

On the Use of a System Need Statement in Functional Decomposition

Michael Ryan

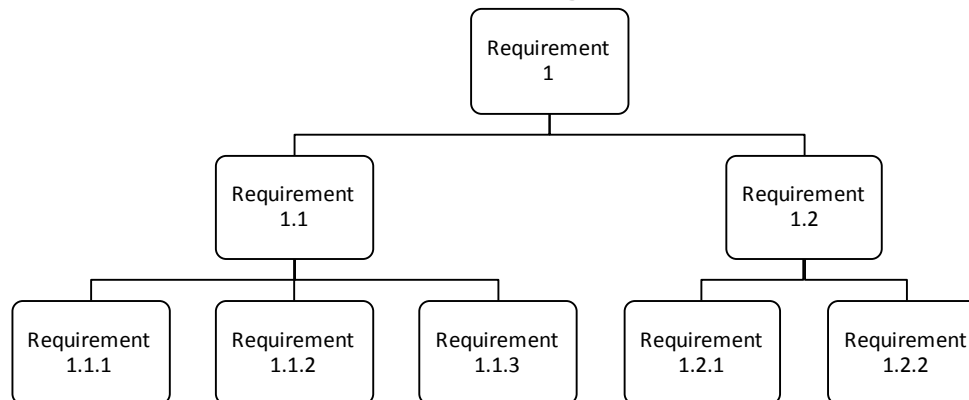
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System Functional Hierarchy

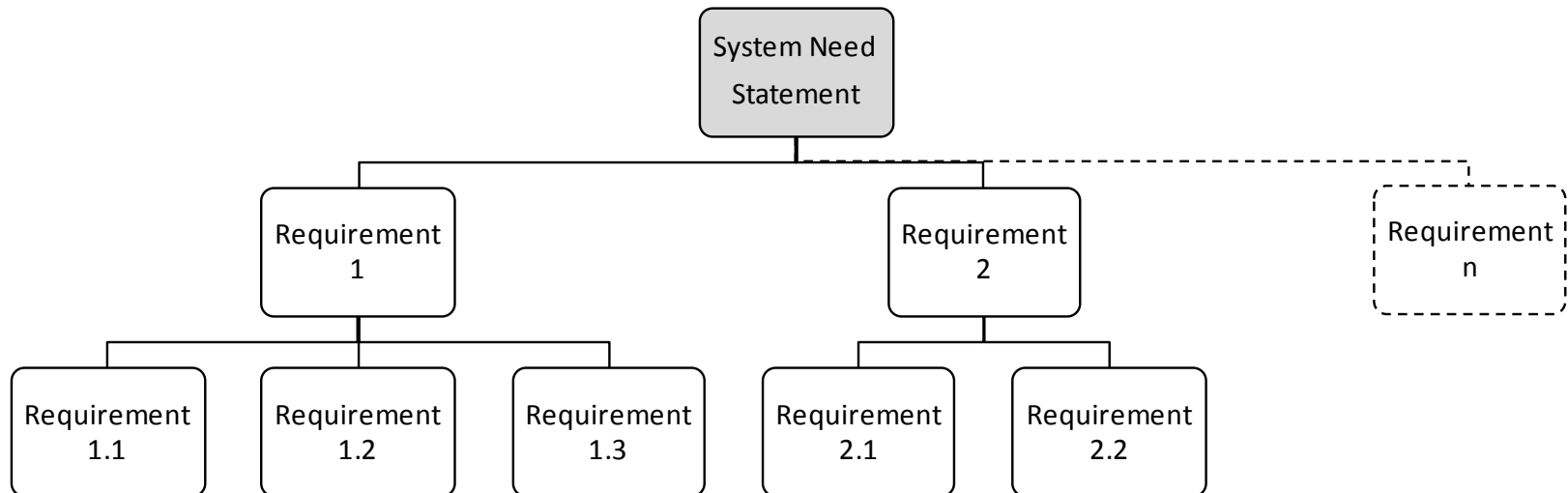


- For well-behaved systems, requirements in System and Subsystem Specifications are normally grouped in a hierarchical fashion:
 - Through *forward traceability*, design decisions can be traced from any given system-level requirement (a parent requirement) down to a detailed design decision (a child requirement).
 - Similarly, through *backward traceability*, any individual design decision (any child) must be able to be justified by being associated with at least one higher-level requirement (a parent).



Ultimate System Requirement

- Backwards traceability from children to parent requirements leads to a useful observation that there is a single parent statement which serves as the highest-level requirement statement back to which all subsequent requirement statements should be able to be traced.



