Traceability

By James D. Palmer

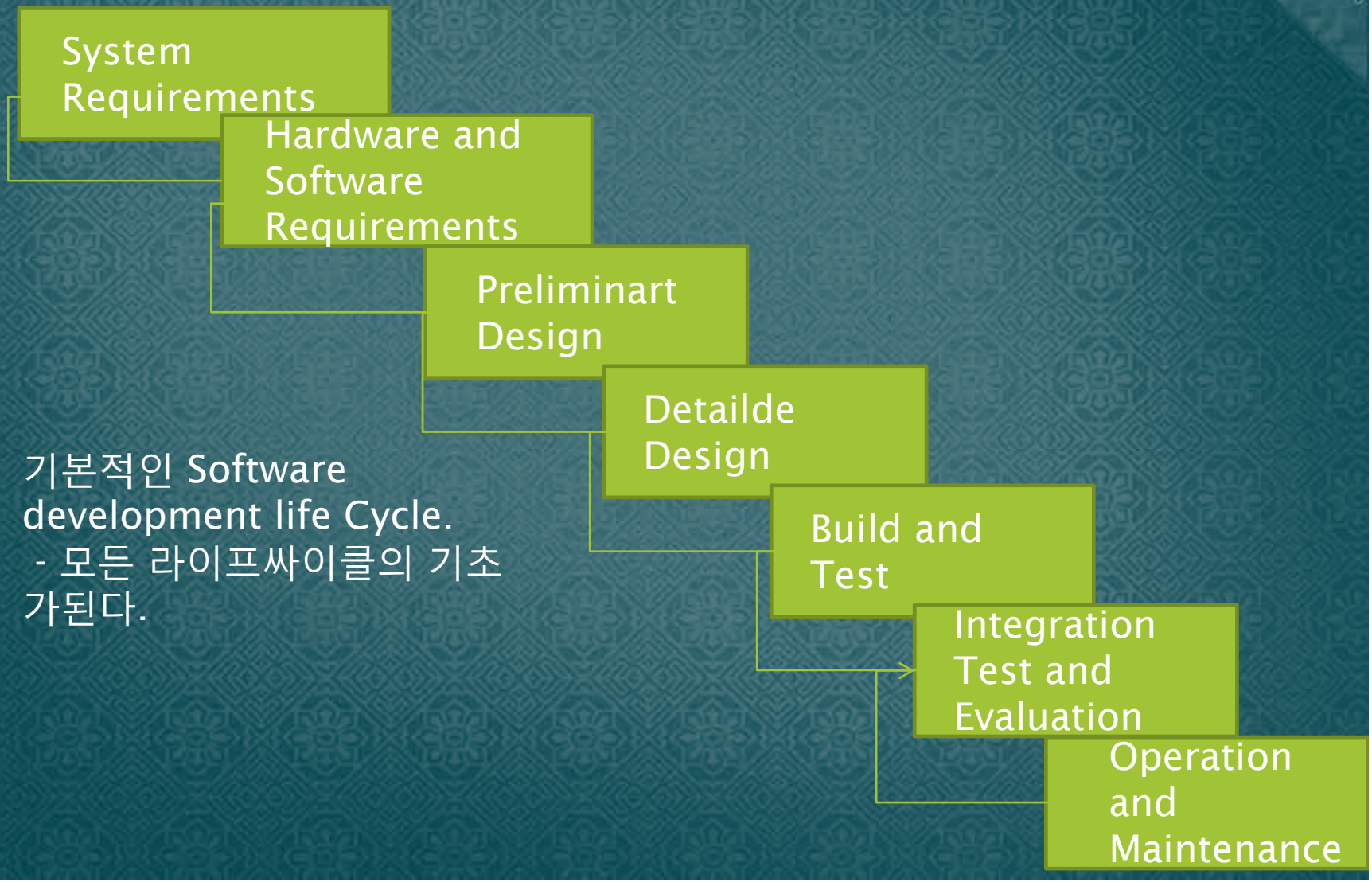
Traceability

- What is traceability?
- Why is traceability important?
- How is traceability performed?
- What tools perform traceability?
- What is the future of traceability?

