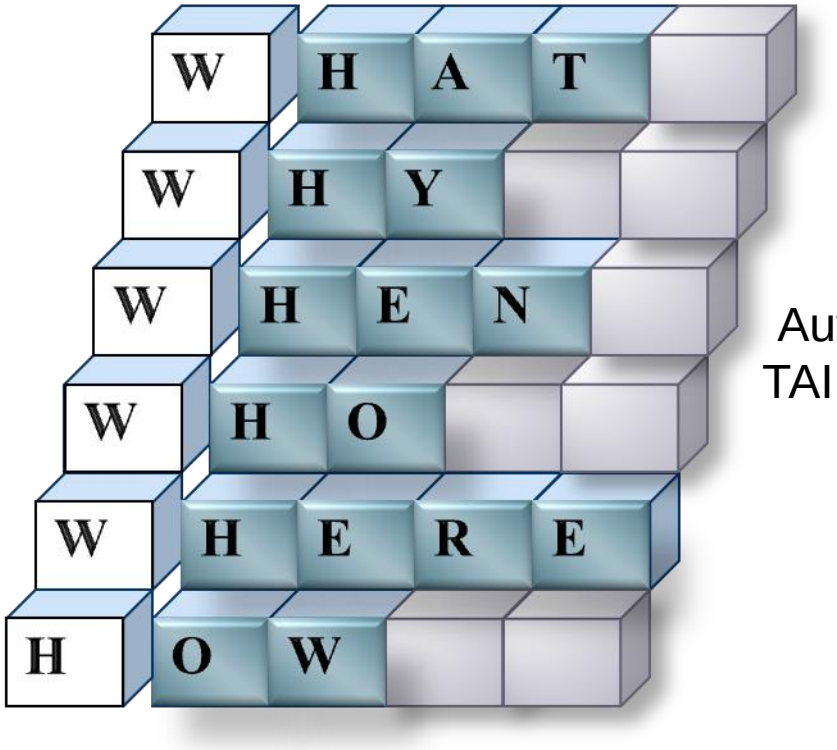

TAI
TUSAŞ - TÜRK HAVACILIK ve UZAY SANAYİİ A.Ş.
TURKISH AEROSPACE INDUSTRIES, INC.
www.tai.com.tr

WRITING GOOD TECHNICAL REQUIREMENTS USING KIPLING METHOD IN AVIATION

16. ANNUAL SYSTEMS ENGINEERING CONFERENCE,
30, October 2013_Washington



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TAI (Turkish Aerospace Industries), Ankara - Turkey