Functional Decomposition



- Functional decomposition is a useful tool in developing system requirements, particularly where the desired end result is a system functional hierarchy.
- When decomposition begins with stakeholder requirements documents, however, the resultant system requirements tend to take on the structure of the parent documents.
- Unless the stakeholder documents are themselves hierarchically organized, the decomposed requirements must then be regrouped into an appropriate system functional hierarchy.

Functional Decomposition



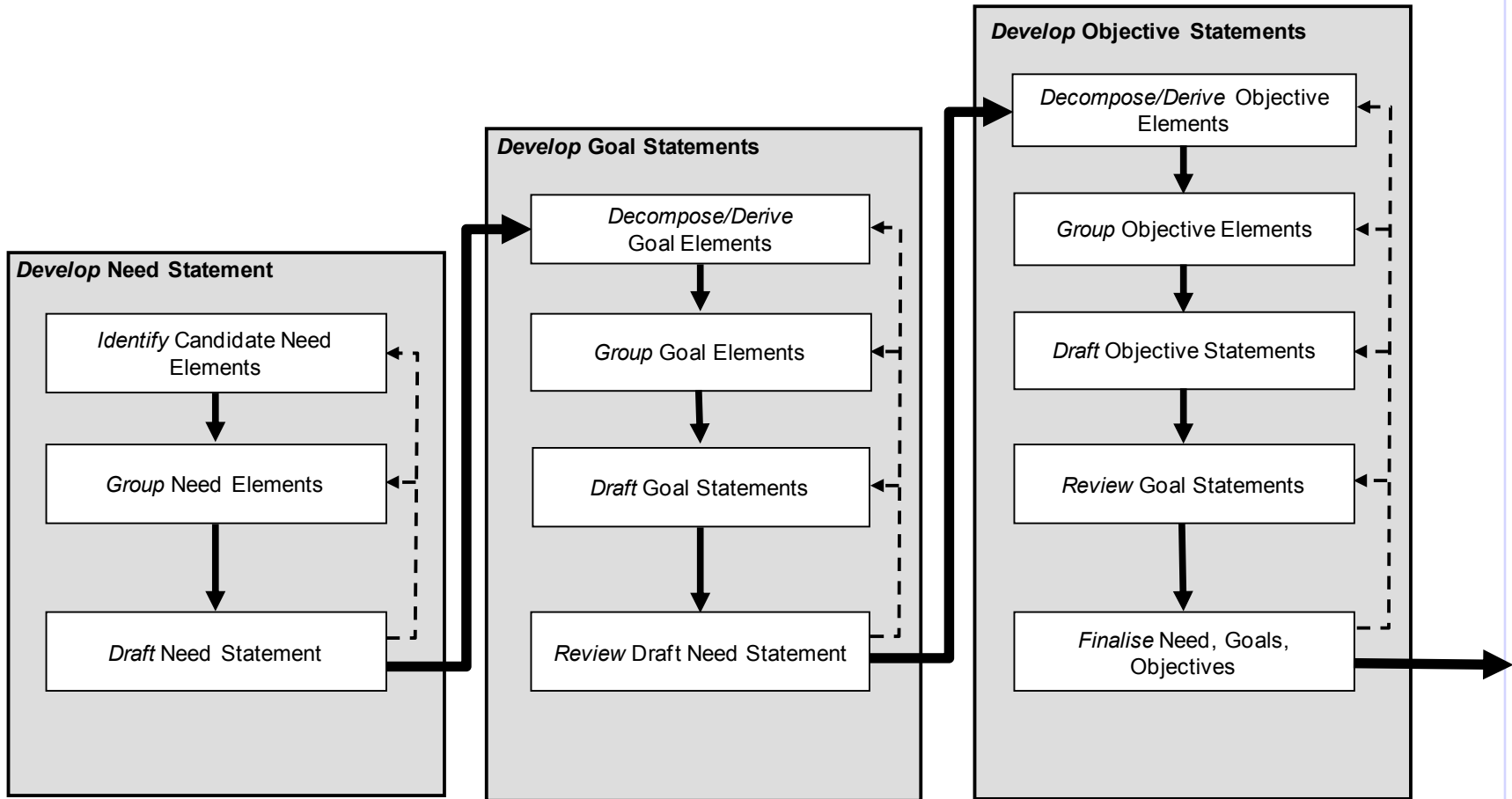
- Since functional decomposition (and derivation) requires a start point, the direct development by decomposition of a cohesive system functional hierarchy requires a single, system-level start point.
- This paper proposes an iterative process for the development of a system need statement and its formal decomposition into goals and objectives (and subsequently into system requirements in a functional hierarchy).

