



Gianluca Monticone

L'importanza di un processo robusto di
Requirements Management

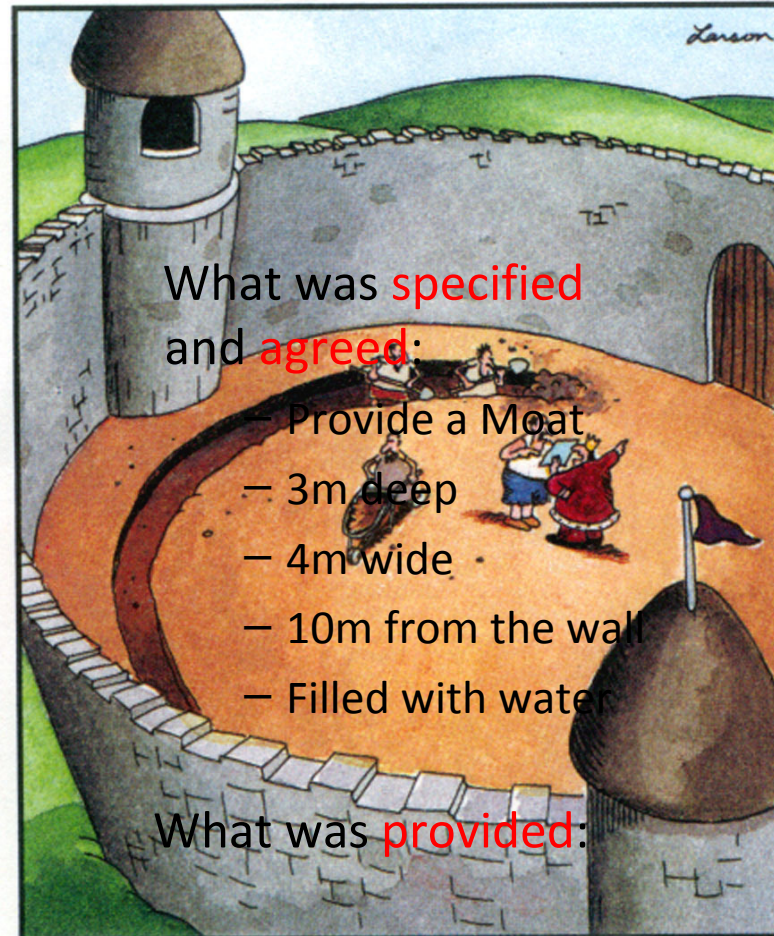


**System Engineering:
Smart Products**

What is Requirements Management?

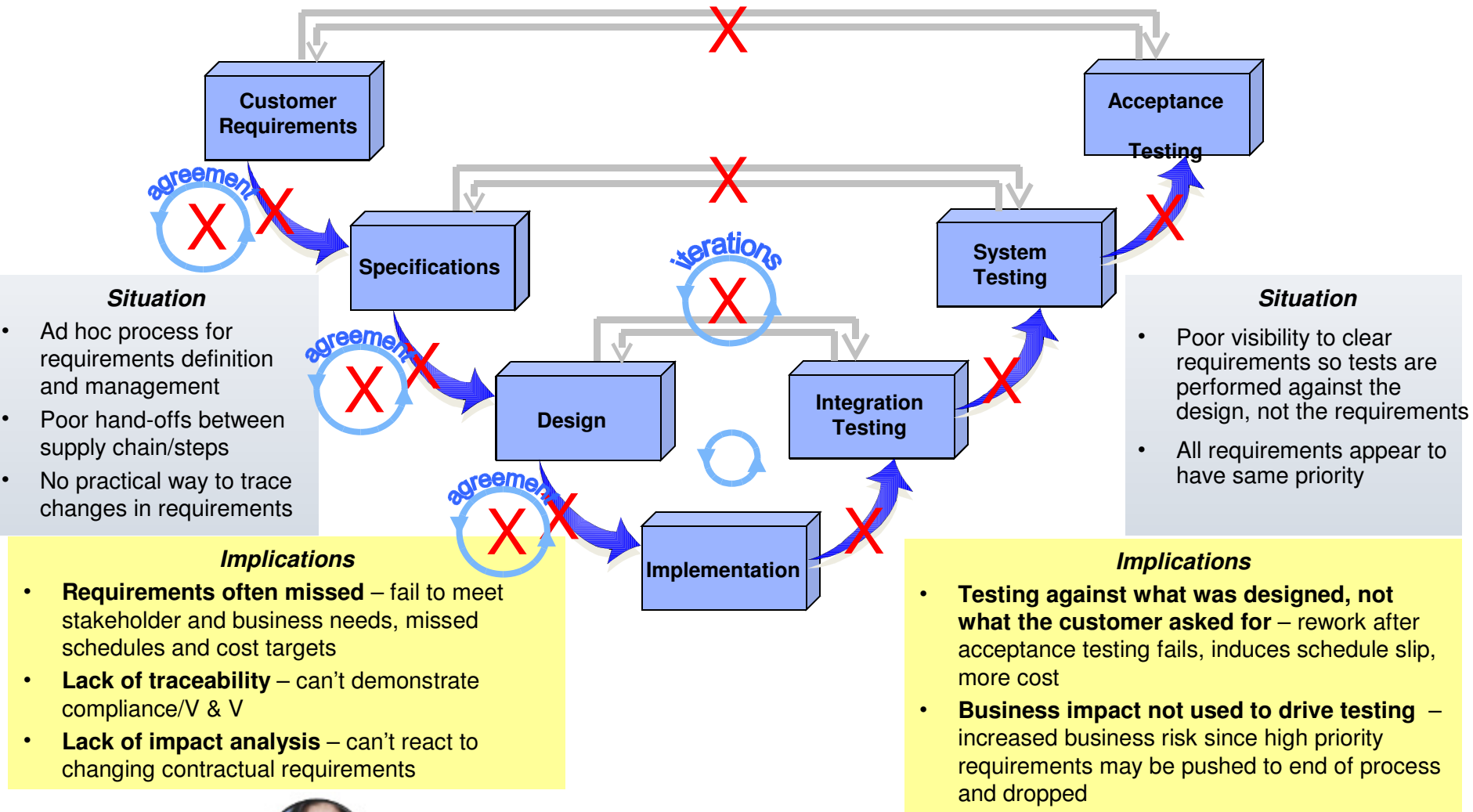
*“The purpose of **requirements management** is to establish a **common understanding** between the customer and the ... project ... This agreement with the customer is the basis for **planning** and **managing** the ... project.”*