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ESTABLISHMENT

May 1984

Establishment of TAI as a joint venture to manufacture F-16 aircraft in Turkey

January 2005

Procurement of Lockheed Martin / General Electric shares (%49) by TUSAŞ

April 2005

Merger of TAI and TUSAŞ

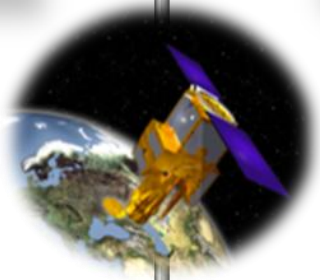
STRATEGICAL BUSINESS UNITS

AIRCRAFT

HELICOPTER

AEROSTRUCTURES

UAV SYSTEMS

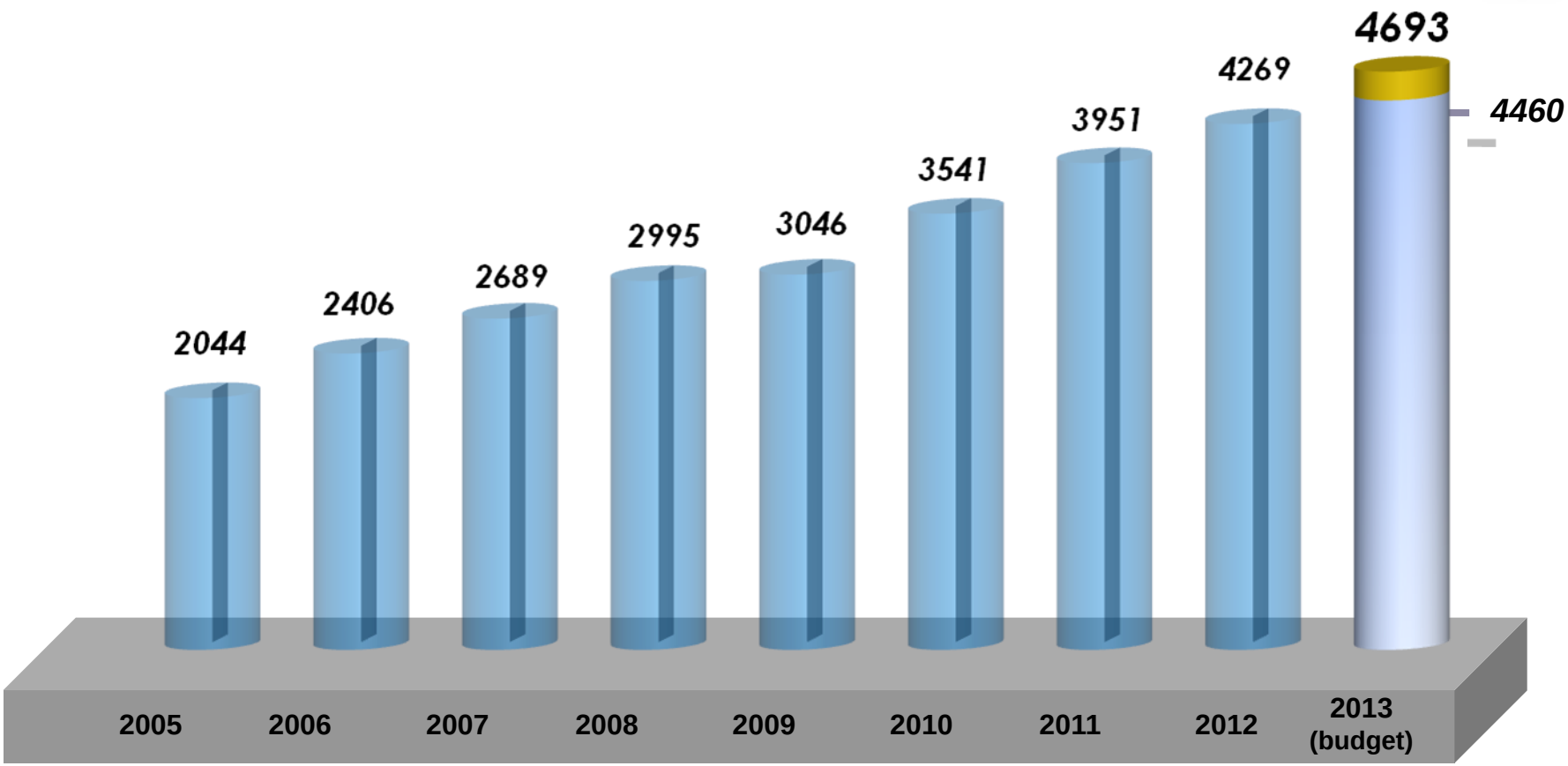


SPACE SYSTEMS

SPECIAL PROGRAMS

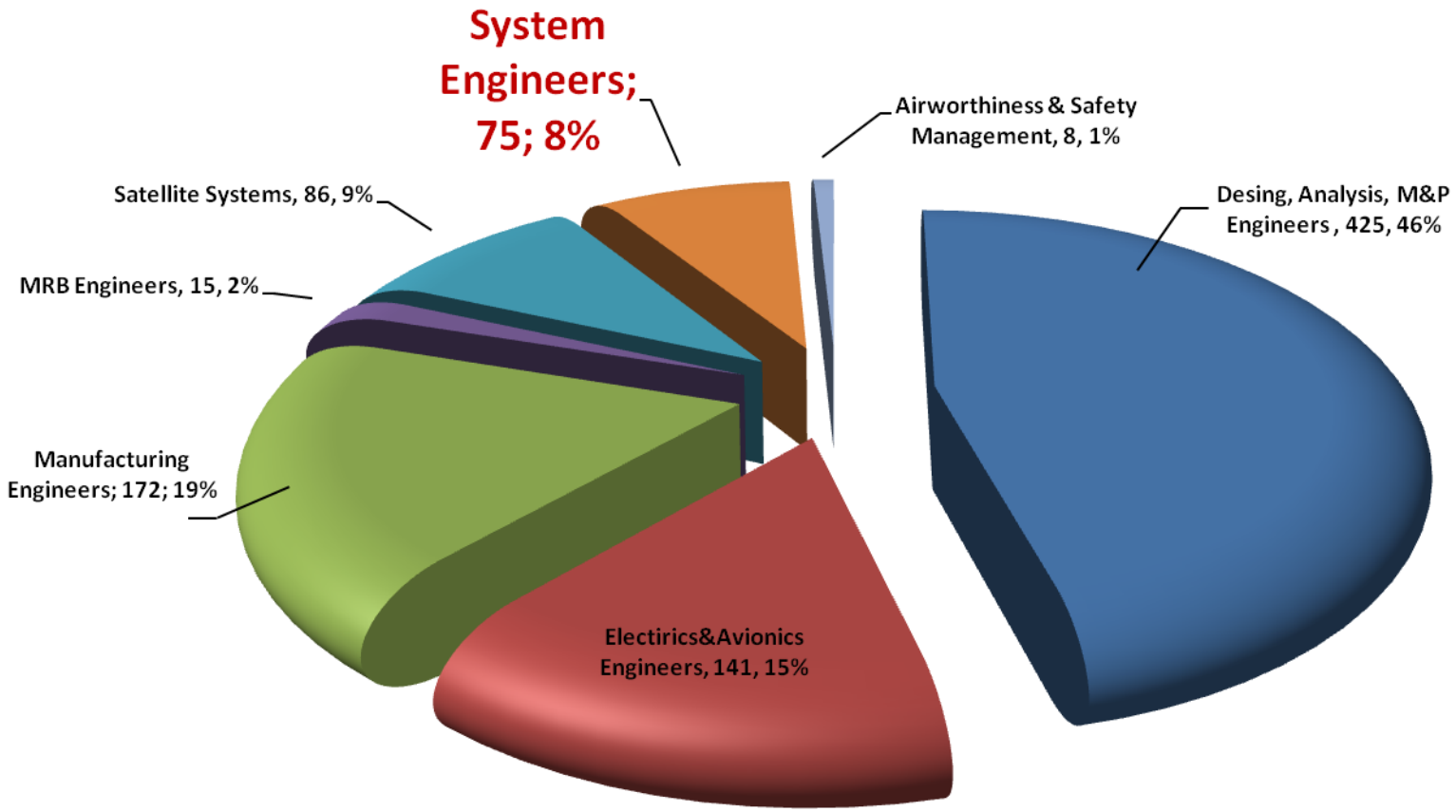
HUMAN RESOURCES

Manpower Histograph



TAI ENGINEERING RESOURCES

TOTAL TAI ENGINEERING RESOURCES : 922 (As of May 2013)



