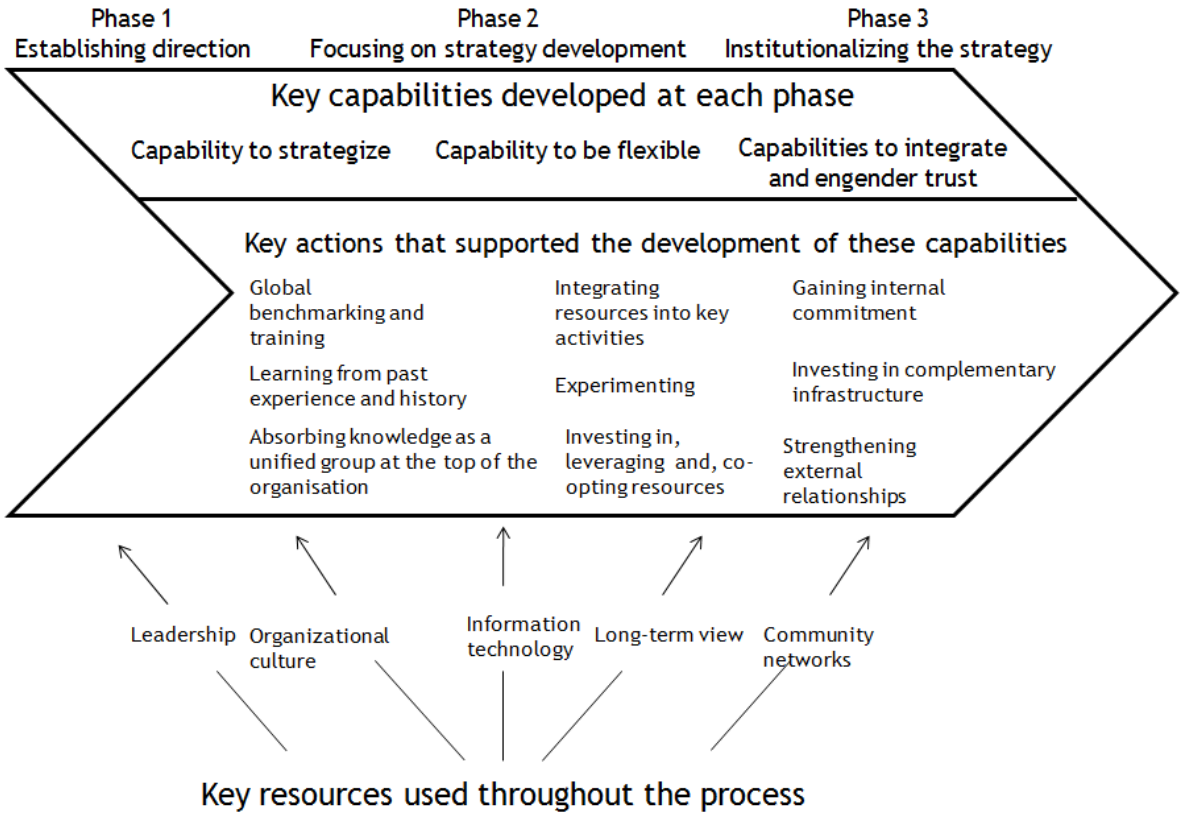


Figure 3: A grounded model of capability development [7]

This process model may also contribute to the methodology proposed in this paper. However, managing hazards caused by human intent provides their own set of unique challenges that may not be present in profit-driven enterprises. In the subsequent section, we define the concept of a "methodology" and introduce a new research approach that may be useful in developing the proposed capability planning/design methodology.

3.2 Research Approach

The challenges associated with the implementation of capability development demands a systematic approach with sufficient detail. Those involved in the implementation must be guided with clear directives. According to Estefan [4] a methodology can be seen as a recipe and is defined as a set of related processes, methods and tools. Processes provide the information on "what" must be done, methods define the "how" of each task and tools are instruments that facilitate the accomplishment of each "how". Another important contributing factor is the environment in which the methodology must be executed. Estefan [4] provides the following definition for the environment: The environment consists of the

surroundings, external objects, conditions or factors that influence the behaviour of an object, individual person or a group. These can include social, personal, cultural, physical, organizational and functional conditions that must work together to support and enable the "what" and the 'how". A methodology encompasses enough detail to provide clear and specific details on what must be done, how it must be done and with what it can be done in the context of the environment where it must be done.