The Capability Maturity Model for Software (CMM®) from the Software Engineering Institute at Carnegie Mellon University. - www.sei.cmu.edu/cmm



Suddenly, a heated exchange took place between the King and the moat contractor, and hence, requirements management was born.

Today's Typical Siloed Systems Engineering Process



So how do I fix this mess? And stop being late and over budget?

4 Principles for Effective Requirements Lifecycle Management

Recognize the needs of all stakeholders

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Use abstraction to manage complexity

Automate your requirements process

Integrate requirements across the lifecycle



Principle 1: Recognize the needs of all stakeholders

Avoid Premature Details at Top Levels

Problem

State what the stakeholders want to be able to do: **Capabilities**

Solution

State what the system must do: **Function**



Principle 1: Recognize the needs of all stakeholders

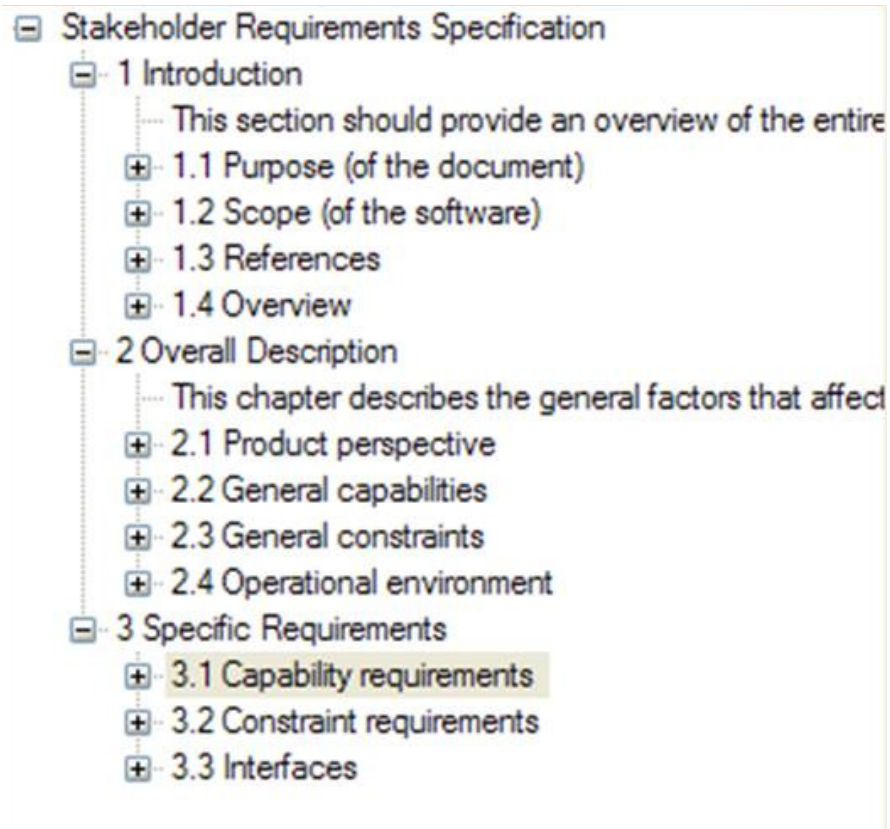
An Exercise in clear and concise descriptive writing?

The system **shall** perform at the maximum rating at all times **except** that in emergencies it **shall** be capable of providing up to 125% rating **unless** the emergency condition continues for more than 15 minutes **in which case** the rating **shall** be reduced to 105% **but** in the event that only 95% can be achieved **then** the system **shall** activate a **reduced** rating exception **and shall** maintain the rating within 10% of the stated values for a minimum of 30 minutes.