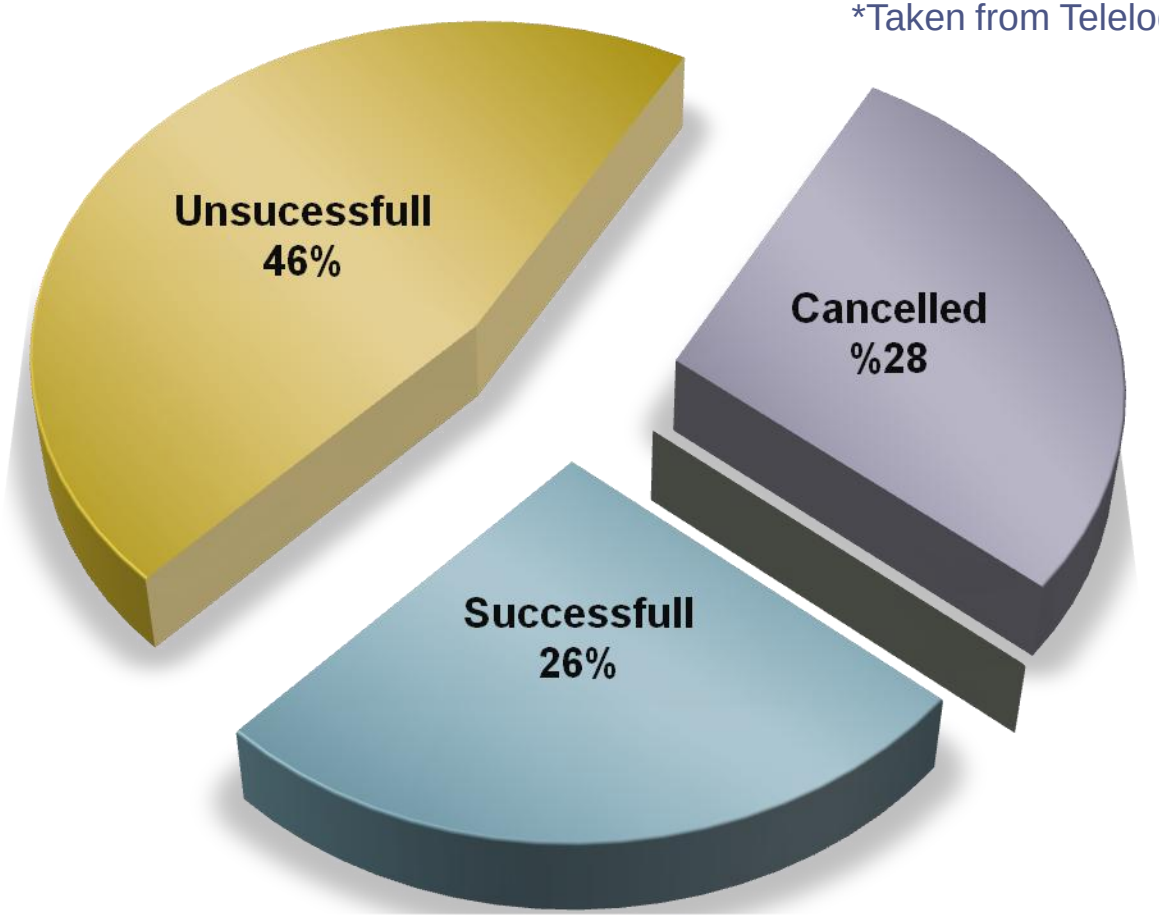
TAI INTERNAL CUSTOMERS

- BAE SYSTEMS
- BOEING
- BOMBARDIER
- LMAC
- LMMFC
- MARVIN ENGINEERING
- NORTHROP GRUMMAN
- SIKORSKY
- SPIRIT AEROSYSTEMS
- AGUSTA WESTLAND
- AIRBUS SPAIN
- AIRBUS MILITARY
- ALENIA AERMACCHI
- EADS-EUROCOPTER
- FOKKER
- IAMCO
- PAG
- RUAG AEROSPACE
- TELESPAZIO
- THALES

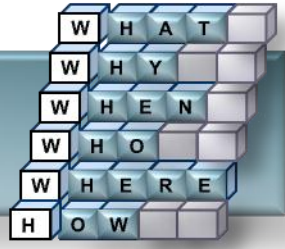
AMAZING FACTS...

- *The results of the statically study for the “Data Processing Technology Projects” performed by “Standish Group International, Inc.” in USA in 2000.