Introduction

- 무엇이 프로젝트를 성공적으로 하는가?
  - 고객의 요구를 얼마나 충족시키는가
- 어떻게 그렇게 되도록 할 수 있을까?
  - Traceability
- Traceability !
  - 설계, 구현, 테스트 그리고 유지보수에 관한 요구사항들을 연결하는 전후 연관성을 나타낸다.
  - 모든 것에 대한 추론과 어떻게 테스트할지 알게 한다

System life cycle for traceability management



기본적인 Software development life Cycle.
- 모든 라이프싸이클의 기초가된다.

Need for traceability

- 나은 제품을 개발하는 데 사용되는 시스템 및 프로세스를 더 잘 이해하는 데 필요하다.
- 기술 시스템 개발을 위한 시각화 사용에 제공한다.
- 변경 관리, 개발, 공정 제어, 위험을 관리할 수 있다.
- 그것을 실현 가능하고 선택된 전체에 걸쳐 관계를 검토함으로써 충돌 탐지를 지원합니다.

왜 필요한가

- Ensures that requirements are met
- Understand relationship between requirements and the delivered system
- Lowers risk
- Creates an audit trail
- Consistency
- Control
  - Change
  - Development
  - Risk

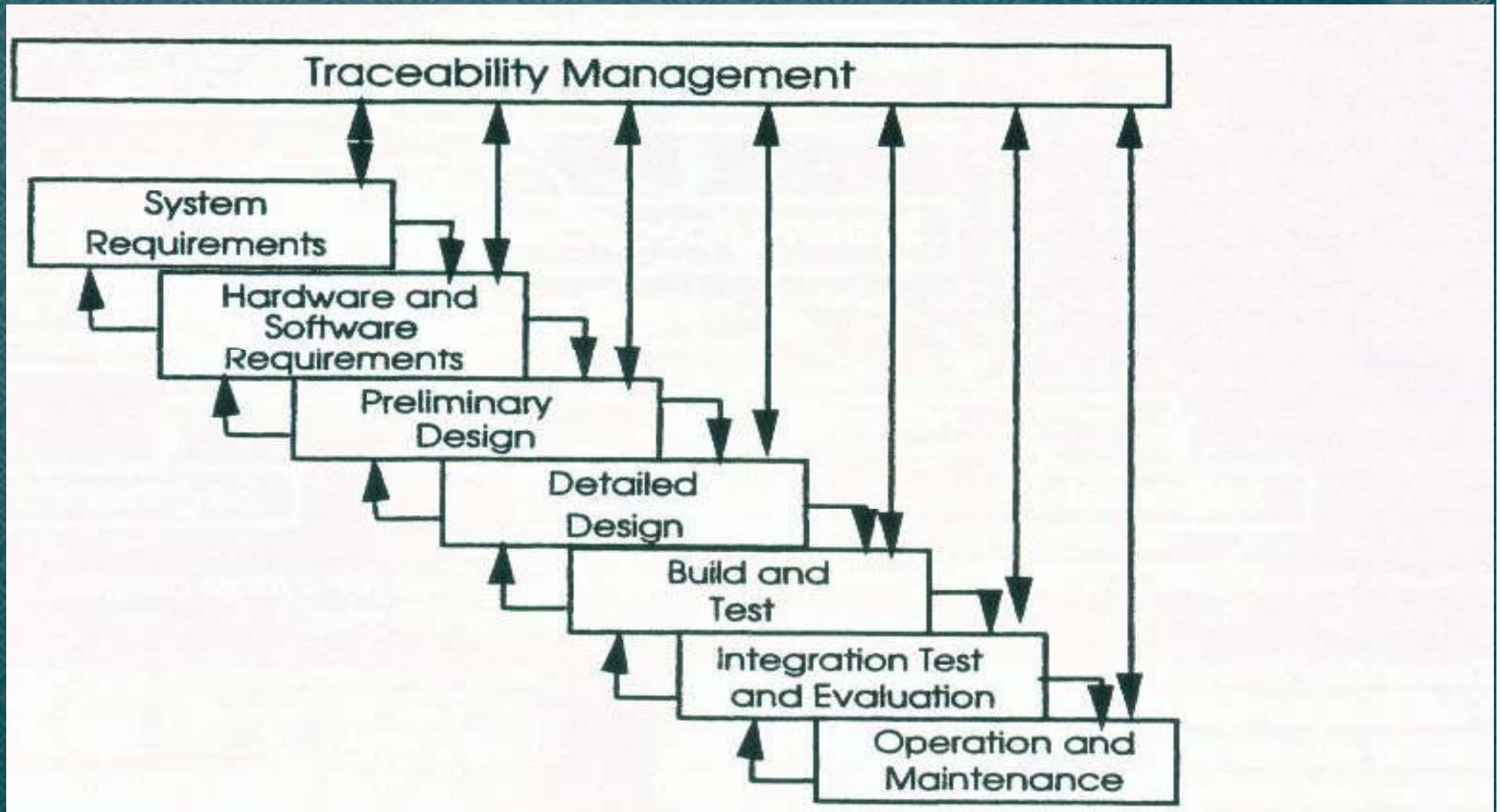
Problems & Issues Concerning Traceability