Functional Decomposition



- The development of a functional hierarchy helps formalise the output of the technical process of Stakeholder Requirements Definition and serves as a useful start point for the process of Requirements Analysis.
- The functional hierarchy therefore also provides a useful structure for both the Stakeholder Requirements Specification and the System Requirements Specification.

Development of Need, Goals & Objectives

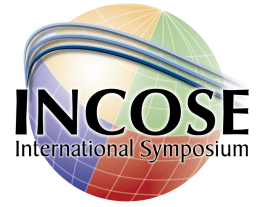


- ACME Medical Services has just acquired a vacant block of land (the old Canberra Hotel location) at the edge of a major suburban shopping centres in Canberra's with the intention of developing a medical centre called "One-stop Medical Centre". Ample car parking for patients is available around the shopping centre.
- ACME's business analysis has identified a profitable mix comprising a doctor's surgery (with three GPs), a dentist's surgery (two dentists and two assistants), a physiotherapy centre (three physios), and a pharmacy (one pharmacist and an assistant).

...

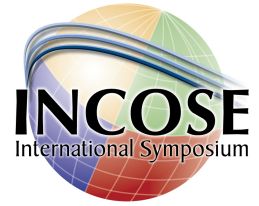
- ...
- ACME would like a centre that provides a comfortable (but not extravagant) environment for patients. Security is important as are the maintenance and logistics aspects of the centre, however, ACME are concerned that the operational aspects of the centre are not obvious to the patients and do not intrude on the centre.
- ACME is an employer with a strong record of caring for its employees. The accommodation for staff should be comfortable with provision of tearoom and restroom facilities separate from the patients. Private parking is not required for centre staff.

Identify Candidate Need Elements



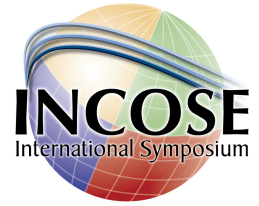
- redevelop the Canberra Hotel location
- build ACME Medical Centre
- provide GP services
- provide dental services
- provide physiotherapy services
- provide pharmacy services
- provide a secure environment
- provide a comfortable environment
- provide privacy
- to the local community

Group Need Elements



- NE1. redevelop Canberra Hotel location into ACME Medical Centre
 - redevelop the Canberra Hotel location
 - build ACME Medical Centre
- NE2. provide a selected range of medical services
 - provide GP services
 - provide dental services
 - provide physiotherapy services
 - provide pharmacy services
- NE3. provide a secure and comfortable environment
 - provide a secure environment
 - provide a comfortable environment
 - provide privacy

Draft Need Statement



- ... to redevelop the Canberra Hotel location into a medical centre (ACME Medical Centre) that provides a selected range of medical services in a secure and comfortable environment

are we sure of the range of medical services?

Add rationale: in order to ... ? (profitable?)