Principle 1: Recognize the needs of all stakeholders

Document Structure



Structure helps:

- Understand context
- Assess completeness
- Identify repetition/conflict
- Navigate/search requirements

Principle 1: Recognize the needs of all stakeholders

Structure and Templates

Document Structure

- 1 Introduction
- 1.1 Purpose (of the document)
- 1.2 Scope (of the software)
- 1.3 References
- 1.4 Overview
- 2 Overall Description
- 2.1 Product perspective
- 2.2 General capabilities
- 2.3 General constraints
- 2.4 Operational environment
- 2.4.1 Assumptions
- 3 Specific Requirements
- 3.1 Capability requirements
- 3.2 Constraint requirements

Hamony/ITSW Stakeholder Requirements Specification

1 Introduction

1.1 Purpose (of the document)

1.2 Scope (of the software)

1.3 References

1.4 Overview

2 Overall Description

2.1 Product perspective

2.2 General capabilities

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3.1 Capability requirements

3.2 Constraint requirements

Boiler-plate text

Requirement templates

Project templates



Principle 1: Recognize the needs of all stakeholders

Attributes



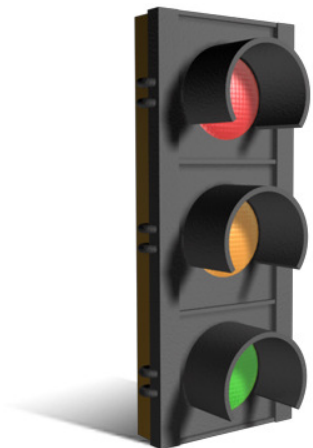
Identification



Type



Performance



Priority



Status



Principle 1: Recognize the needs of all stakeholders

Virtually unlimited user-defined attributes

- Nearly unlimited number of attributes in a spreadsheet-like view
- Values can be calculated for metrics collection
- A value or attribute may be displayed in any column

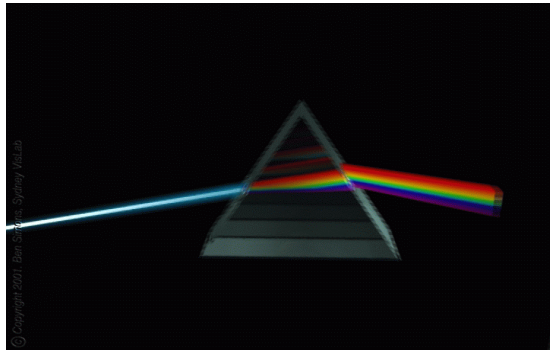
The screenshot displays the DOORS software interface. The main window shows a spreadsheet titled 'User Requirements' for 'User requirements for SUV 4x2'. The spreadsheet has columns for 'Object Identifier', 'User requirements for SUV 4x2', 'Allocated Budget', 'Spent', 'Remaining', and 'Risk'. The rows list various requirements (SOW 37-48) with checkboxes and descriptions. A secondary window, 'Object 42 (Baselined) - DOORS', is open, showing a detailed view of the attributes for a specific requirement. This window has tabs for 'General', 'Access', 'History', 'Attributes', and 'Links'. The 'Attributes' tab is active, showing a table of attributes and their values.

Attribute	Value
Created On	11 February 1997
Created Thru	Manual Input
Critical Issues	
Criticality	Medium
Detailed requirement	
History count	0
Last Modified By	Dave Mason
Last Modified On	23 November 2007
Object Heading	
Object Number	4.1.5.0-2
Object Short Text	
Object Text	Users shall be able to travel at th...
OLE	False

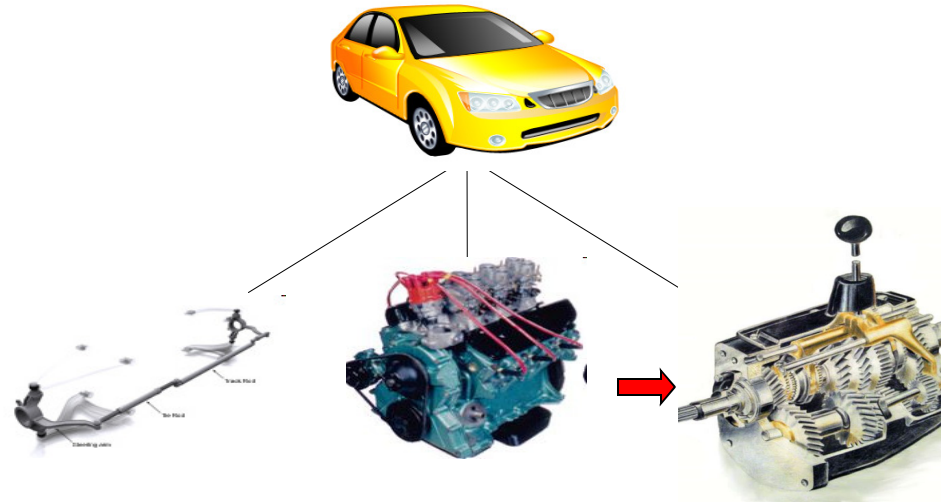


Principle 2: Use abstraction to manage complexity

Building a Requirements Hierarchy



Decomposition



Design-driven



Transformation



Allocation



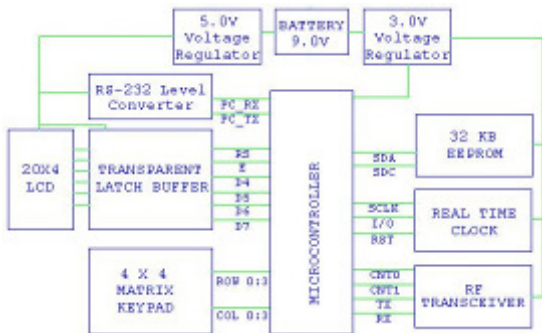
Principle 2: Use abstraction to manage complexity

Why is Traceability Important?

Why are we building this?