- Lack of ability to trace across discipline,
- which may lead to errors in trace matrices use
- to provide linkages, within and across disciplines.
- 수동프로세스
- Vew 낮은순서로 개발된 View
- 잘못된 이해
- 단일 모델링 방법
- - 싸이클의 나중까지 혜택을 많이 받을수가 없다.
- (유효성 검사, 테슽, 시스템설치, 운영)
- 더 복잡한 시스템에서 맞는 구현을 하기가 더어렵다.

Definition of Terms

- Allocation
- Audit
- Behavior
- Bottom-up
- Classification
- Flowdown
- Function
- Hierarchy

State of practice of Traceability



gure 2. Traceability management across the system development life cycle

Contemporary Traceability Practices

le 1. Traceability matrix for multi-segment system

SRD	SS	Segment 1	Segment 2	Segment 3	ICD
3.1.2.1	3.3.4.5 3.3.4.6	3.2.2.5.6 3.2.2.5.7 3.4.5.6.2	3.5.3.2		3.1.4.6.7 3.1.4.6.8 3.1.4.6.9
3.4.3.1	3.6.7.2 3.8.4.3	3.5.2.5.1	3.7.4.3.1 3.7.4.3.2	3.6.4.5.2	3.3.2.4.5 3.3.2.4.7

SRD: Stakeholder input.
SS : Initial interpretation of these high level requirements by developers.
Segment specs: Provide more detailed info to design.
ICD (Interface Control Doc): Provides linkages for all messages that occur within and across segments.

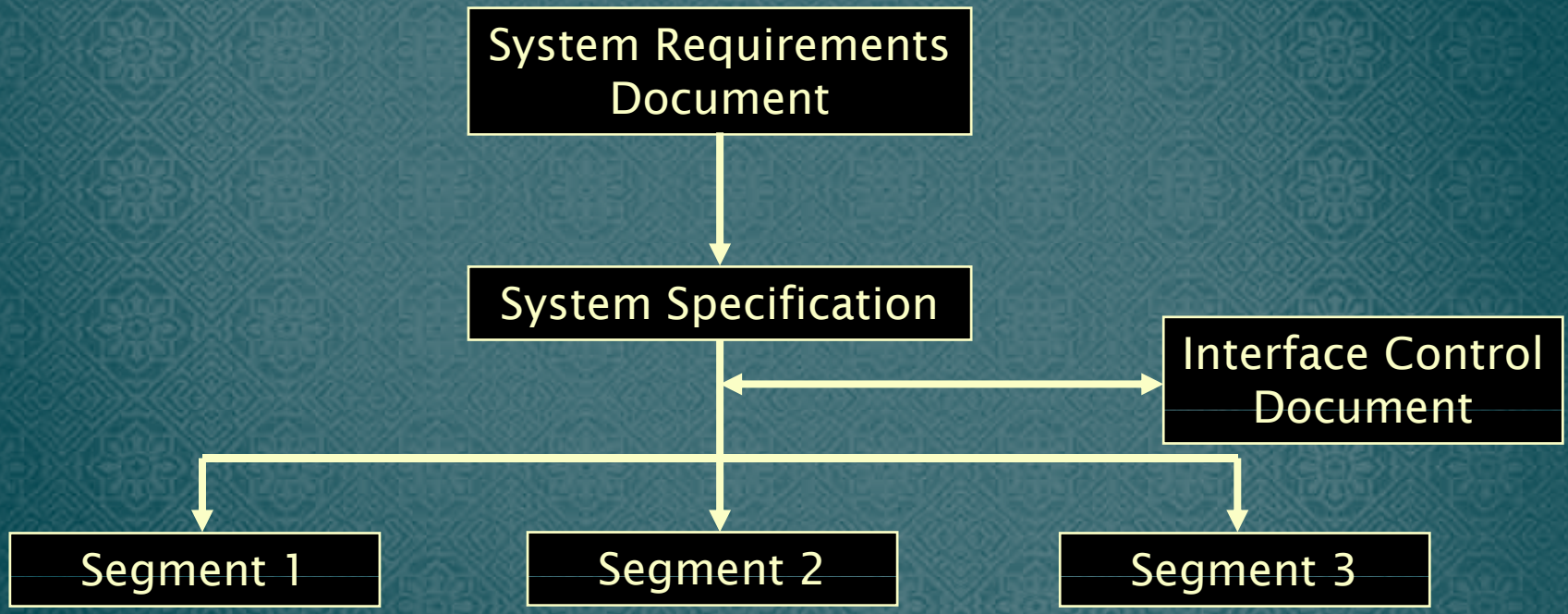
How is Tracing Performed?