*Taken from Telelogic presentation



AS A CONCLUSION…

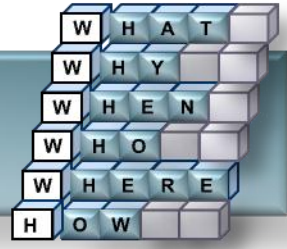


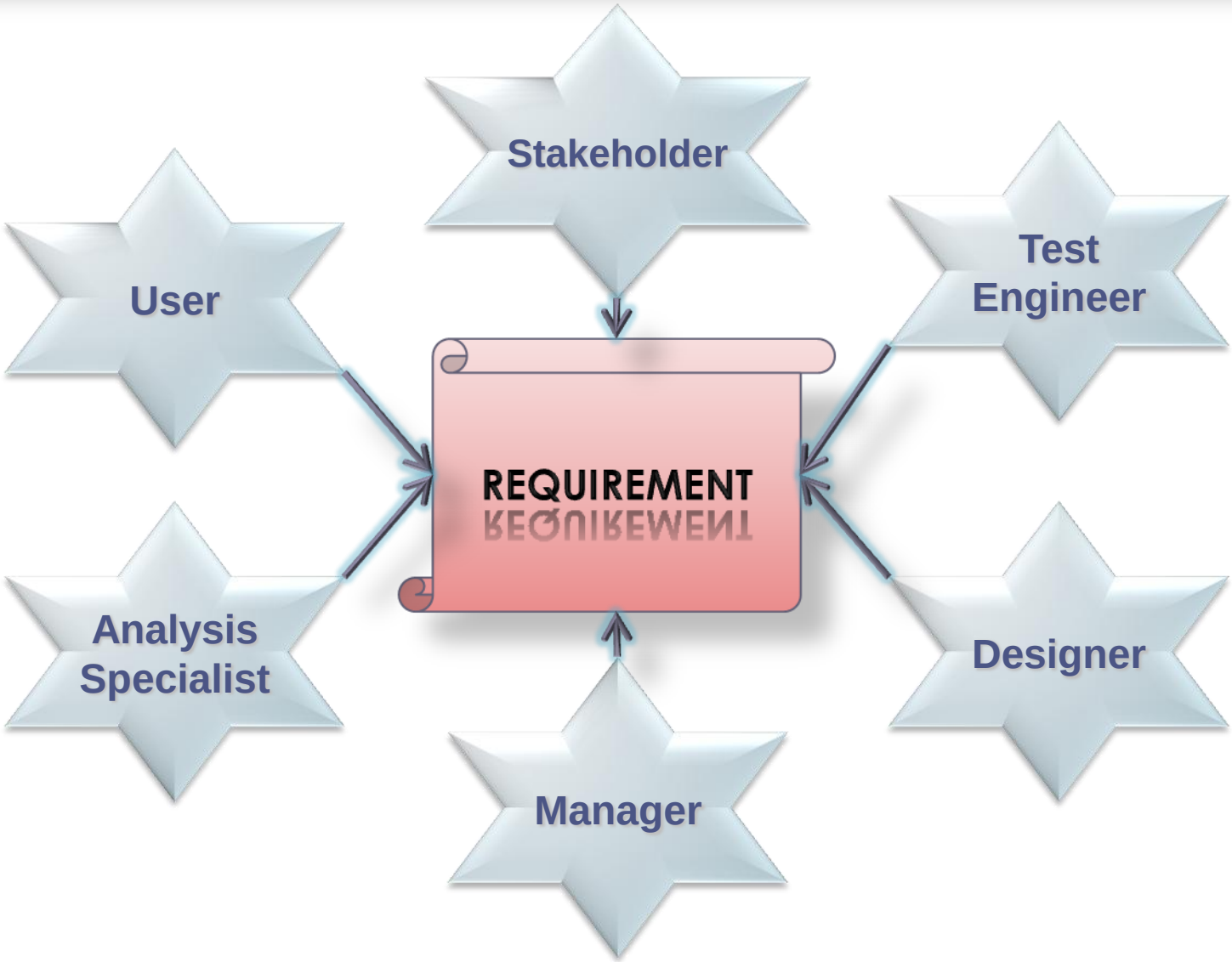
- The CAUSE of the problems are not related with the technical issues.

- %30 are related with management (source, calendar, support).

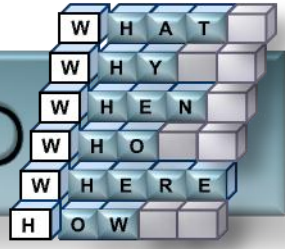
- **…%50 are related with REQUIREMENTS**

WHAT is the REQUIREMENT for you?



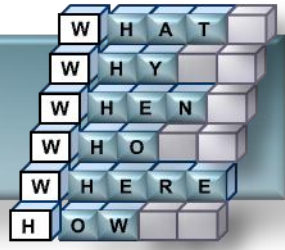


INTRODUCTION to KIPLING METHOD



- Kipling Method is a formula for getting the full story on something.
- Let you explore a problem or extend your ideas by challenge it with the questions; WHAT, WHERE, WHEN, WHY, HOW.
- Kipling method has a large application area in journalism, research and in police investigations.
- This presentations shows interpreting of Kipling Method in a different way to write requirement sets and writing good requirements.

"WHAT" QUESTIONS



- Three 'Whats' that may be asked in sequence to solve problems are:

➢**What** are you trying to achieve?	→	➢ The first question in a project to be asked.
➢**What** is the real problem?	→	➢ Determines the borders and helps choosing the correct items.
➢**What** is the solution?	→	➢ Never ask this question.