The design of such a methodology requires knowledge and understanding of the existing theory and the specific problem context. A recent trend in literature is design research defined by Kuechler & Vaishnavi [6] as a method for investigation. Design research aims to create "solutions to specific classes of relevant problems by using a rigorous construction and evaluation process" [18]. Design research was originally developed within the Information Systems discipline. According to Romme [11] and Van Aken [16] design research may also contribute to organisational theory development and improvement of professional practice. The current focus of design research is on the creation of low level artefacts (IT mechanisms), but Keuchler & Vaishnavi [6] is in favour of a broader scope. Figure 4 demonstrates the cycle behind design research that begins with awareness of the problem as the first process step. The next step is to make suggestions from the existing knowledge/theory base of the problem area. During the development process step an artefact may be implemented according to the suggested solution. The implementation is then evaluated to ensure that all the requirements have been met. The development and evaluation step may lead to a re-visitation of the problem. Numerous iterations may be required before the design reaches the conclusion step.

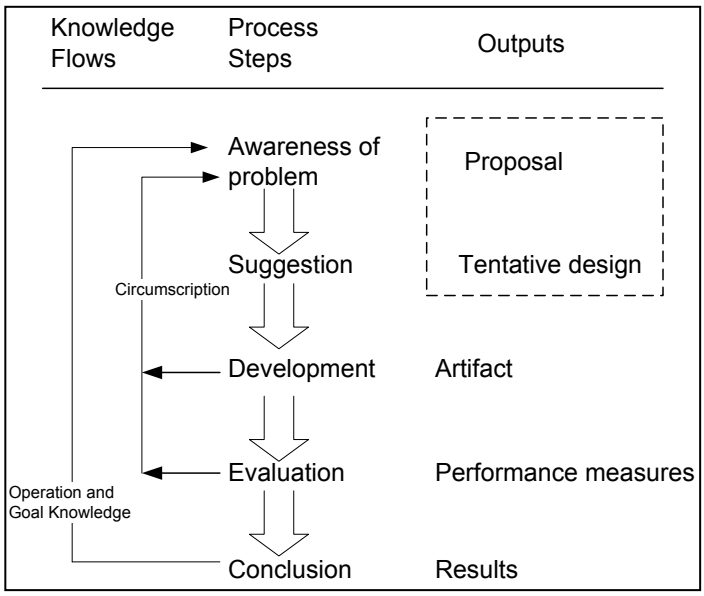


Figure 4: Reasoning in the design cycle [15]

Due to its iterative, incremental nature, accommodating learning through action, design research will be useful to assist in the design of a capability planning/design methodology as an artefact.

In this article, we have already started with the first two process steps of the design cycle, depicted in Figure 4 (see *awareness of problem* and *suggestion*). Figure 5 demonstrates a summary of *problems*, linked to *suggested* solutions. As this study is still in an exploratory stage, the suggestions are not comprehensive and will be extended as we learn through the process of developing the methodology artefact. Figure 5 (gray-shadowed) also indicates possible areas that may contribute towards the development of the methodology at a later

stage. Although we have made some suggestions, we have not defined a tentative design yet, which is usually required as output for the suggestion step (see Figure 4, *tentative design* output).