- 클라이언트는 개발자에게 요구사항을 준다.
- 개발자는 system, hardware, and software 요구서를 만든다.
- 각 요소에는 고유 식별자가 주어진다.
  - Element – requirement, design attribute, test, etc
- Linkages는 수동으로 완료되고 CASE툴에 의해 관리된다.
- Traceability tables are made
  - matrix

Traceability Example

- SRD – System Requirements Document
  - 높은 레벨의 요구서
  - Stakeholders에 의해 완료된다.
- SS – System Specification
  - 좀더 상세한 요구서
  - 개발자가 해석한다.
- Segments
  - SS보다 더 상세하다.
  - 디자인 정보를 포함한다.

Traceability Example



Traceability Example

Traceability Matrix

SRD	*SS*	*Seg 1*	*Seg 2*	*Seg 3*	*ICD*
3.1.2.1	*3.3.4.5*	*3.2.2.5.6*	*3.5.3.2*		*3.1.4.6.7*
	3.3.4.6	*3.2.2.5.7*			*3.1.4.6.8*
		3.4.5.6.2			*3.1.4.6.9*
3.4.3.1	*3.6.7.2*	*3.5.2.5.1*	*3.7.4.3.1*	*3.6.4.5.2*	*3.3.2.4.5*
	3.8.4.2		*3.7.4.3.2*		*3.3.2.4.7*

Traceability Management

- 요구 사항을 추가 / 삭제 / 수정
- Impact를 분석
- Trace changed
- 계속된 유지 보수

Traceability in a Perfect World

- 단계
  - Identification of requirements
  - Architecture selection
  - Classification schema
    - Functions, Performance and Security
    - Translate into views
  - Allocation into schemas
  - Flow-down to design, code, and test
  - Entry into traceability database
  - Linkages
  - Management

Traceability in the Real World

- Labor Intensive
- 분류된 스키마들은 배정되는 요구사항에 따라 빈번히 변경됩니다.
- 의미와 구문의 정확성을 보장합니다.

Semantics and Syntax

- Semantics required to assure that a trace is used in context
- Syntax required to assure that a trace goes to a specific word or phrase
- Manual verification of outcomes

Real World Traceability Workflow

- Receipt of requirements documents
- Select architecture form to be followed
- Select classification schema
- Parse document and assign unique numbers
- Allocate according to classification scheme
- Establish linkages across all requirements
- Generate traceability matrices
- Maintain traceability linkages in database
- Maintain traceability links across entire project

Return on Investment(투자수익)

- Very difficult to measure
- Many factors
- Costs
  - Time
  - CASE Tools
  - Training
- Benefits
  - Only an estimation
- What rework was avoided?