REQUIREMENT

"WHY" QUESTIONS

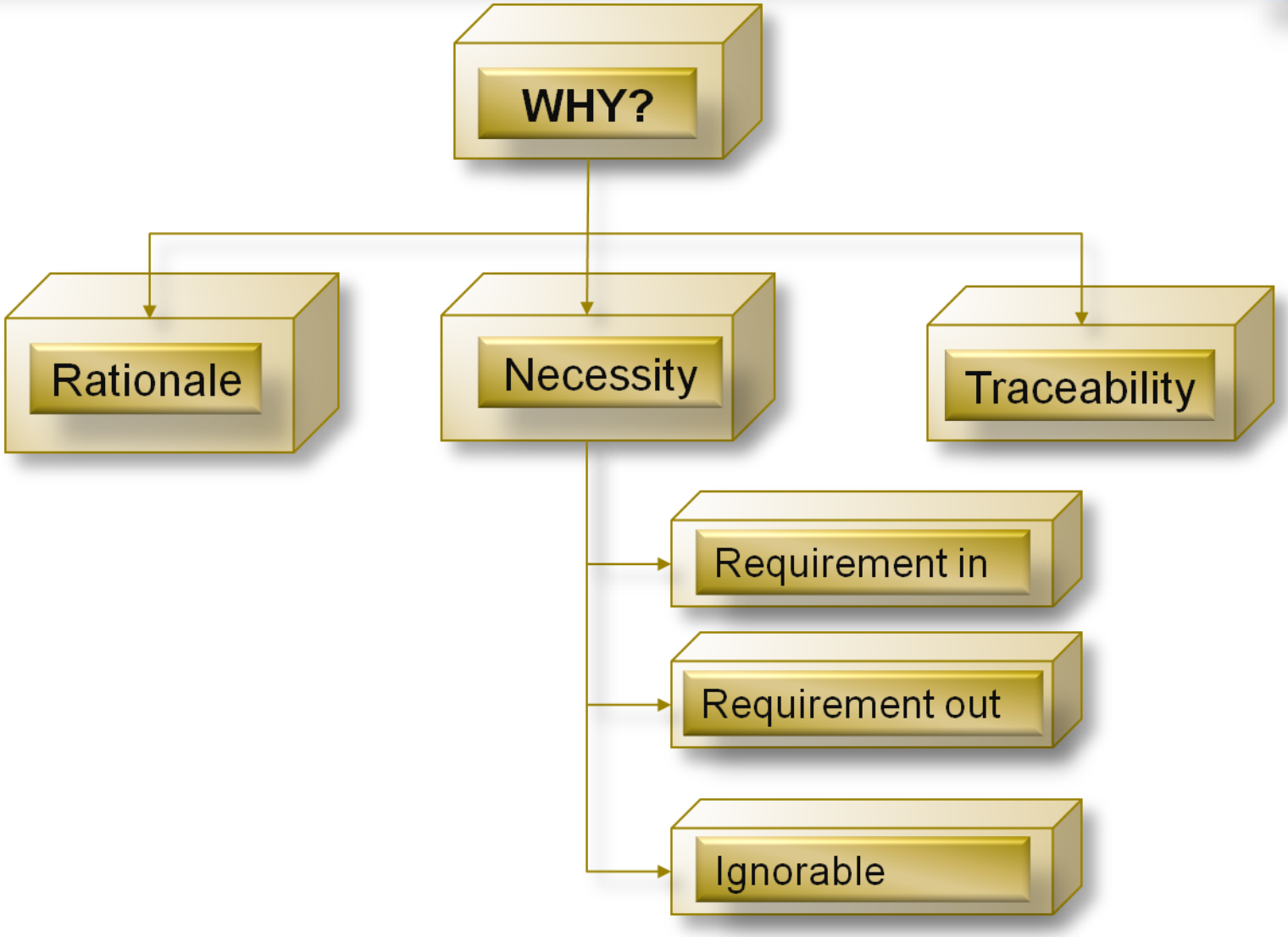
- The question "**why**" have to be asked to the answers of question "what".

- **Why** this requirement is composed?
- **Why** this requirement is needed?
- **Why** this requirement is important?
- **Why** not?

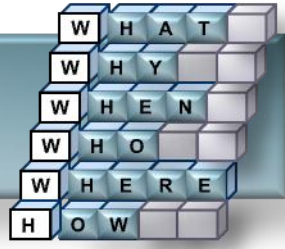
→

- Seeks cause-and-effect
- Deeper understanding
- Affects on the product
- Rationale
- Traceability
- GO, NO GO

"WHY" QUESTIONS



"WHEN" QUESTIONS



- The question "**when**" have to be asked to the answers of question what.
- When seeks location in time and it can be asked for two different aims.

➢ **When** the requirement will be in force? →	➢To be asked for systems with different scenarios and modes.
➢**When** the requirement will be verified? →	➢To be asked to determine phase/milestone

"WHO" QUESTIONS

- The question "**who**" has two dimensional usage.

➢**Who** are the stakeholders of this design/product?

➢**Who** is this product for?

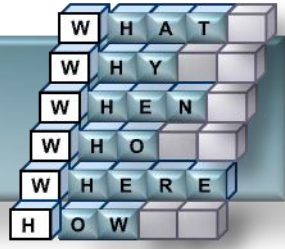
➢**Who** will benefit most from this product?

➢**Who** else would be interested?

➢to write the requirements with

➢to verify the requirements with

"WHERE/WHICH LEVEL" QUESTIONS



- The question "**Where/Which level**" have to be asked to the answers of question "what".

The question is:

- Where/which level this requirement will be verified.

Gives the verification levels as:

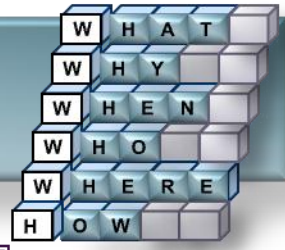
- Coupon
- Part
- Prototype
- Component
- Section
- Aircraft Level

"HOW" QUESTIONS

- The question "**how**" have to be asked to the answers of question "what".
- How' seeks verbs of verification process.

➢How this requirement will be verified?	→	➢ To determine verification methods
➢How can we achieve this?	→	➢ Never ask this question.

