How to capture and display system knowledge
A3 Architecture Overview Cookbook
(Summary)

Definitions / Abbreviations

A3 Architecture Overview: Approach to capture design and system knowledge for shared understanding and better decision-making.

A3 Summary: Structured text description of the design and system knowledge in an A3 sheet

A3 Overview: Structured model-based description of the design and system knowledge in an A3 sheet.

System Concern: x

HFO: High Open Field;

Owner

Name: Who will be responsible for this Design Report? You?

Contact Details: best.A3creator.ever@philips.com

Model Status: DRAFT (v1 Dec 2009)

Model ID: XJ-? Ask for one once before you start, and populate it.

Reviewers: There is someone out there who must review this! Name him/her here!

Commentators: Many people want to comment your nice A3 to provide feedback, include them here!

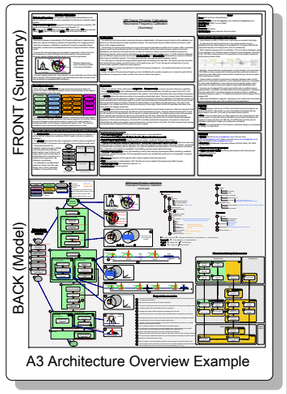
Introduction

- The **A3 Architecture Overview** (A3AO) get its name from the paper size used to print it. It consist on two A3s (see picture), one with a text description and other with a model description of a system aspect.

- The A3 format has been chosen as it is considered the maximum size that people will be willing to read, therefore encouraging focus, brevity and the use of visual models. This format has been proven successful on Toyota's lean production system [3].

- An A3AO presents the **essential information** about one focused subject on a single A3 sheet of paper, using visual models to deepen shared understanding. The goal is to keep the overview; readers may focus on one part at a time, but they can always see the whole.

- This cookbook presents a set of guidelines and the template (the cookbook is the template itself) to map your mental model into an A3AO, that can be hopefully understood by a broad set of stakeholders.



A3 Architecture Overview Example

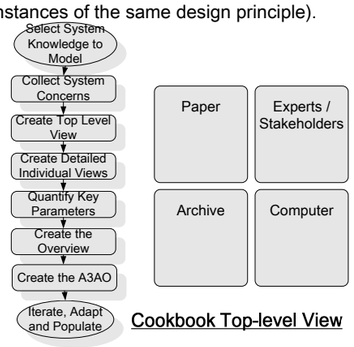
Top-level View / System partition (baseline to create the Overview, see back page)

- Here we present the system partition we will use to decompose our system.

- The baseline to create the system partition will be a **functional view** (WHAT is being done) and a **physical view** (WHERE is being done). Here we will explain the rationale for our decomposition (that might be shared by different instances of the same design principle).

- This system partition serves the user as a starting point, and provides the rationale for later budgeting.

- When decomposing the top level view, there are different aspects that you may want to highlight (e.g. when in the life-cycle this action is done). For that, **color coding** will be used in both views to differentiate when in the life-cycle a specific action required is performed.



Cookbook Top-level View

Functional View

- In the functional view we want to highlight the WHAT. In this box you can use words to clarify the functional model you have created in the overview.

- One question you should ask yourself is how deep should you go into the functional decomposition. The limit is the A3 in itself, thus if you need more room means that you probably are already using too much detail. Try removing unnecessary things.

- What is a **function**: *a specific or discrete action that it is necessary to achieve a given objective.* In the model view it is represented by VERB + NOUN within a box. The problem of this definition is that sometimes it leads to ambiguity. That's why in the functional decomposition some clarification in the form of pictures is usually needed (visual aid).

- The function should (when possible) be a transformation of inputs into outputs (which should be present in the decomposition).

- The functional flow does not need to be accurate but descriptive (e.g. some actions can be done in parallel in the implementation, but the goal is to provide a logical flow of actions).

- If you need / want to address a specific issue (e.g. an exception for system x), you can use a star of the appropriate color (the color relates to the color of the system concern this issue address).