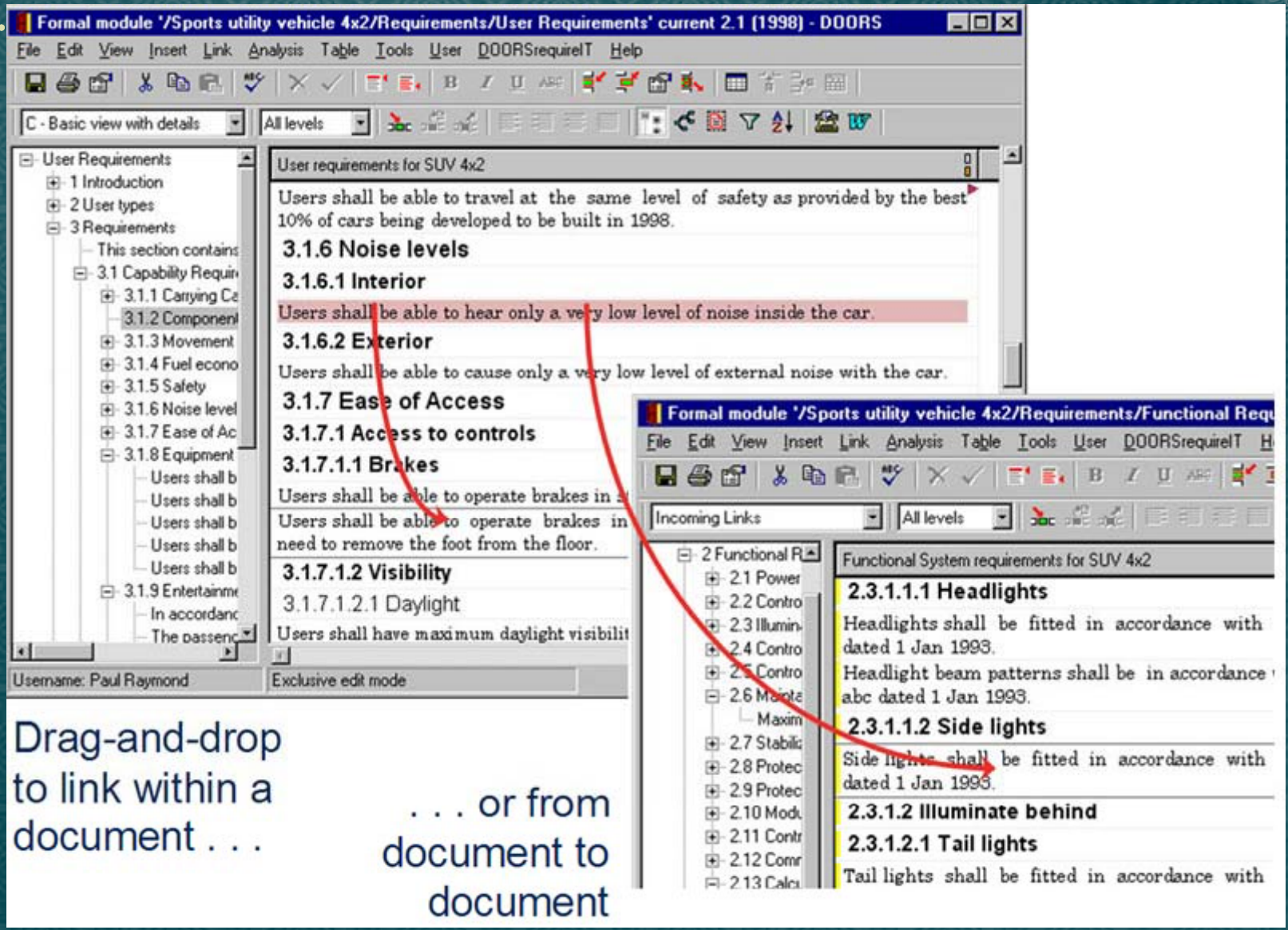
Tools

- CASE Tools
- Characteristics
  - Hypertext linking
  - Unique identifiers
  - Syntactical similarity coefficients
- Problems
  - Hypertext linking and syntactical similarity does not consider context
  - Unique identifiers do not show requirement information
  - Choosing architecture view and classification schemas will always be manual