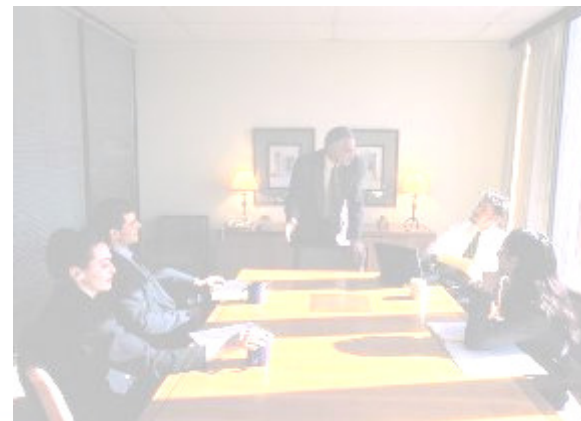
Where is this implemented?



How do I test this?

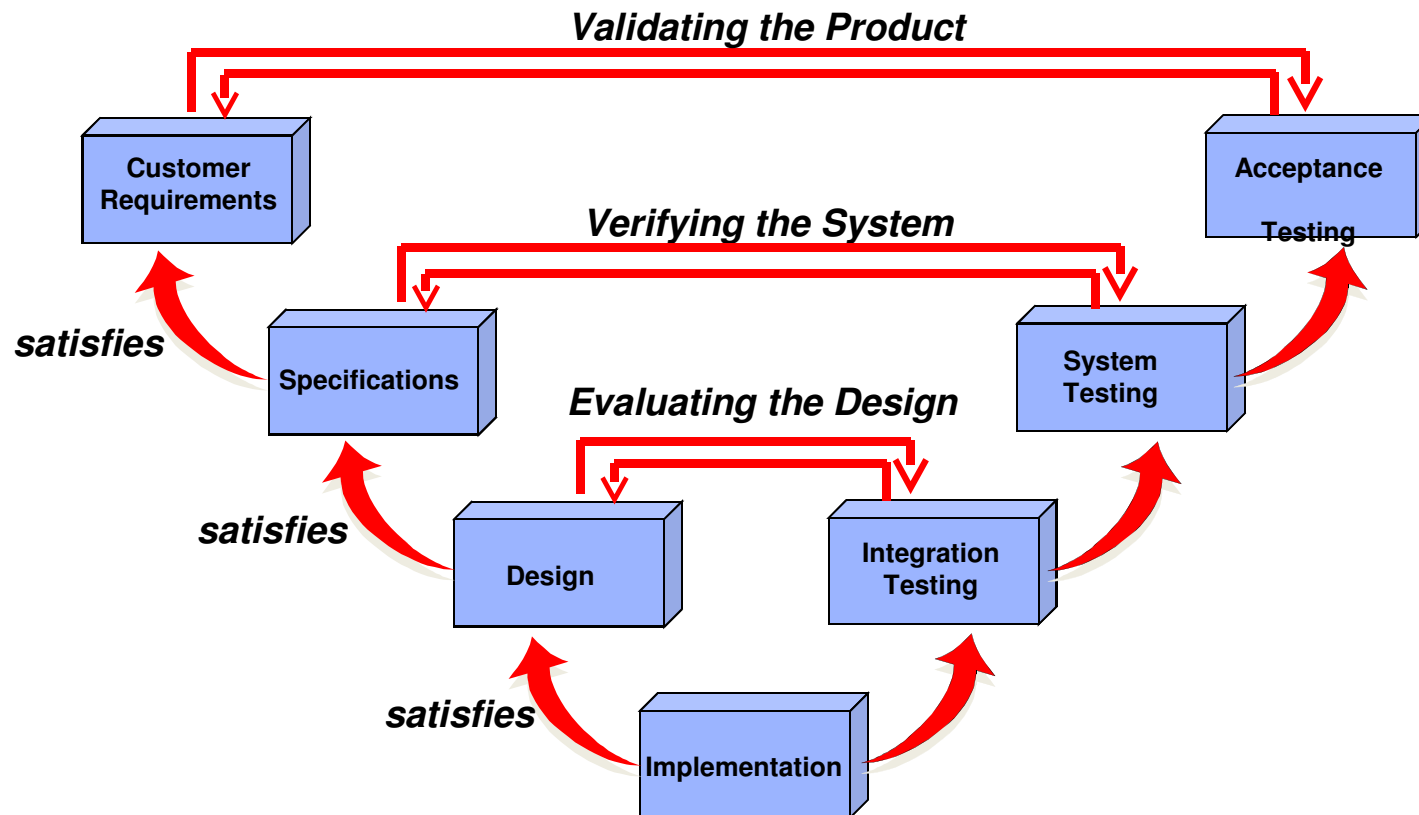


Can we show these answers? (Governance)