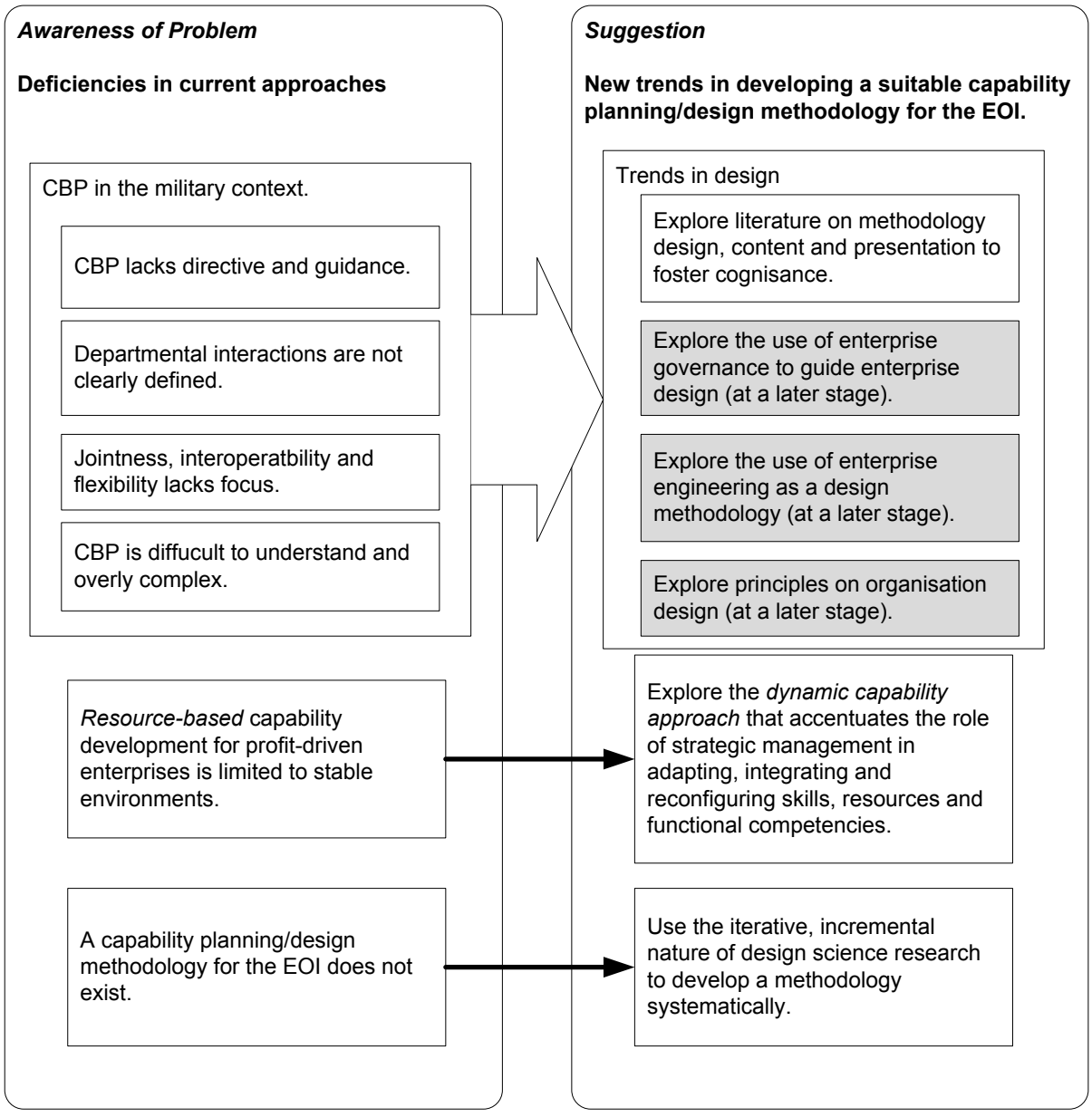


Figure 5: Mapping problems to suggestions

4 CONCLUSION

This paper aims to provide a rationale and set a research agenda for the development of a capability planning/design methodology for the EOI. Existing capability development models are investigated that may contribute towards the research agenda. The complex nonlinear dynamic nature of capability development and the complexities involved in developing capabilities across enterprise boundaries is discussed. Capability based planning rooted in systems engineering provides a framework for the development of defence capabilities. CBP provides useful information that may be relevant for the development of the capability to handle anthropogenic hazards. The process model for capability development designed by Montealegre [8] may also be investigated further. To reduce design and implementation complexity, and facilitate incremental learning by doing, it is suggested that design research is used to facilitate the design of a capability development methodology to for the EOI.

As this study is still in an exploratory stage, this paper only addressed the first two steps of the design research cycle, i.e. *problem awareness* and *suggestions*. Further exploration is required prior to the formulation of a tentative design for the capability planning/design methodology artefact.

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