Draft Need Statement

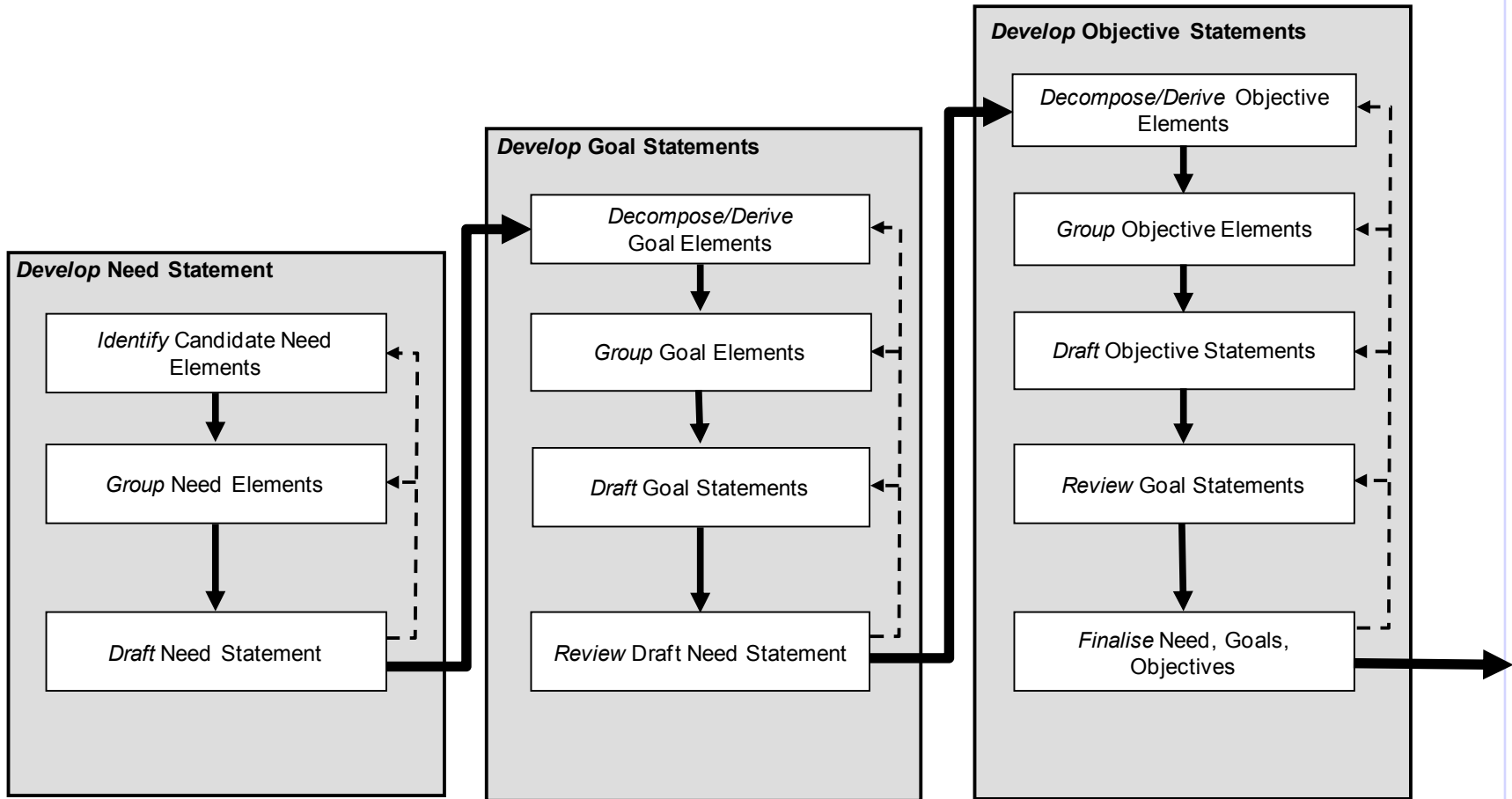


- ... to redevelop the Canberra Hotel location into ACME Medical Centre that provides a selected¹ range of Medical Services in a secure and comfortable environment, in order to attain a nominated Profit²

Notes:

1. Medical services to include doctor's surgery supporting three GPs, a dentist's surgery for two dentists and two dental assistants, a physiotherapy centre supporting three physios, and a pharmacy that provided a basic dispensing service provided by one pharmacist and an assistant.
2. Profit level of x% is to be attained within y years (confirm with business case).

Development of Need, Goals & Objectives



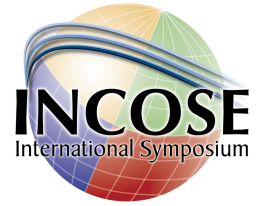
Decompose/Derive Goal Elements



... to **redevelop the Canberra Hotel location** into **ACME Medical Centre** that provides a **selected range of Medical Services** in a **secure** and **comfortable** environment, in order to attain a nominated **Profit**

- The following functions are *decomposed* from the need:
 - GE1. Redevelop the current site into the medical centre
 - GE2. Provide medical centre infrastructure
 - GE3. Provide selected range of medical services
 - GE4. Provide a secure environment
 - GE5. Provide a comfortable environment
 - GE6. Attain nominated profit level
- The following functions are *derived* from the need:
 - GE7. Manage medical centre and its services
 - GE8. Support medical services

Group Goal Elements



- 1. Provide Medical Centre
 - *GE1. Redevelop the current site into the medical centre*
 - *GE2. Provide medical centre infrastructure*
- 2. Deliver medical services
 - *GE3. Provide a selected range of medical services*
- 3. Manage Medical Centre
 - *GE7. Manage medical centre and its services*
- 4. Support Medical Centre
 - *GE8. Support medical services*
 - *GE4. Provide a secure environment*
 - *GE5. Provide a comfortable environment*
- 5. Attain nominated profit
 - *GE6. Attain nominated profit level*