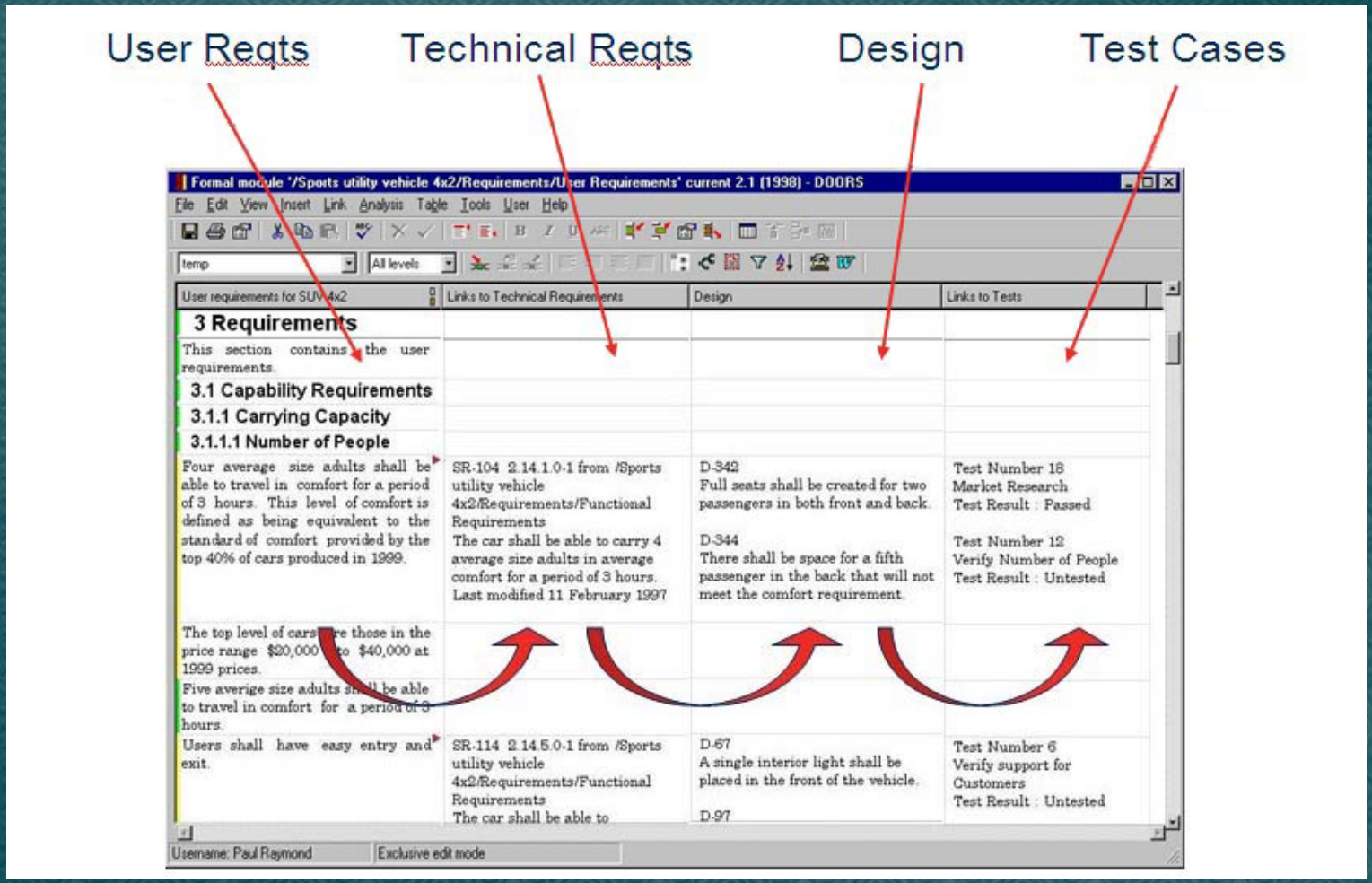
Tools

- DOORS
  - Telelogic
  - "capture, link, trace, and manage"
  - For large applications
  - From the datasheet
    - Similar look and feel to explorer
    - Gap analysis for unaddressed requirements
    - Traceability analysis for identifying areas of risk
    - Impact analysis reports
    - Volatility
    - Traceability by drag and drop