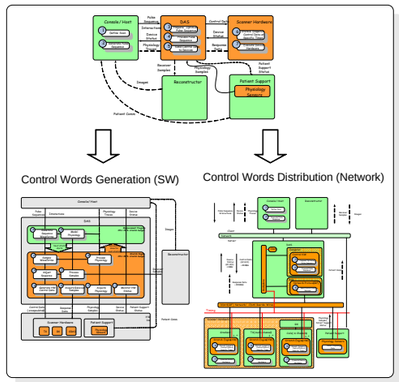
Physical View

- In the physical view we want to highlight the WHERE the action is performed. This is closest to the system. The top level view is used as a baseline to decompose and create a more detailed physical view.

- You may want to allocate the functional view here, or make a more general description in which the functional view is only one step, or you might want to make explicit the elements in the system that contribute to the design principle, etc.

- Of special importance are the interfaces. (e.g. Dotted lines indicate the interchange of information/data among functions or subsystems)

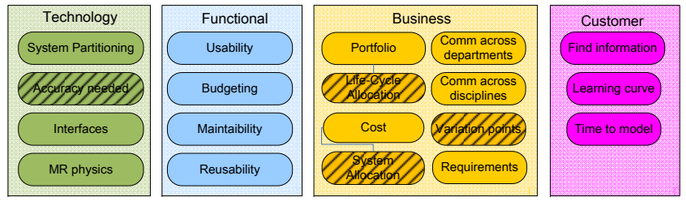
- As before, if you need / want to address a specific issue in a step (e.g. an exception for system x), you can use a star of the appropriate color.



Related System Concerns

- When dealing with **"System Aspect X"**, there are some concerns that should be taken into account to make a good decision when changing / modifying the design / architecture. Here they are made explicit so people is aware of them (they will be used in the Key Parameters section in the **Summary**)

- These concerns are usually collected from a higher view, and should therefore be shared by all instances of the system aspect (e.g. The concerns are the same for Calibrations design principle, therefore Resonance Frequency Calibration should have the same concerns than Eddy Current Calibration).



- For the **"specific instance"** of the topic we are dealing with however (e.g resonance frequency calibration), sometimes some concerns are not that relevant. Here we may mention why they are not so relevant for this instance (we hatch them in the view).

Key Parameters & Requirements

- More key parameters that we are willing to admit can be quantified. There is probable not a straightforward way to quantify it, but we can make at least approximations that lead to the correct figures of merit. It is better to have a rough estimation from an expert than to rely on gut feeling.

- You should decide whether the key parameter (extracted/derived from Related System Concerns) can be described or estimated on the spot (e.g. stretch time 1ms), in which case it should be placed here. If you need a more complex description or decomposition (e.g. impact on image quality) in that case you should place it on the quantification view in the model view.

- If possible, a formula or figure of merit should be derived from individual contributions (to understand how individuals contribute to the total).

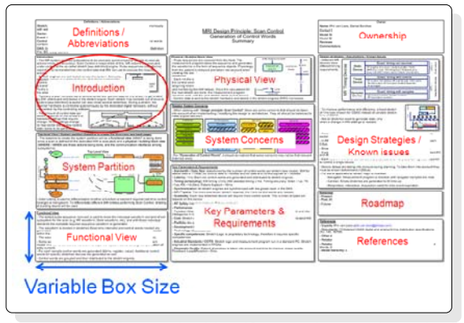
- Complex mathematical expressions might be exact, but if they are hardly understood by all stakeholders, it is better to came up with an approximation. Is there a way to approximate it and make a reference to the exact way to those interested?

- Should there be a requirement on this system concern, this is the place to make it explicit.

- Again, if you need / want to address a specific issue for a parameter (e.g. this value is used for historical reasons), you can use a star of the appropriate color.

Design strategies / Assumptions / Known Issues

- The size of the text boxes used here are not relevant, but the order is! Should you need more room for e.g. introduction, you can expand horizontally or vertically, but be aware that there will be less room for the rest!



- The common layout helps the reader identify at a glance where the information is, and whether or not the report is interesting to him/her.