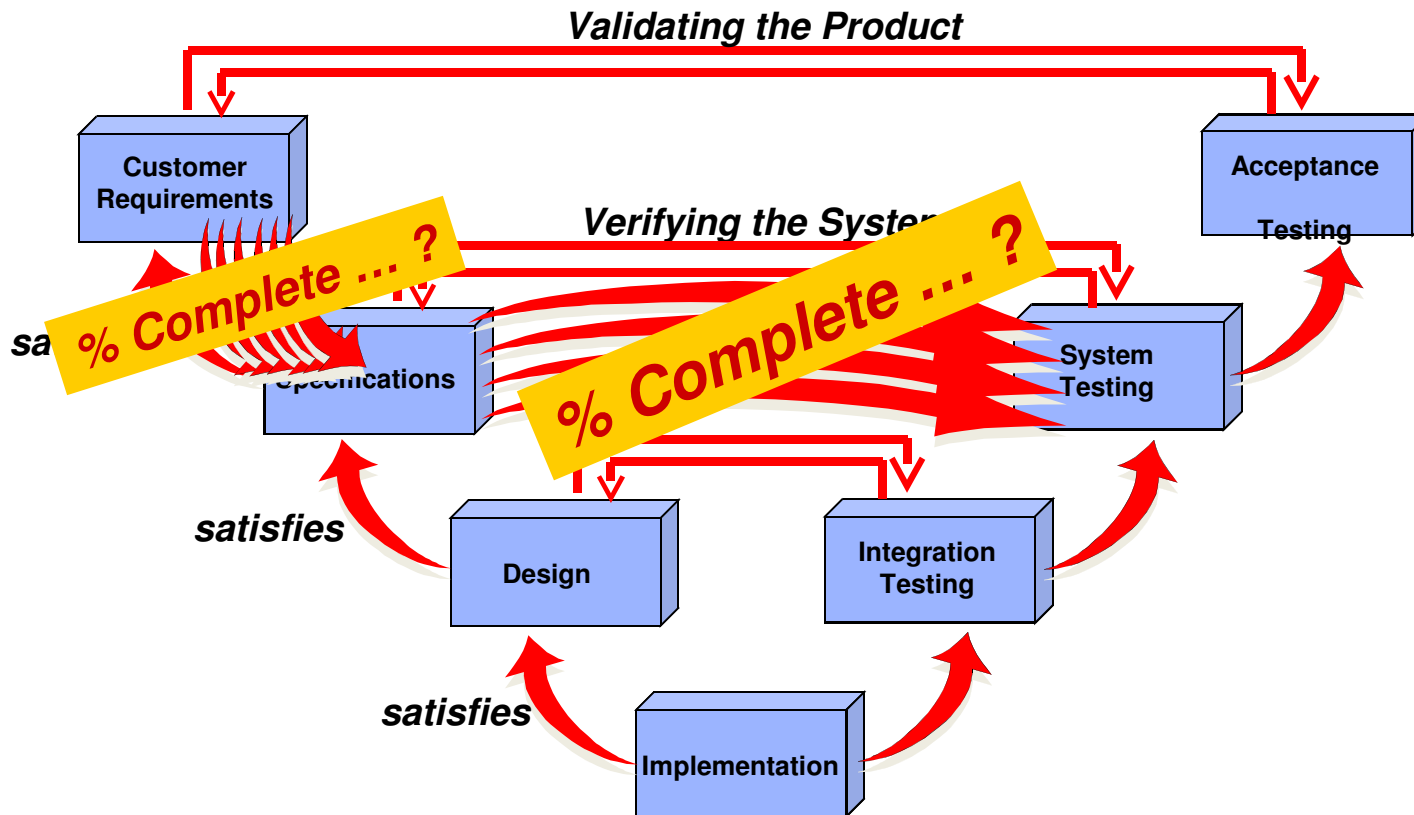
Principle 2: Use abstraction to manage complexity