Draft Goal Statements



- 1. Provide Medical Centre
 - to provide ACME Medical Centre on the Canberra Hotel location
- 2. Deliver medical services
 - to deliver selected medical services
- 3. Manage Medical Centre
 - to manage ACME Medical Centre
- 4. Support Medical Centre
 - to support ACME Medical Centre
- 5. Attain nominated profit
 - to attain $x\%$ annual profit within y years

Review Draft Need Statement



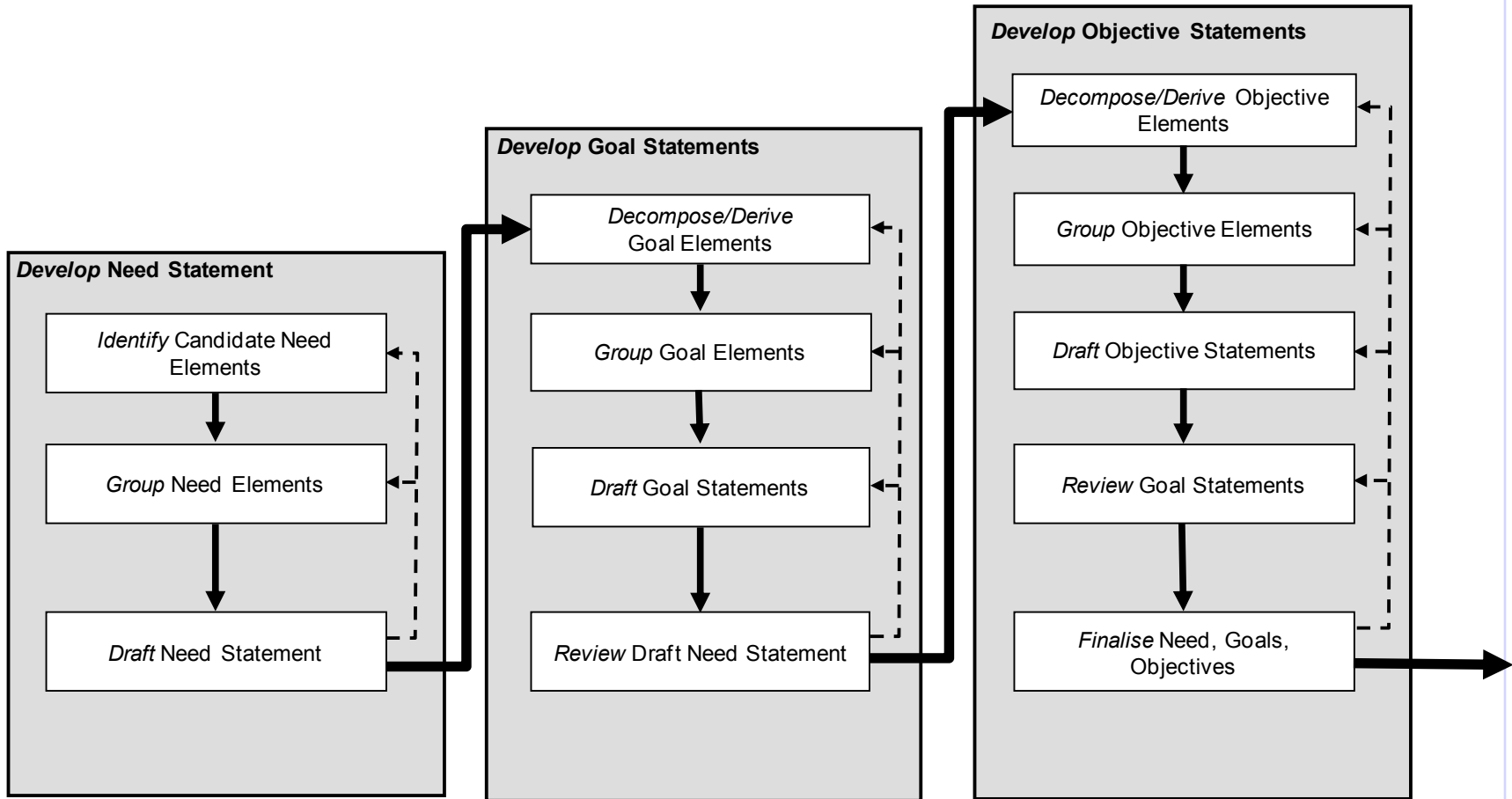
➤ We should now re-write the need so that all goals are explicit:

... to **provide ACME Medical Centre** on the Canberra Hotel location to **deliver Medical Services**¹, with appropriate **management** and **support**, in order to attain (a nominated **Profit**² level).