PROCESS CHART



WHAT

PROJECT

WHEN

MILESTONE

WHY

REQUIREMENT

SCENARIOS/MODES

RATIONALE

TRACEABILITY

WHO

WHICH LEVEL

STAKEHOLDER

VERIFICATION COMPONENT LEVELS

NECESSITY

Requirement in

Requirement out

Ignorable

HOW

VERIFICATION METHODS

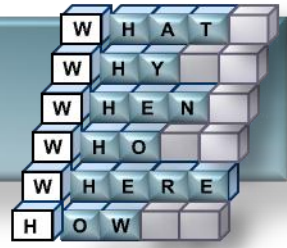
Questions

Attributes

TAI

EXAMPLES

EXAMPLEs USING KIPLING



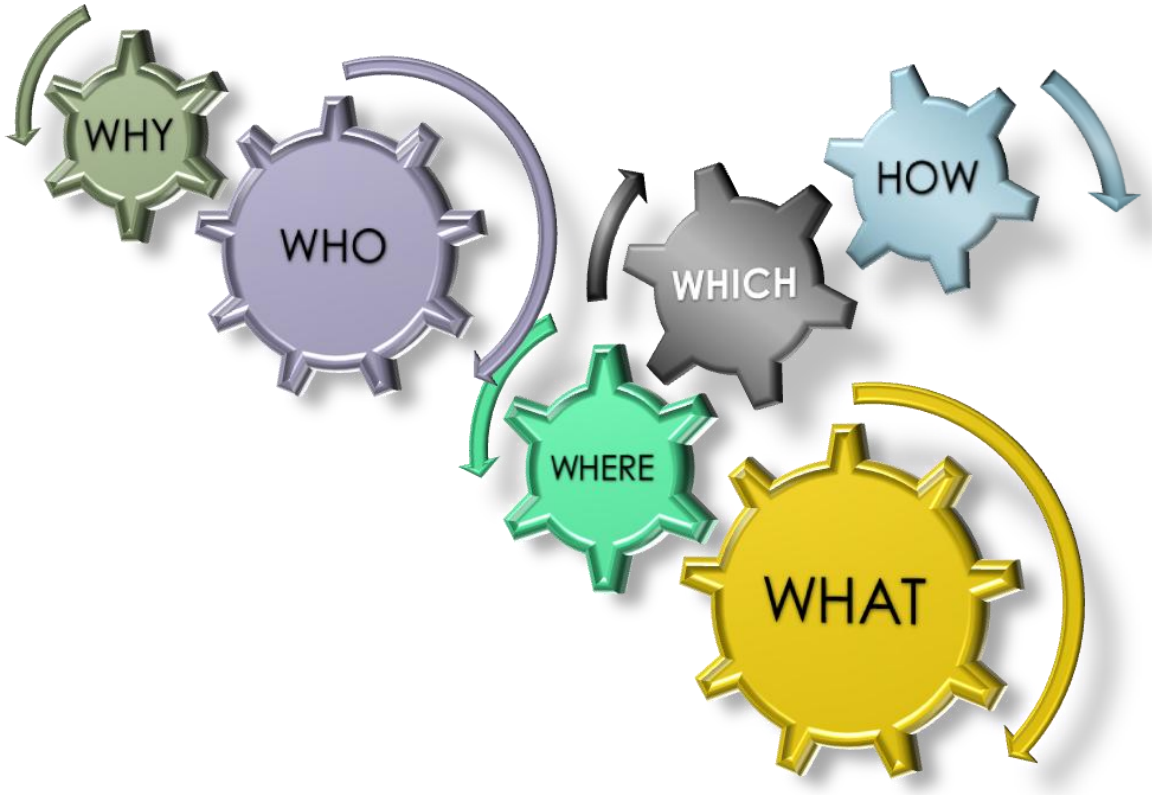
- Two different type examples are studied using the KIPLING METHOD

  - EXAMPLE 1:
    - To ensure the good requirements.

  - EXAMPLE 2:
    - Defining the requirements with attributes.

EXAMPLE_1 (1/9)

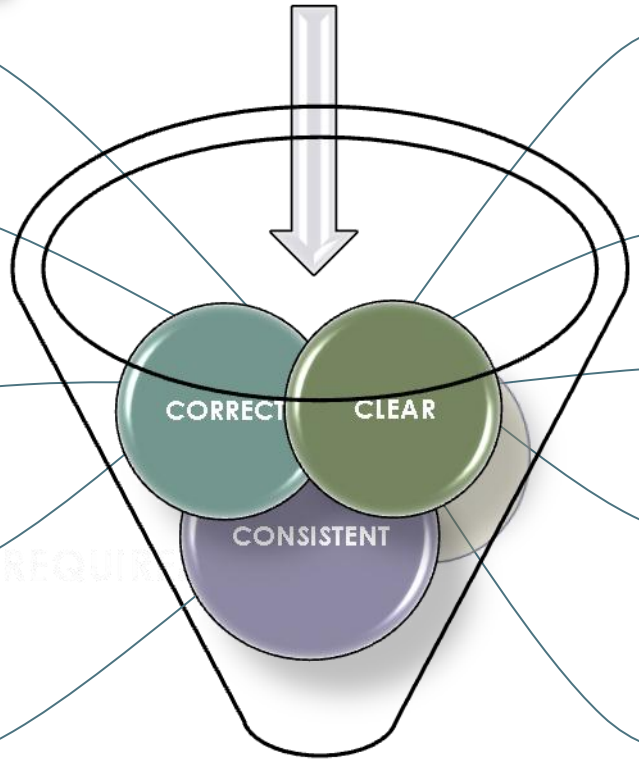
- To ensure the requirements quality by asking 5W and 1H questions.



EXAMPLE_1 (2/9)

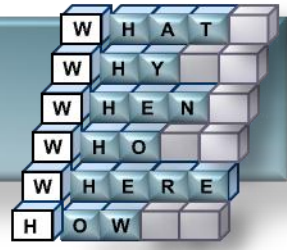
GOOD REQUIREMENTS

- Correctness
- Clearly defined
- Traceable
- Priority
- Feasible



- Completeness
- Consistency
- Verifiable
- Concise
- Design Independent

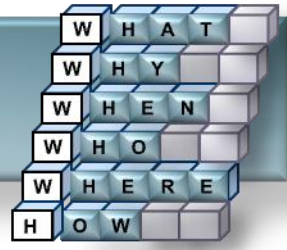
EXAMPLE 1_(3/9)



5W and 1H to be ensure the "CONSISTENCY":

- **W**hat is the inconsistency in the requirement?
- **W**hy the requirement is regarded as inconsistent?
- **W**here is the inconsistency?
- **W**hen the inconsistency will occur?
- **W**ho is responsible for the inconsistency?
- **H**ow will this inconsistency be eliminated?

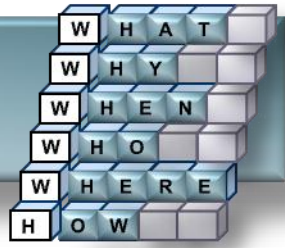
EXAMPLE 1_(4/9)



5W and 1H to be ensure the "VERIFIABLE":

- **W**hat is the verification evidence?
- **W**ho is responsible for the verification?
- **W**hy is the requirement is not verifiable, if so?
- **H**ow is it going to be verified?
- **W**hen or in **W**hich phase will this requirement will be verified?
- **W**here or **W**hich environment will this requirement be verified?