- You can also include images / pictures here! A picture is worth a thousand words, and as we do not have room for many words, a picture might be what you need!

- The guidelines presented here are not fix, should you want to add a personal touch (as long as you keep the structure) you can do it.

- When modeling, you have to take into account some basic rules: people will not remember more than five colors, therefore if you need to make more distinctions use shading, change the format, etc (and include that in the legend!). Icons (such as a star) are also a good way to make people remember a specific thing.

- You can't put everything you know about this topic in this A3! So do not try to do it. You may think that there is an important aspect that has been neglected. In that case, you should think whether it belongs to other system aspect and make a explicit link to it (in References) (e.g. MR Physics of eddy currents vs Calibration of eddy currents).

Roadmap

- **Present:** How are we implementing this today?

- **Past:** How did we implemented it in the past?

- **Future:** Do we expect some changes in the future? Are there some issues that we need to deal with in the future?

References

- **Experts:** Guru 1 (guru1@philips.com), Guru N (guruN@philips.com)

- **Documents:** [1] Referenced doc / model (XJS157-2555), [2] Referenced doc / model (XJS154-0877)

- **Other documents:** [3] Understanding A3 Thinking, ISBN 9781563273605

- **Relation with other system aspects:** List those system aspect that relate to the one described here.

- **Relation with other models:** Which other models complement/expand/refine this one? Which models should be linked to get an even broader picture?

- **Model hierarchy:** From which other A3AO is this model derived from? (if any)

How to capture and display system knowledge
A3 Architecture Overview Cookbook (Overview)

Legend

Function
Data / information exchange
Validation by consensus
Validation by architect
Validation by expert(s)
Validation by measurements
Optional
Cooperation needed
1 Workflow
1 Key Parameter Element
1 Technology design constraint / choice
2 Functional design constraint / choice
3 Business design constraint / choice
4 Customer design constraint / choice
Known Value
Estimated Value
Unknown Value

I Functional flow

What needs to be done to create an A3 Architecture Overview

1 Select System Knowledge to Model
A3AO Title & Running Title
2 Collect System Concerns
4 column model
3 Create Top Level View
Top level view
4 Create Detailed Individual Views
Detailed views
5 Quantify Key Parameters
Key parameter quantification
6 Create the A3 Model
A3 Model
7 Create the A3 Summary
A3AO
8 Iterate, Adapt and Populate

1 Select System Knowledge to Model
1 Choose specific topic and add it as a running title
1 Ask for document identification (DocID)
2 Collect System Concers 4
1 Find and select stakeholders of this System Aspect
Interview them to find out the System Concerns
Place system concerns into model
Shade those concerns not relevant for this specific topic
3 Create top level view
Take a broad view of the system that covers all aspects of your topic
Create a Functional top level view
Create a Physical top level view 2
4 Create Detailed Individual Views
Create detailed functional view
Decompose the functional top view in a more detailed view
Create detailed physical view
Using the top view, choose an appropriate physical decomposition
Allocate / map functions into physical building blocks
Use color coding and other techniques to highlight relevant aspects
5 Quantify key parameters
Select key parameters that need further elaboration/decomposition
Annotate contributions to those key parameters
Try to add typical values or estimations to those parameters 2
Derive or provide a formula / figure of merit to quantify the key parameter based on those contributions
6 Create the A3 Model
Fit individual views into an A3 2
Link views (by using icons to make references)
Annotate design constraints / choices
7 Create the A3 Summary 5 1
Create an A3 summary to clarify and complement the overview
Finish A3 Architecture Overview; add legend, references, owner, etc
8 Iterate, Adapt and Populate

Visual aids 1 4

System Concerns model 1.2 1
Technology: System Partitioning, Allocation of Resources, Interfaces, MR physics
Non-Functional: Usability, Budgeting, Maintainability, Reusability
Business: Portfolio, Comm across departments, Comm across disciplines, Cost, Requirements
Customer: Find information, Learning curve, Time to model

10 2
Functional Top View
Physical Top View

Functional decomposition 3
3.1

Building block / physical decomposition 4
Control Words Generation (SW)
Control Words Distribution (Network)
Control Words Dispatch (HW)