Create, review and use traceability



Principle 2: Use abstraction to manage complexity

Create, review and use traceability

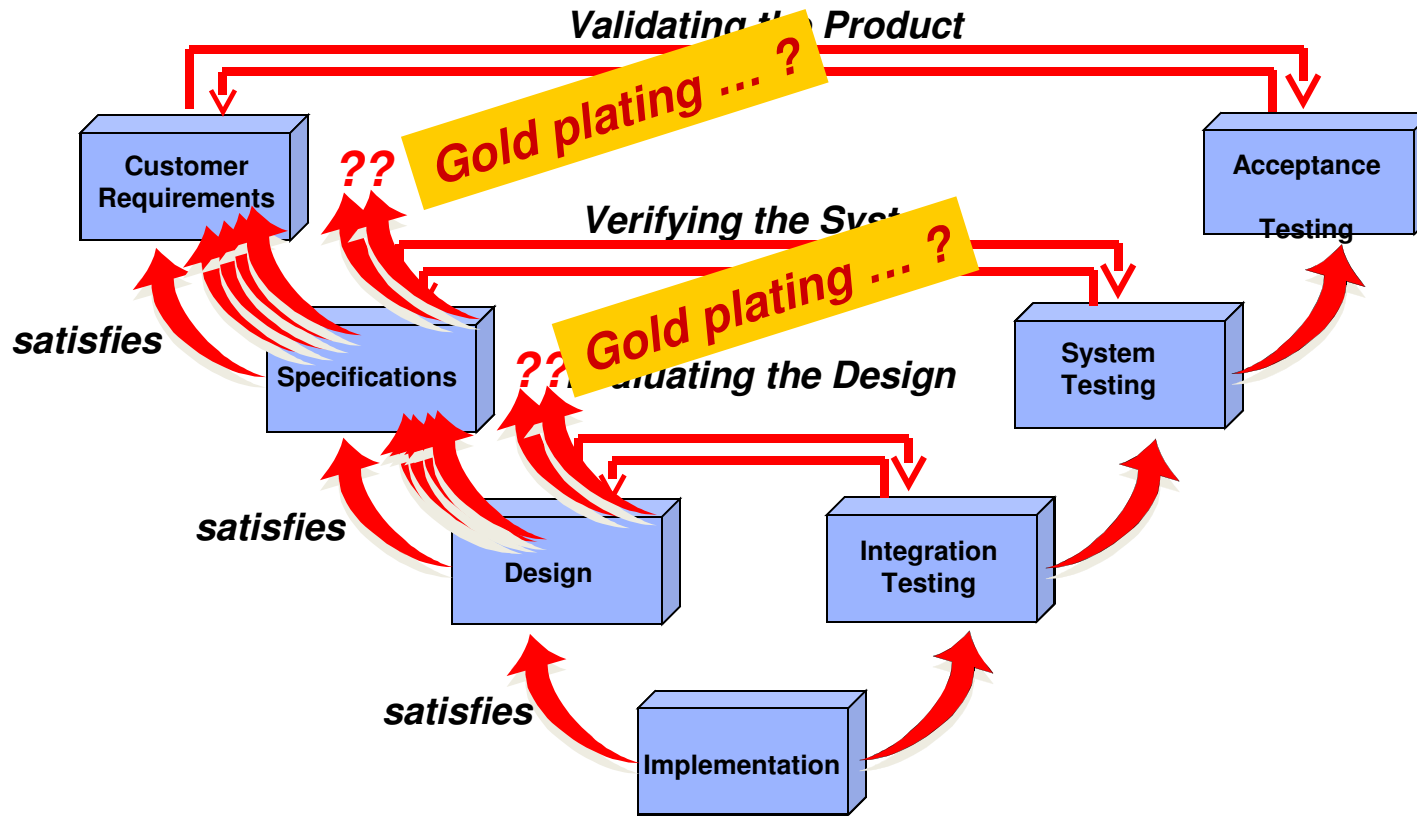


Coverage Analysis – Top Down



Principle 2: Use abstraction to manage complexity

Create, review and use traceability



Coverage Analysis – Bottom Up



Principle 2: Use abstraction to manage complexity

Multi-Level Traceability - *Information transparency allows you to take control*

Complex traceability made as simple as drag and drop

Trace through multiple levels of documentation in a single display

The screenshot shows a software application window titled 'Product Definition' current 0.3 (Second Internal) in /Transmissions (Formal module) - DOORS. The interface is divided into five vertical panes, each representing a different level of abstraction:

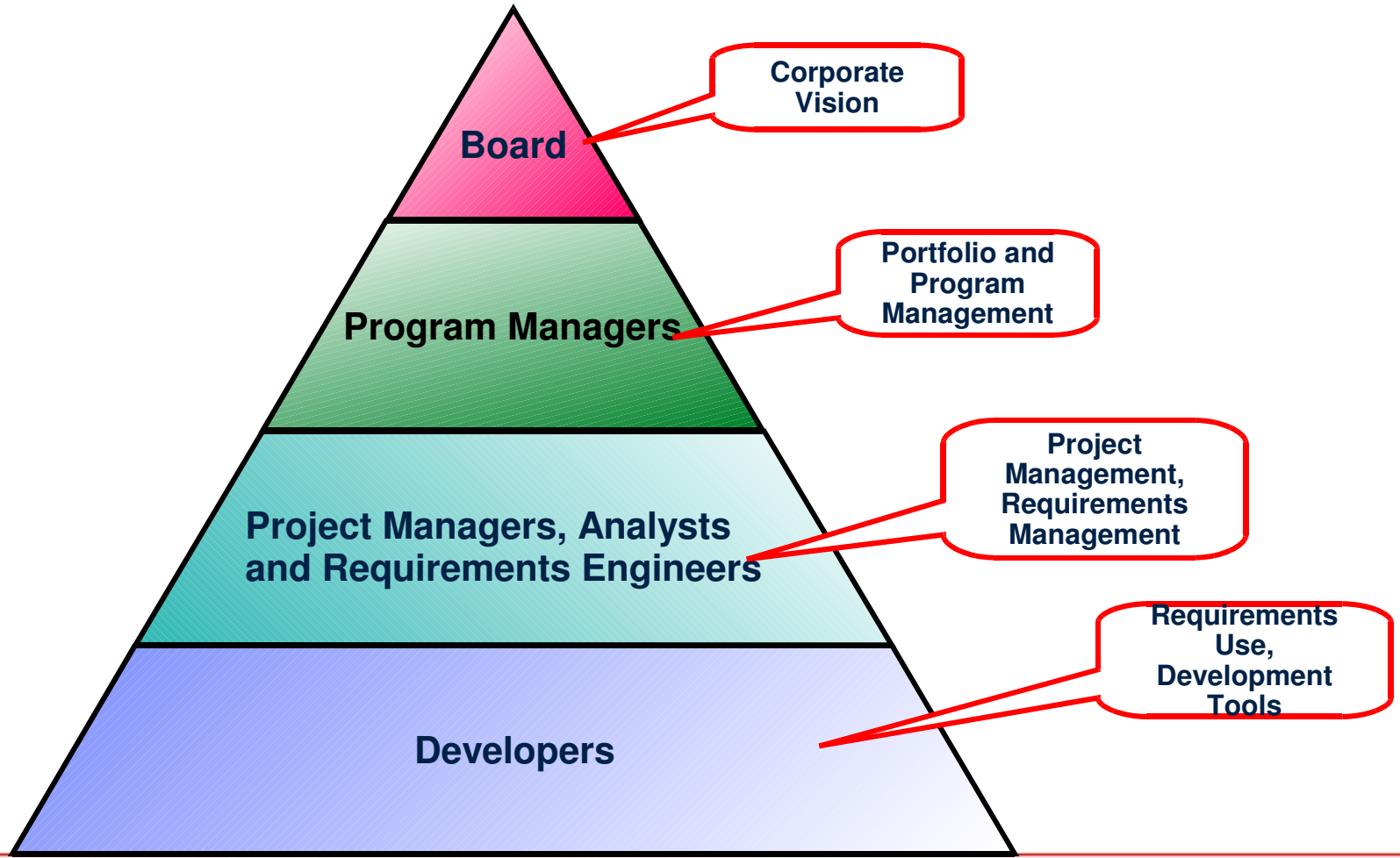
- Product Reqs:** Shows '3 Product Features' and '3.1 Features'. A requirement is listed: '"Manual" mode holds the current gear or allows for driver selected shifts.'
- System Reqs:** Shows requirement SR-45: 'The system must provide a manual mode for the driver to select a gear.'
- Design:** Shows a 'System overview diagram' with images of a gear assembly and electronic components.
- Software Requirements:** Shows requirement SRS-81: 'The CSCI will support 2 fundamental states labelled 'Manual Mode' and 'Auto Mode'.'
- Test Plans:** Shows requirement STP-32: 'Use the Testword code 758 to switch from Manual to Auto mode and check the state message identifies the correct state of the system.' Below the text is a timing diagram for a Manchester Code telegram, showing a 2400 baud rate and a 5 Hz Manchester Code.