Notes:

1. Medical services to include doctor's surgery supporting three GPs, a dentist's surgery for two dentists and two dental assistants, a physiotherapy centre supporting three physios, and a pharmacy that provided a basic dispensing service provided by one pharmacist and an assistant.
2. Profit level of x% is to be attained within y years (confirm with business case).

Development of Need, Goals & Objectives



Decompose/derive Objective Elements (Goal 1)



1. Provide Medical Centre

- 1OE1 Engage building designer
- 1OE2 Conduct building design
- 1OE3 Approve building design
- 1OE4 Clean building site
- 1OE5 Acquire appropriate approvals
- 1OE6 Provide site security
- 1OE7 Engage building contractor
- 1OE8 Build Centre building
- ...
- ...
- 1OE9 Provide utilities interfaces
- 1OE10 Provide medical facilities
- 1OE11 Provide staff facilities
- 1OE12 Provide customer facilities
- 1OE13 Install medical equipment
- 1OE14 Install general equipment
-

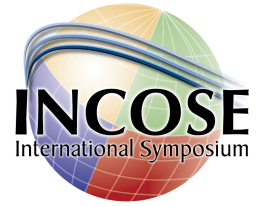
Group Objective Elements

(Goal 1: Provide Medical Centre)



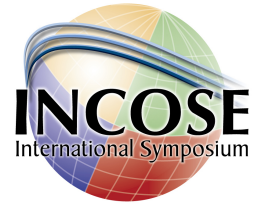
- 1.1 Design Medical Centre
 - 1OE1 Engage building designer
 - 1OE2 Conduct building design
 - 1OE3 Approve building design
- 1.2 Prepare for build
 - 1OE4 Clean building site
 - 1OE5 Acquire appropriate approvals
 - 1OE6 Provide site security
- 1.3 Build Medical Centre
 - 1OE7 Engage building contractor
 - 1OE8 Build Centre building
 - 1OE9 Provide utilities interfaces
- 1.4 Fit out building
 - 1OE10 Provide medical facilities
 - 1OE11 Provide staff facilities
 - 1OE12 Provide customer facilities
 - 1OE13 Install medical equipment
 - 1OE14 Install general equipment
- 1.5 Commission Medical Centre
 - ...

Goal 1. Provide Medical Centre



- 1.1 Design Medical Centre
 - 1.1.1 Engage building designer
 - 1.1.2 Conduct building design
 - 1.1.3 Approve building design
- 1.2 Prepare for build
 - ...
- 1.3 Build Medical Centre
 - ...
- 1.4 Fit out Medical Centre
 - ...
- 1.5 Commission Medical Centre
 - ...

Goal 2. Deliver Medical Services



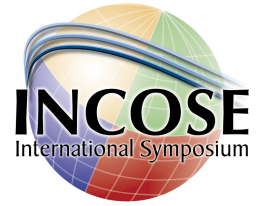
- 2.1 Deliver GP services
- 2.2 Deliver dental services
- 2.3 Deliver physiotherapy services
- 2.4 Deliver pharmacy services
- 2.5 Deliver medical support

Goal 3. Manage Medical Centre



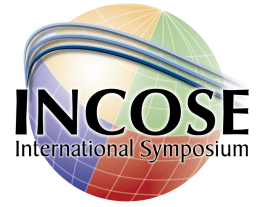
- 3.1 Manage centre administration
- 3.2 Manage centre finances
- 3.3 Manage centre staff
- 3.4 Manage centre contracts
- 3.5 Manage support services