Doors


Formal module '/Sports utility vehicle 4x2/Requirements/User Requirements' current 2.1 (1998) - DOORS
File Edit View Insert Link Analysis Table Tools User DOORSrequireIT Help
C - Basic view with details
All levels
User Requirements
1 Introduction
2 User types
3 Requirements
This section contains
3.1 Capability Requir
3.1.1 Carrying Ca
3.1.2 Component
3.1.3 Movement
3.1.4 Fuel econo
3.1.5 Safety
3.1.6 Noise level
3.1.7 Ease of Ac
3.1.8 Equipment
Users shall b
Users shall b
Users shall b
Users shall b
Users shall b
3.1.9 Entertainme
In accordanc
The passeng
User requirements for SUV 4x2
Users shall be able to travel at the same level of safety as provided by the best 10% of cars being developed to be built in 1998.
3.1.6 Noise levels
3.1.6.1 Interior
Users shall be able to hear only a very low level of noise inside the car.
3.1.6.2 Exterior
Users shall be able to cause only a very low level of external noise with the car.
3.1.7 Ease of Access
3.1.7.1 Access to controls
3.1.7.1.1 Brakes
Users shall be able to operate brakes in
Users shall be able to operate brakes in need to remove the foot from the floor.
3.1.7.1.2 Visibility
3.1.7.1.2.1 Daylight
Users shall have maximum daylight visibilit
Username: Paul Raymond
Exclusive edit mode
Formal module '/Sports utility vehicle 4x2/Requirements/Functional Requ
File Edit View Insert Link Analysis Table Tools User DOORSrequireIT H
Incoming Links
All levels
2 Functional R
2.1 Power
2.2 Contro
2.3 Illumin
2.4 Contro
2.5 Contro
2.6 Maint
Maxim
2.7 Stabili
2.8 Protec
2.9 Protec
2.10 Modu
2.11 Contr
2.12 Comr
2.13 Calcu
Functional System requirements for SUV 4x2
2.3.1.1.1 Headlights
Headlights shall be fitted in accordance with dated 1 Jan 1993.
Headlight beam patterns shall be in accordance abc dated 1 Jan 1993.
2.3.1.1.2 Side lights
Side lights shall be fitted in accordance with dated 1 Jan 1993.
2.3.1.2 Illuminate behind
2.3.1.2.1 Tail lights
Tail lights shall be fitted in accordance with
Drag-and-drop to link within a document . . .
. . . or from document to document

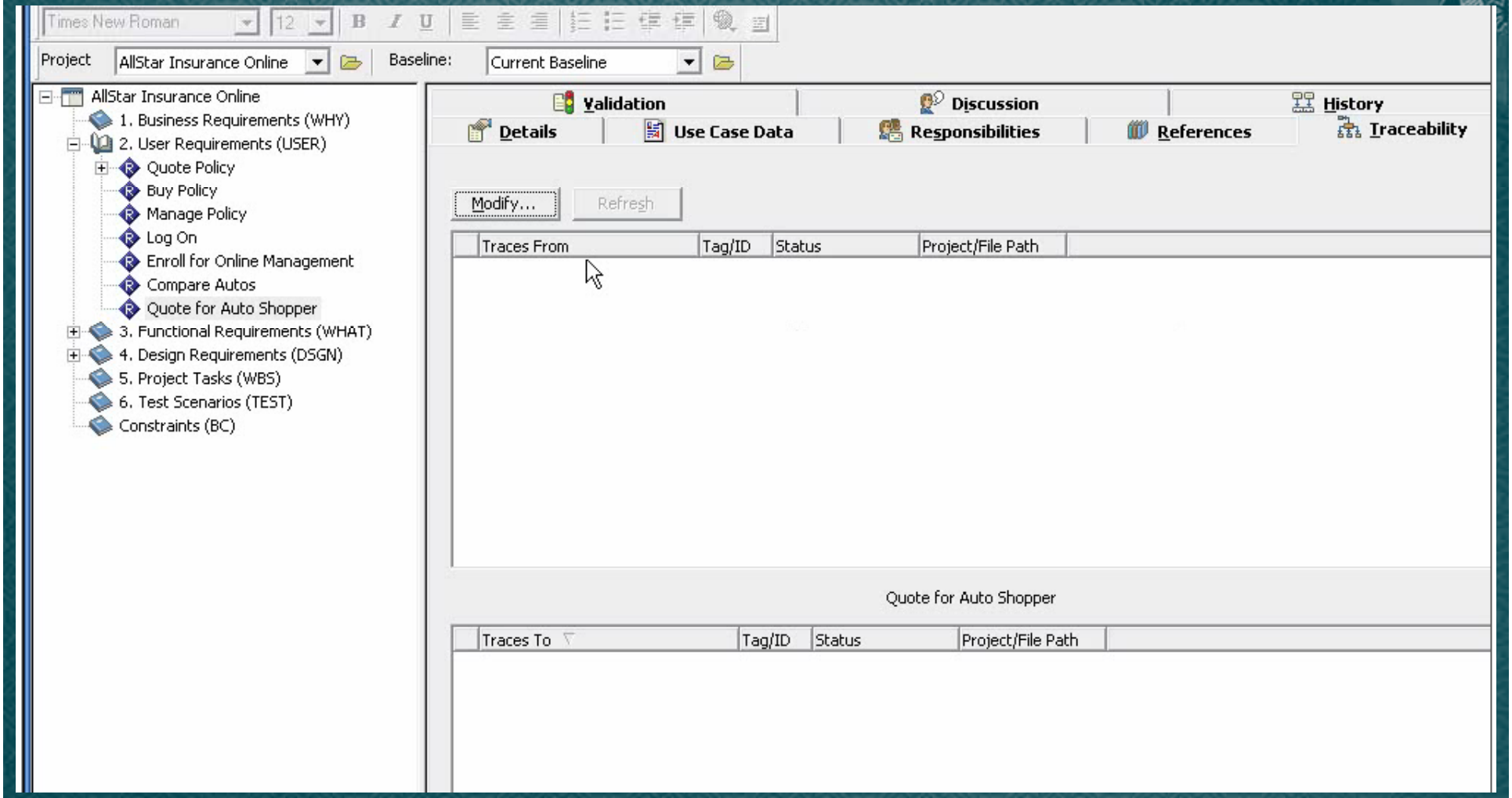
Doors(cont..)