Make maintaining traceability an asset rather than an overhead

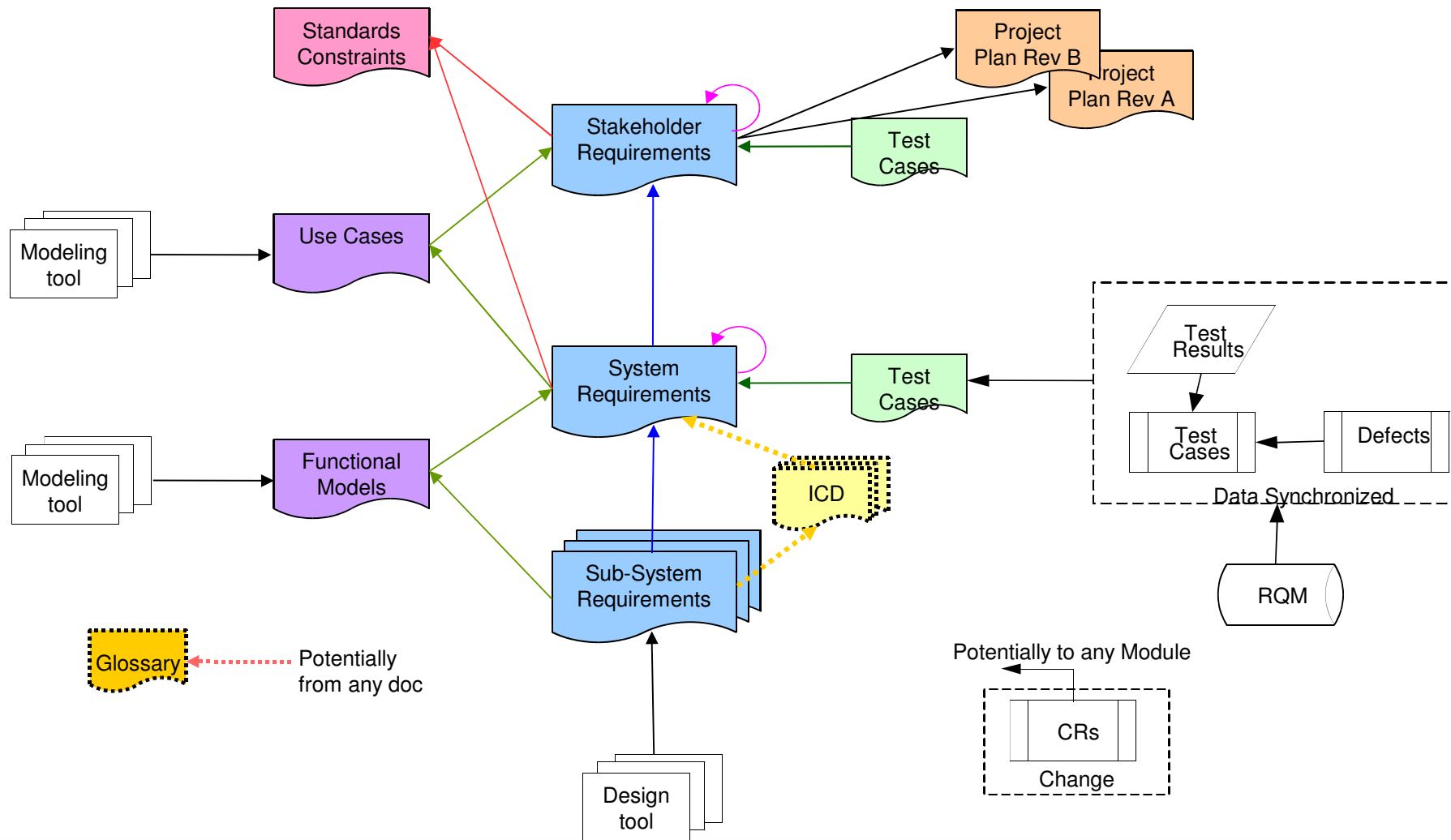


Principle 3: Integrate RM across the lifecycle

RM across the Enterprise



Principle 3: Integrate RM across the lifecycle



Principle 4: Automate your requirements process

Measure the requirements process

- CMMI, ITIL and other process assessment frameworks expect measurement
 - ▶ CMMI needs RM to get to level 2
 - ▶ Need measurement to understand efficiency and consistency
 - ▶ Key to continuous process improvement