Goal 4. Support Medical Services



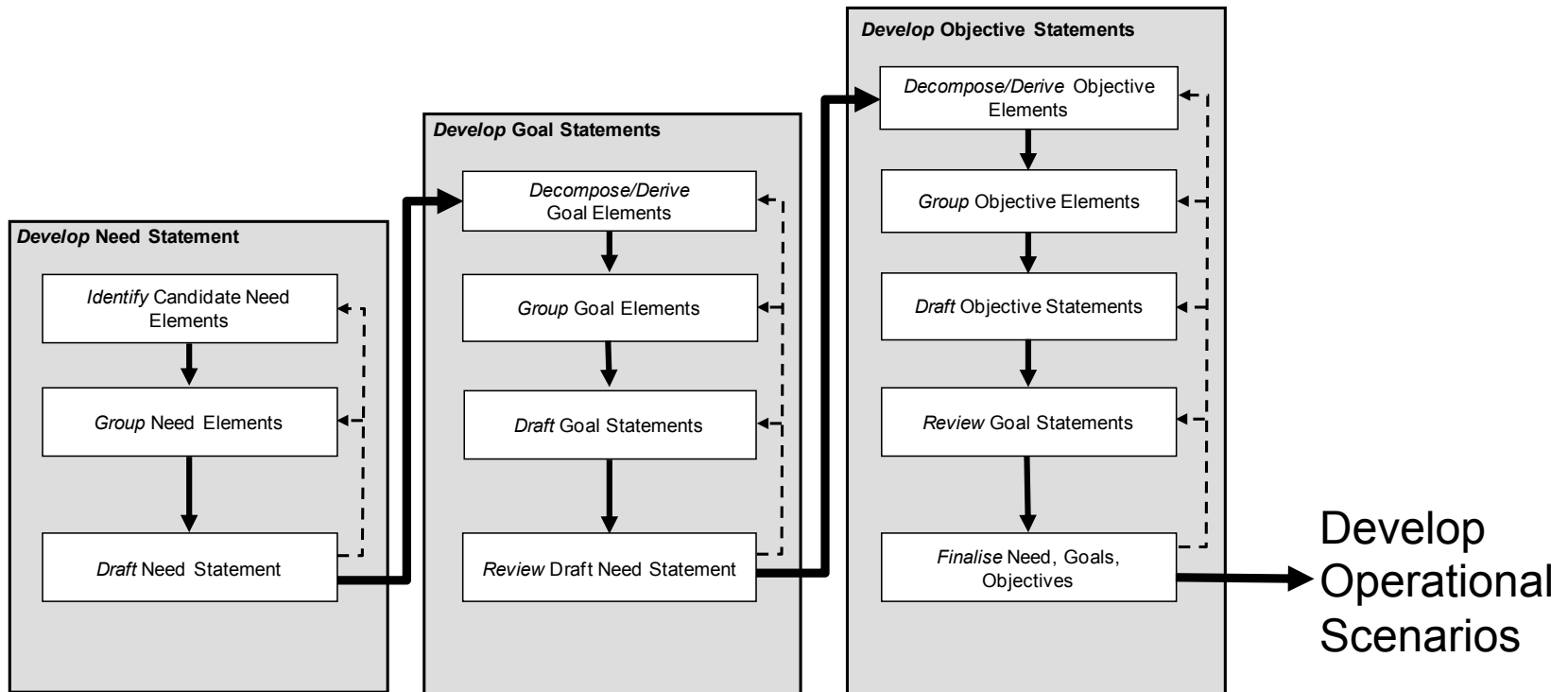
- 4.1 Provide financial services
- 4.2 Provide logistic support
- 4.3 Provide administrative support
- 4.4 Provide comfortable environment
- 4.5 Provide secure environment

Goal 5. Attain Nominated Profit

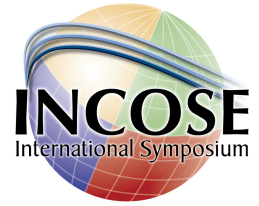


- 5.1 Implement business strategy
- 5.2 Understand customer needs
- 5.3 Maintain customer satisfaction
- 5.4 Undertake centre marketing
- 5.5 Engage local community

