MBARI Guidelines for Project Design Reviews and Requirements Documents

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Functional Requirements
System Design Requirements
Concept Design Reviews
Preliminary Design Reviews
Critical Design Reviews

Functional Requirements Documents (FRD)

When should these documents be used?

- *essential for every project*. They should be carefully kept up to date during the life of the project

When are they needed by?

- *a draft FRD should be completed before design work starts* and before development plans are defined
- *a well developed draft FRD should be presented at the Concept Design Review*
- *completed FRD should be presented at the PDR*

What should they include?

- *top level requirements:* The FRD should list all of top level requirements that the project must meet to be successful (hint: if the product of the design could do only the functions that are listed on the FRD would you be happy with the product?
- *preliminary list of interfaces* (the interfaces may not be defined at this stage, but they should be identified)

Who should attend?

- project team
- users

System Design Requirements Documents (SDRD)

When should these documents be used?

- the System Design Requirements Documents should contain a detailed list of engineering parameters that will allow detailed design work to proceed

When are they needed by?

- *the System Design Requirements Documents must be COMPLETED by time of the Preliminary Design Review*
- it is normally necessary to perform concept design and analysis to develop the System Design Requirements Documents

What should they include?

- the SDRD should *include detailed engineering definition of the product*, such that, if you gave the SDRD to a design contractor you would be confident that they would be able to develop a design that would meet the Functional Requirements of the Project. The SDRD should be written to allow a designer the ability to evaluate and select suitable hardware, the SDRD should not define a specific manufacturer or a model number
- the SDRD should *include a definition of all the interfaces* between the product and all other systems that the product interfaces with

Who should attend?

- project team
- users

Concept Design Review

Aim of the Concept Design Review:

- at the Concept Design Review, design options should be presented to experts in different fields (engineering, operations, consultants) to get feedback on the advantages and disadvantages of the options
- *select most promising design* option that will be carried forward to the PDR (you may decide to evaluate 2 or 3 designs, but between this review and the PDR you should be concentrating effort on the preferred concept)
- *identify all of the Functional Requirements* before starting PDR level design work
- *identify all of the interfaces* (these will be defined later)
- *identify high risk elements of the program*
- the Concept Design Review should *ensure* that before you invest significant design resources *you do not miss obvious solutions or overlook difficulties*.

At what stage of the project should they be held?

- *before starting design layouts*, undertaking complex analysis or starting development test programs
- at this stage it is not know with a high degree of confidence whether these concepts will meet all of the Functional Requirements

What should be presented at the review?

- *Draft Functional Requirements*
- *sketches of design concepts* with summaries of the advantages/ disadvantages of various concepts
- *high risk elements* of the design options
- *list of interfaces and constraints*

Who should attend?

- project team
- engineering/ science experts
- outside experts

Tips:

- recommend having many brainstorming sessions for solving complex problems prior to holding a Concept Design Reviews
- select the personnel for the review carefully
- keep the group small as this will help interaction develop atmosphere where anyone can feel they can make suggestions without feeling that they will be ridiculed as some of the most stupid ideas develop into the best solutions
- keep an open mind and avoid the mentally of “not invented here”

Preliminary Design Review (PDR)

Aim of the Preliminary Design Review

- *ensure that you have selected the best design approach for meeting the Functional Requirements*, and that the selected design concept will meet all of the Functional Requirements, before starting the detailed design phase
- *ensure that the Functional Requirements have all been identified* and carefully defined
- holding this review will allow you to be confident that when someone says "why don't you do it this way?" at Critical Design review, you will be able to explain why your selected solution is optimal

At what stage of the project should they be held?

- *when you are confident that the design will meet the Functional Requirements*, but before you start the detailed design

What should be presented at the review?

- the *Functional Requirements* (at the end of this review the Functional Requirements should be completed and you should have a well *developed draft of the System Design Requirements*)
- an *evaluation and the relative performance of the most promising concept designs*
- the *performance of the selected concept design*, together with the engineering (bench-testing, analysis, layouts) that proves that the selected concept will meet all of the Functional Requirements
- *how the high risk elements identified at the Concept Design Review have been mitigated*
- *a test plan* listing the tests (with a brief description) that will be required to prove the system meets the requirements before it is required to produce science result.
- *definition of all of the interfaces*

Who should attend?

- project team
- users
- experts

Critical Design Review (CDR)

When should you hold one of these reviews? CDR's are:

- *particularly useful for complex projects*
- *excellent project milestone*
- an opportunity for the workshop to *evaluate the manufacturability* of the design, although I would recommend that this is done earlier, nearer the 50% design stage
- valuable for *ensuring that issues and concerns raised at the PDR have been adequately addressed*
- ensuring *interfaces are checked* before the start of manufacture
- valuable for *assessing a variety of issues including assembly procedures, alignment procedures, control and operation, deployment and testing, data management*

At what stage of the project should they be held?

- When design has used 90% of the total design resources needed to complete the design. The remaining 10% design effort is for completing details of the design that are not relevant to the performance of the design, and for addressing issues raised at the design review

What should be presented at the review?

- *Functional Requirements*
- *System Design Requirements*
- *Detailed description of the design* with *complete assembly and sub-assembly drawings*, together with *predictions of the performance of the design* verified by analysis or development test programs
- *Detailed definition of all interfaces*
- *Integration and Test Plans*
- How the *system performance will be verified*

Who should attend?

- project team
- users
- experts

Tips:

- after the PDR finish your SDRD ***before starting detailed design work***
- my experience with CDR's is that CDR's are less useful that Concept DR's and PDR's. By the time you have reached a CDR the design work is essentially completed, so any change in the design requires significant engineering rework. At CDR's there is a tendency to defend the design to the death. If you did the Concept DR and PDR correctly this should not be needed

- CDR's are important for commercial contracts to allow customer opportunity to raise concerns before fabrication work starts… after CDR customer pays for changes….. expensive!