5
5.1

14 6 12 9.3 9.1 9.3 3.2 9.4 9.2
Functional View
Visual Aid
Design Constraints / Choices
Physical View
Quantification of Key Parameters

5 Definitions 7 Ownership
Introduction
Physical View
System Concerns
Design Strategies / Known issues
System Partition
Key Parameters & Requirements
Roadmap
References
Functional View
Variable Box Size

III Quantification of Key Parameters

Time to model an A3 Architecture Overview 3

1 Collecting System Concerns 2h 30m
1.1 Discussion 2h
1.2 Model System Concerns 30m
2 Create top level view 2h
3 Create detailed functional view 4h30m
3.1 Create functional flow 30m
3.2 Create visual aid 2h
4 Create detailed physical view 4h
5 Create quantification view 4h
5.1 Derive formula 1h
6 Create the Overview 3h
6.1 Merge individual views 1h
6.2 Solve fitting problems 2h
7 Create the Summary 3h
8 Reviewing process 2-4 weeks
8.1 Find reviewers / commentators 30m
8.2 Send mail 20m
8.3 Incorporate feedback 1h

Time to model ≈ T1 + T2 + T3 + T4 + T5 + T6 + T7 + T8

A3 Readability 2

9 Structure / layout
Where to put the functional view Left
Where to put the physical view Bottom right
Where to put the quantification view Top right
Where to put design choices / constraints Look for room
Where to put the visual aid Next to the functional view
10 Color coding No more than 5 colors, combine with shading
11 Font
30pt for title
18pt for subtitles
14pt for rest
12 Size of model
Virtual model in screen A3, A2, A1 in Visio 3
Printing model A3
13 Links within the model
Quantification
Flow
Functions into physical view
14 Labeling / Legend

Readability (%) ≈
Structure 20%
Color coding 10%
Font 10%
Size of model 40%
Links 10%

IV Design decisions / constraints

1 We use a 4 column model; Technology, Functional, Business and Customer system concerns.
2 Do not forget to include the interfaces
3 If you need an A2,A1 virtual page to fit your models, take into account that fonts need to be bigger to be able to visualize them in A3

1 To align pictures to the left improves redeability
2 If the value is known, use blue color, if the value is an estimation, use orange color, and if the value is unknown or a wild guess use red.
3 So you can refer to it while is being created, discussed and reviewed.
4 These concerns may already be present if this A3 is an extension or related to another A3. In this case you should reuse those and strip those not relevant for this topic.

1 To reduce communication barriers across disciplines and deparments.
2 This is the same information contained in the overview but more textual / verbal. This view is to assist people with a different way to absorb information.

1 Contact an architect to find out who to talk to.
2 To help the reader to find the information, a common structure for the Overview is needed (see Readability in Quantification Section)
3 This time is reduced considerably when you reuse previous A3 Design Reports you've done before.
4 Visual Ads in this cookbook are not readable as they are meant to show how the views might look like. Details are not relevant.
5 This is the same information as in the Overview (Model) in a textual/ verbal format to assist people with different ways to absorb information.

II Physical view

Where / when to create the A3 Architecture Overview

Paper

2 Find experts in this Topic
3 Create system partitioning
Write system concerns
4 Decompose functional view
Decompose physical view 2
Use color coding in views
5 Select Key Parameters to model
Fin contributors to Key Parameters
Derive a formula / figure of merit to relate individual contributions
Find a way to validate the formula

Experts / Stakeholders

Stakeholders
Interview stakeholders
Collect system concerns
Reach agreement on concerns
Experts
Ask / find values or estimations 2
Architect
Validate your decompositions
Reviewers
Collect feedback

Archive

1 Ask for Doc ID for the A3 Architecture Overview

Computer

Ms Visio / Modeling tool
6 Model individual views
Model system concerns 1
Create Overview
Shade non relevant concerns
Link Views
7 Create A3 Design Report
Ms Outlook
8 Send A3 for review

Repository
Store A3 Architecture Overview
Check documentation references