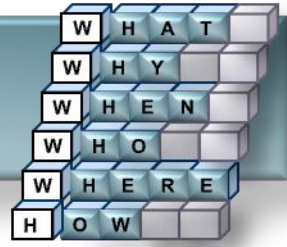
EXAMPLE 1_(5/9)



- **Correctness :**
  - ✓ **W**hat is the incorrect feature in the requirement?
  - ✓ **W**ho is responsible for the incorrect feature(s)?
  - ✓ **W**hy is the requirement regarded as incorrect?
  - ✓ **H**ow can an incomplete feature be corrected?
  - ✓ **W**hen can the incorrectness be a reason for a shortcoming?
  - ✓ **W**here is the error?

- **Clearly defined :**
  - ✓ **W**hat is the ambiguous feature of the requirement?
  - ✓ **W**hy is the requirement regarded as unclear?
  - ✓ **W**here is the ambiguity?
  - ✓ **W**hen can the unclear definition be a reason for a difficulty?
  - ✓ **W**ho is responsible for the unclear feature(s)?
  - ✓ **H**ow can an ambiguous feature be converted to a clear statement?

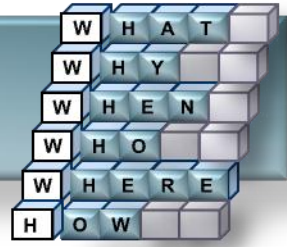
EXAMPLE 1_(6/9)



- **Traceable :**
  - ✓ **W**hat is the untraceable feature of the requirement?
  - ✓ **W**hy is the requirement regarded as untraceable?
  - ✓ **W**here is the untraceable feature?
  - ✓ **W**hen can the untraceable feature cause a problem?
  - ✓ **W**ho is responsible for the traceability of the required feature?
  - ✓ **H**ow can the feature in the requirement be made traceable?

- **Prioritized :**
  - ✓ **W**hat is the requirement feature not correctly prioritized or not prioritized at all?
  - ✓ **W**hy is the requirement regarded as not correctly prioritized?
  - ✓ **W**here is the feature not correctly prioritized?
  - ✓ **W**hen can the a feature not prioritized appropriately cause a problem?
  - ✓ **W**ho is responsible for the prioritization of the required feature?
  - ✓ **H**ow can the requirement be revised to make the feature(s) be prioritized?

EXAMPLE 1_(7/9)



- **Feasible:**
  - ✓ **W**hat is the unfeasible aspect of the requirement?
  - ✓ **W**hy this requirement unfeasible, if so?
  - ✓ **W**here is the unfeasibility?
  - ✓ **W**hen will the unfeasibility occur?
  - ✓ **W**ho is responsible for the unfeasibility?
  - ✓ **H**ow will the unfeasibility be eliminated?

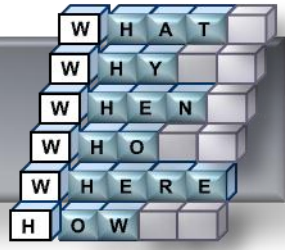
- **Design Independent :**
  - ✓ **W**hat is the depending feature?
  - ✓ **W**hy is it dependent?
  - ✓ **W**here is the dependency?
  - ✓ **W**hen will the dependency occur?
  - ✓ **W**ho is the responsible for the dependency?
  - ✓ **H**ow will the dependency be eliminated?

EXAMPLE 1_(8/9)

- **Concise :**
  - ✓ **W**hat is the inexplicit of the requirement?
  - ✓ **W**hy is the requirement regarded as inexplicit?
  - ✓ **W**here is the complication?
  - ✓ **W**hen can the be a reason for a shortcoming?
  - ✓ **W**ho is responsible for this confusion??
  - ✓ **H**ow will the confusion be eliminated?

- **Complete :**
  - ✓ **W**hat is the incompleteness in this requirement?
  - ✓ **W**hy is the requirement regarded as incomplete?
  - ✓ **W**here is the incompleteness?
  - ✓ **W**hen can the incompleteness be a reason for a shortcoming?
  - ✓ **W**ho is responsible for the incompleteness?
  - ✓ **H**ow can an incomplete aspect be remedied?

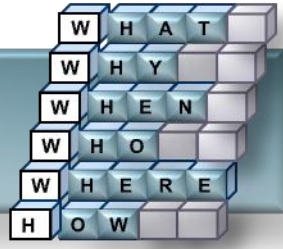
EXAMPLE 1_(9/9)



FORMULATION for THE QUESTIONs

QUESTIONs	Positive or Negative Questions?
What is the ….. (feature) in / of requirement?	Generally (-) Verifiable (+)
Where is the ……..?	Generally (-) Verifiable (+)
Why is the requirement (regarded as) …….?	Generally (-)
Who is responsible for the …….?	Generally (-) Verifiable and Traceable (+)
When will the ….. occur? When will the …. feature cause a problem **Just for verifiable, how is it going to be verified?	Generally (-) Verifiable
How can an …..(feature) corrected /eliminated /remedied? **Just for verifiable, how is it going to be verified?	Generally (-) Verifiable (+)

EXAMPLE 2_(1/9)



- **Example 2:** Writing requirements and related attributes by using 5W 1H

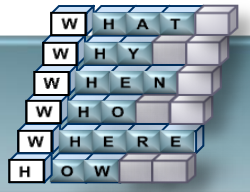
- The requirements have to defined with the necessary related attributes. Requirements without the attributes are meaningless!!

- In this example, two requirements and neccesary attributes of "**An Emergency Exit Doors used in Military A/C"** are studied by using 5W and 1H questions.