User Reqts
Technical Reqts
Design
Test Cases
Formal module '/Sports utility vehicle 4x2/Requirements/User Requirements' current 2.1 (1998) - DOORS
File Edit View Insert Link Analysis Table Tools User Help
temp
All levels
User requirements for SUV 4x2
Links to Technical Requirements
Design
Links to Tests
3 Requirements
This section contains the user 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 3 hours. This level of comfort is defined as being equivalent to the standard of comfort provided by the top 40% of cars produced in 1999.
SR-104 2.14.1.0-1 from /Sports utility vehicle 4x2/Requirements/Functional Requirements
The car shall be able to carry 4 average size adults in average comfort for a period of 3 hours.
Last modified 11 February 1997
D-342
Full seats shall be created for two passengers in both front and back.
D-344
There shall be space for a fifth passenger in the back that will not meet the comfort requirement.
Test Number 18
Market Research
Test Result : Passed
Test Number 12
Verify Number of People
Test Result : Untested
The top level of cars are those in the price range $20,000 to $40,000 at 1999 prices.
Five averige size adults shall be able to travel in comfort for a period of 3 hours.
Users shall have easy entry and exit.
SR-114 2.14.5.0-1 from /Sports utility vehicle 4x2/Requirements/Functional Requirements
The car shall be able to
D-67
A single interior light shall be placed in the front of the vehicle.
D-97
Test Number 6
Verify support for Customers
Test Result : Untested
Username: Paul Raymond
Exclusive edit mode

Tools

- Caliber-RM
  - Borland
- From the datasheet
  - Centralized repository
  - Requirements traceability across the lifecycle
  - Impact analysis

Caliber-RM


Times New Roman
12
Project
AllStar Insurance Online
Baseline:
Current Baseline
AllStar Insurance Online
1. Business Requirements (WHY)
2. User Requirements (USER)
Quote Policy
Buy Policy
Manage Policy
Log On
Enroll for Online Management
Compare Autos
Quote for Auto Shopper
3. Functional Requirements (WHAT)
4. Design Requirements (DSGN)
5. Project Tasks (WBS)
6. Test Scenarios (TEST)
Constraints (BC)
Validation
Discussion
History
Details
Use Case Data
Responsibilities
References
Traceability
Modify...
Refresh
Traces From
Tag/ID
Status
Project/File Path
Quote for Auto Shopper
Traces To
Tag/ID
Status
Project/File Path

Future Predictions

- Automation of allocation into architectures and classification schemas
- Little additional automation seen in current tools

Pros/Cons

- Pros
  - Traceability 의 중요성과 필요가 명확하게 반영
  - 실용적인 workflow
- Cons
  - 예시는 라이프 사이클을 반영하지 않았다.
  - 도구는 실용성이 적다.