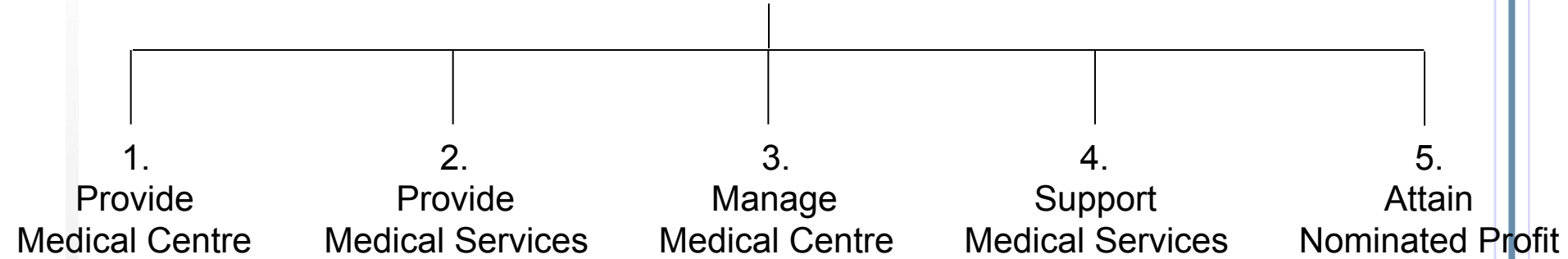
Development of Need, Goals & Objectives



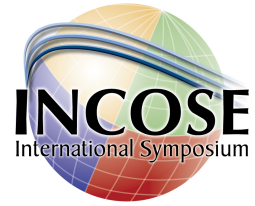
Functional Hierarchy—Level 1



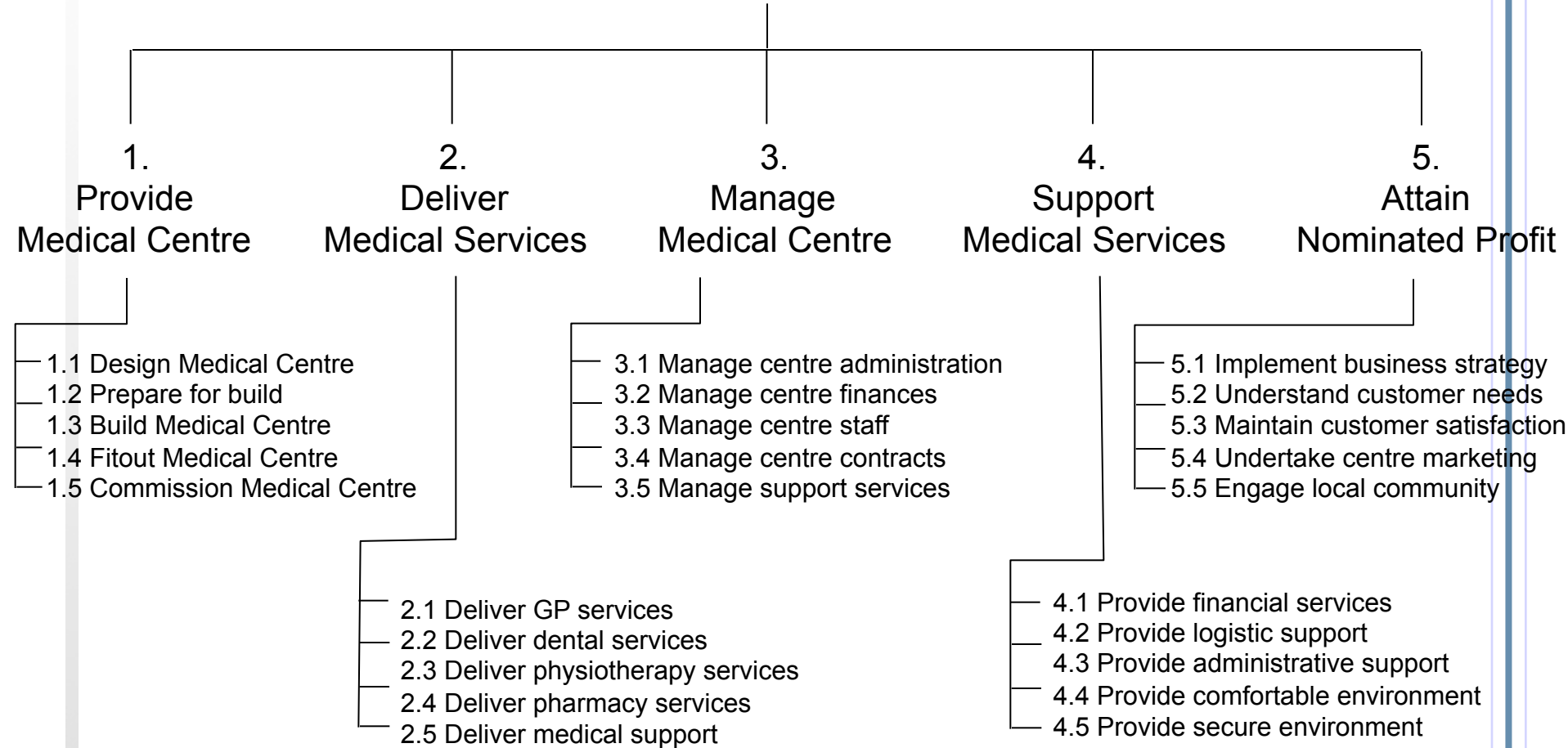
Medical Centre



Functional Hierarchy—Level 2



Medical Centre



Conclusions



- While not suited to all system developments, functional decomposition is a useful tool.
- Since functional elaboration (decomposition and derivation) requires a start point, it is useful to decompose the system need statement into goals and then objectives and subsequently into system requirements in a functional hierarchy.
- The abstracted nature of the process remains within stakeholders' intuition.
- The iteration of the process allows the participants to avail themselves of their increased understanding and to describe the system more appropriately at each stage.

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