Requirement Attributes

- Requirement Number
- Rationale
- Additional Information
- Source
- Stakeholder
- Created on
- Author
- Maturity (Captured, Analyzed, Validated, Rejected)
- Allocation
- Verification Method
- Milestone

EXAMPLE 2_(2/9)



REQUIREMENT ATTRIBUTES

WHAT

- Requirement Number
- Additional Information
- Source

WHEN

- Created on
- Milestone

WHY

- Rational

WHO

- Stakeholder
- Author

HOW

- Verification Method

WHERE / WHICH LEVEL

- Verification Level
- Maturity
- Allocation

EXAMPLE 2_(3/9)

"WHAT" LIST FOR REQUIREMENTS CLASSIFICATION

- Emergency Exit Door
  - Storage / Packing / Transportation
  - General
  - Environmental
  - Physical
  - Design
  - Functional
    - Labeling & Marking
  - Interface
  - Load & Safety Factor
    - Materials & Corrosion Protection
  - Supportability / Maintainability

WHAT" LIST FOR REQUIREMENTS

Design	General	Supportability / Maintainability	Interface	Physical	Functional
Design principles	*Contractual Requirements*	*Lifting/Jacking concept*	*Installation design principles*	*Weight, not to exceed weight*	*Performance*
Vulnerability/survivability requirements in case of a military usage	*Certification requirements*	*Interchangeability requirements and interchangeable components*	*Tolerances*	*Dimensions in terms of width, height, cross section.*	*Speed*
General tolerances	*Directives, documents and applicable rules*	*Replaceability requirements and replaceable components*		*Top coat application*	*Different modes in accordance with the scenarios*
Greasing/lubrication		*Equipment, furnishing, handling systems*			
Roughness		*Accessibility*			
Lightning strike-protection		*Removable elements*			
EMI/EMC		*Repairability*			
Structure assembly requirements		*Human health goals*			
Design and product constraints		*Maintenance task*			
Producibility in terms of: *- Chemical milling, - Cleaning, -Forging, - Forming, - Hole preparation, -Machining - Inspection*		*Adjustment/calibration*			
Temperature , radiation, acoustic, pressured controlled area requirements					
Greasing/lubrication					

WHAT" LIST FOR REQUIREMENTS

Environmental	Materials & Corrosion Protection	Load and Safety Factor Load	Storage/ Package/ Transportation	Label & Marking
Temperature/Temperature variation/Altitude	*Material/Part reference documents*	*Fatigue loads design criteria:*	*Transportation /delivery related requirements*	*Marking (placards, nameplates, stencils, markings)*
Humidity	*Material*	*- For structural loads for fatigue and damage tolerance*		
Operational Shocks	*Heat treatment*			
Crash safety		*- For crash loads*	*Packaging /Storage*	
Vibration	*Corrosion protection practices i.a.w zones*	*Damage tolerance/resistance*		
Explosion Proofness	*Chemical surface treatments*	*Minimizing risk of damage*		
Waterproofness	*Sealant application*			
Fluid susceptibility	*Primer application*			
Sand and dust	*Lacquer application*			
Fungus Resistance				
Salt spray				
Magnetic Effect				
Power Input				
Voltage Spike				
Audio Frequency susceptibility				
Emission of radio frequency energy				
Lightning direct effects				
Icing				
Electrostatic Discharge				
Fire, Flammability				
Erosion				
Ditching				

EXAMPLE 2_(6/9)

CASE STUDY 1_(1/3)

What is the requirement ?

W

FUNCTIONALITY

The Emergency Exit Doors shall be capable of manual opening and closing from inside the Aircraft and capable of manual door opening from outside.

What is it Number	When is it created ?	What is the Source?	What is the Additional Information
W	W	W	W
RQ-FCF-DOORS-011	10.09.2013	Contract	Ground test on Aircraft for opening from inside and outside will be done by A/C Level

EXAMPLE 2_(7/9)

CASE STUDY 1_(2/3)

What is the requirement ?

W

FUNCTIONAL

The Emergency Exit Doors shall be capable of manual opening and closing from inside the Aircraft and capable of manual door opening from outside.

Who is this requirement for?

W

-Designer
-Test Specialist
-Analysis Specialist
-User
-Contractor

Why is it needed?

W

To Define Functionality

How is it verified?

H

-Design Documents
- Ground Tests
- Laboratory Tests
- Equipment Qualification-

Which Maturity Level

W

Validated

EXAMPLE 2_(8/9)

CASE STUDY 1_(3/3)

What is the requirement ?

W

FUNCTIONAL

The Doors shall be capable of manual opening and closing from inside the Aircraft and capable of manual door opening from outside.

Allocated to Which parts?

W

Doors Equipment

When is it verified?

W

-C-MAT (Critical design review)
-FAL (Final Acceptance Line),

Which Level be verified?

W

-Equipment Level
-Component Level
-A/C Level

EXAMPLE 2_(9/9)

➢ Application for a physical requirement is given by selecting only one question for each of 5W and 1H questions

CASE STUDY 2

Stakeholder, Rationale Verification Method, Verification Level, Milestone

What is the requirement ?	Who is this requirement for?	Why this req. is needed?	How this req. is verified?	Where/ Which level?	When Verified
W	W	W	H	W	W
PHYSICAL	- Designer - Analysis Specialist	To Define Dimensions	-Techical Drawings	Component Level	PDR
The emergency exit door shall have a diameter of not less than 0.90 metres.					

REFERENCES

- ✓ Writing a Requirements Document_ Rachel S. Smith 2
- ✓ Kipling questions_Changingminds.org
- ✓ Specifying Good Requirements_Donald Firesmith, Journal of Object Technology, 2003
- ✓ Telelogic Presentation

THANK YOU