Metrics Collection	Total NC	Total C	Agreed C	Delta NC	Delta C	Allocated NC	Allocated C	Proven NC	Proven C	Deleted NC	Deleted C
24 21/5/05 - 22/5/05											
24.1 21/5/05 - 21/5/05											
24.1.1 /01 - Period ending now - real time/Reqts - Standard view	4	13	0	0	0	3	10	1	4	0	0
24.1.2 /01 - Period ending now - real time/Reqts - 01 - Data Entry	4	13	0	0	0	3	10	1	4	0	0
24.2 22/5/05 - 22/5/05											
24.2.1 /01 - Period ending now - real time/Reqts - Standard view	0	0	0	0	0	0	0	0	0	0	0
24.2.2 /01 - Period ending now - real time/Reqts - 01 - Data Entry	0	0	0	0	0	0	0	0	0	0	0



Principle 4: Automate your requirements process

Effective Requirements Management realizes quantifiable savings
and with a tool you are able to measure

Example: how to measure and results

- Development releases consisting of typically **8000 requirements** used to take **6 months**
- Phase 1 - Application of robust process and tool enforcement reduced this period to **12 Weeks** over a period of 1 year
- Phase 2 - Continuous process improvement for a further 12 months reduced this period to **6 weeks**
- Over time, **defect removal** and effectiveness was **55% at phase 1, 88% at phase 2 and still improving**
- Defects undetected end up with the customer – the figures represent huge improvements in cost of re-work, quality and customer satisfaction



Principle 4: Automate your requirements process

Use a Requirements Management Tool

Document structure

- 2 User types
 - 2.1 Nationalities
 - The car will be used in the following countries: UK, USA, Northern Europe, Eastern Europe, Japan, Russia, Australia.
 - 2.2 User sizes
 - People come in all shapes and sizes. The car must be suitable for people maximum and minimum sizes 1.3 m to 2 m weighing 25 kilograms to 140 kilograms.
- 3 Requirements
 - 3.1 Capability Requirements
 - 3.1.1 Carrying Capacity
 - 3.1.1.1 Number of people
 - Four average size adults shall be able to travel in comfort for a period of 4 hours. This level of comfort is defined as being equivalent to the standard of comfort provided by the top 30% of cars produced in 2006.
 - The top level of cars are those in the price range £13,000 to £30,000 at 2006 prices.
 - Five average size adults shall be able to travel in comfort for a period of 4 hours.

Attributes

Car user requirements	Percentage cost	Progress
1 Introduction	0.172835	0
This module contains the user requirements for a new car to be commercially available by 1 August 2006.		0
2 User types	1.370889	0
2.1 Nationalities	0.642687	0
The car will be used in the following	0.769025	0

Filter to focus

Stakeholder Requirements

- 1 Introduction
- 2 User types
 - 3 Requirements
 - 3.1 Capability Requirements
 - 3.1.1 Carrying Capacity
 - 3.1.1.1 Number of people
 - Users shall be able to travel in comfort for a period of 4 hours.
 - Users shall be able to travel in comfort for a period of 4 hours.
 - Users shall be able to travel in comfort for a period of 4 hours.
 - Users shall be able to travel in comfort for a period of 4 hours.
 - 3.1.2 Cost Points
 - 3.1.3 Movement
 - 3.1.4 Fuel economy
 - 3.1.5 Safety
 - 3.1.6 Noise levels
 - 3.1.7 Ease of Access

Car user requirements

ID	Car user requirements
TRN-CSR-3	2 User types
TRN-CSR-4	2.1 Nationalities
TRN-CSR-5	The car will be used in the following countries: UK, USA, Northern Europe, Eastern Europe, Japan, Russia, Australia.
TRN-CSR-6	2.2 User sizes
TRN-CSR-7	People come in all shapes and sizes. The car must be suitable for people maximum sizes 1.3 m to 2 m weighing 25 kilograms to 140 kilograms.

View related information

Car user requirements

In-links (System Requirements)

3.1.2.1.1 Forwards

Users shall be able to travel at speeds up to 200 kilometers per hour.

TRN-SR-5
The car shall be able to move forwards at all speeds from 0 to 220 kilometers per hour on standard flat roads with winds of 0 kilometers per hour, with 280 BHP.
Not Set

TRN-SR-26
The car shall have a mechanism to enable it to be moved forwards or backwards.
Not Set

View historical information

3.1.1.1 Number of people

Five average size adults shall be able to travel in comfort for a period of 4 hours.

Two average size adults and 3 average size children shall be able to travel in comfort for a period of 3 hours. This could be accomplished with a three seat arrangement.

This level of comfort required is defined as being equivalent to the standard of comfort provided by the top 30% of cars produced in 2009.

Users shall have easy entry and exit.

3.1.1.1 Number of people
(Next object differs.)
~~Deleted object 'TRN-CSR-12' follows here:-~~
~~Four average size adults shall be able to travel in comfort for a period of 4 hours. This level of comfort is defined as being equivalent to the standard of comfort provided by the top 30% of cars produced in 2006.~~

Five average size adults shall be able to travel in comfort for a period of 4 hours.
(Previous object differs.)

Two average size adults and 3 average size children shall be able to travel in comfort for a period of 3 hours. This could be accomplished with a three seat arrangement.

This level of comfort required is defined as being equivalent to the standard of comfort provided by the top 30% of cars produced in 2009.

Users shall have easy entry and exit.



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Recognize the needs of all stakeholders

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Automate your requirements process

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Use abstraction to manage complexity

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Integrate requirements across the lifecycle





Further information:

“Requirements Engineering” by Hull, Jackson and Dick, Edition 2, Springer 2005

“10 Principles of Requirements Management” by Professor Ken Jackson

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Jesi, 8 Luglio 2010