The Systems Engineering Tool Box

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"Give us the tools and we will finish the job"
Winston Churchill

Systemic Textual Analysis (STA)

What is it and what does it do?

Systemic Textual Analysis (STA) is concerned with the analysis of expressed customer requirements with the purpose of interpreting, expanding and clarifying and identifying missing requirements. It uses a systems approach through the consideration of a Holistic Requirements Model to help identify deficiencies and omissions in the source requirements.

Why do it?

Customers typically express[1] requirements that are:

- Inconsistent with themselves and other requirements
- Incomplete
- Ambiguous and vague
- Un-measurable and therefore difficult to verify.

In order to understand and derive what the customer actually requires we need to analyse their expressed requirements in order to:

- Identify where there is ambiguity
- Check for completeness and consistency
- Identify and derive missing requirements
- Identify unnecessary requirements.

which can be discussed with the customer for clarification and agreement.

Where and when to use it?

STA is used to analyse customer/stakeholder expressed requirements and is conducted wherever we need to gain a greater understanding of the customers' needs. It is particularly useful when the customer /stakeholders have expressed a large number of requirements. It is less applicable if the customer only provides relatively few requirements or just a statement of need. It is often a "good" starting point for requirements analysis. (it will, at least, force the analysis team to read the requirements).

[1] The verb express is used to cover verbalised and well as written requirements

Who does it?

STA is team based tool. An individual can use it, but maximum benefit is achieved when used by a multi-disciplinary team to promote discussion and arrive at a shared and common understanding. This is particularly relevant during the early stages of system development. It is best performed by a team that comprises people with expertise of the prime system's expected life cycle. As the development moves into detail design then STA can be performed by the individual designer, however, there is risk of that individual introducing their own personal bias.

How to do it?

Background

Requirements are defined as a "specific need or want" of a particular customer or stakeholder. The requirements for any system are numerous and it is logical to categorise them to aid understanding. There are many ways to categorise requirements such as:

Performance requirements
Safety Requirements
Legal Requirements
Interface requirements
Sub-system requirements
Financial Requirements
Human interaction requirements
etc

While these categories can provide a useful focus they do tend to (unwittingly) emphasise solutions and constraints. In turn this inhibits innovative design and often leads to a sub-optimal system design. This is not to say that we should not use these categories, but we should be aware of bias they introduce. Clearly what is needed is a way of categorising requirements that contribute to understanding the problem in a general way. This can be achieved through a systems approach to requirements. Indeed applying systems thinking to requirements leads to the Holistic Requirement Model. Systemic Textual Analysis makes use of the categories of the Holistic Requirements Model to identify requirement deficiencies and omissions. To use the tool successfully requires an understanding of the Holistic Requirements Model and its associated requirements categories that are shown in Figure 1.

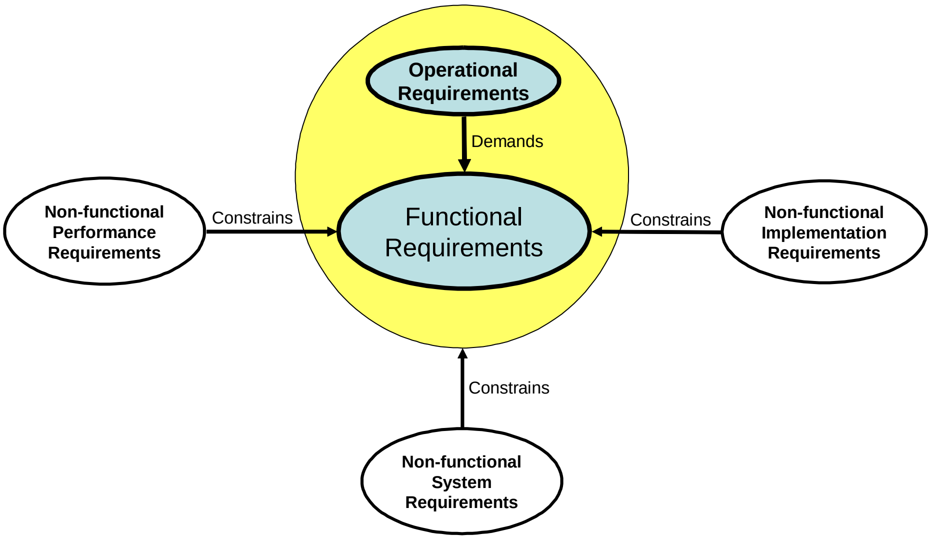

Figure 1: The Holistic Requirements Model[2]

The Holistic Requirements is so called because it provides a complete and consistent model for classifying and structuring any set of requirements of a system. Indeed, it is important to recognise the mutually supportive nature of the relationships between the requirement categories although this cannot be discussed fully until we understand the categories. Furthermore, it is only truly understandable as a whole and isolated consideration of the component requirement types is ephemeral.

He model assumes that the requirements relate to the specification of a system and comprises three basic types:

- Operational Requirements
- Functional Requirement
- Non-functional Requirements

With a further sub-classification of the Non-Function Requirements set into:

- Non-functional Performance Requirements
- Non-functional System Requirements
- Non-functional Implementations Requirements

The following defines the various requirement categories.

[2] This requirements model has its origin in the work performed by BAe (Now BAE SYSTEMS) in defining a software/systems tools called CORE [Cuzin].

Operational Requirements define the major purpose of a system (i.e. what it fundamentally does; its capability) together with the key overarching constrains.

For example:

System	Operational Requirement
Toaster	To toast bread products safely
Dish Washer	To clean eating and cooking utensils without damage
Civil Aircraft	To transfer passengers and their baggage from one point to another safely

The operational requirement(s) is a succinct clear and unambiguous statement as to what the system fundamentals does allied with the key constraints. The key constraints are often the critical Non-Functional System Requirements (see later). Furthermore their origin can be from several stakeholders.

It cannot be emphasized how important the operational requirements of a system are – all systems will have them – but they may not be written down. Experience shows that customers rarely specify operational requirements they believe it is obvious. It is not obvious and it is important to expend effort in developing operational requirements that all parties are happy with. There are two reasons for this:

1. The operational requirements provide precise direction for the system development team. Without an operational requirement individual team members will develop their own internal version. These may be similar but they will be different and those differences will obviate any collective focus.
2. The operational requirement will demand certain system functionality that forms the basis of the functional requirements.

Functional Requirements specify what the system has to do in order to achieve the operational requirement.

For example some of the functional requirements of a civil aircraft are:

navigate from one point to another
control flight
store passengers
control cabin environment
communicate with other aircraft and ATC
etc

There are several points to note about functional requirements:

1. A functional requirement defines what has to be done – not how it is done or how well it is done. A functional requirement is a function of the system.

2. Functional requirement is therefore a verb or verb phrase = verb-noun
   - No verb – not a function – noun-verb –not a function
   - A phrase can have a verb but not be a function! For example "easy to use" has a verb but this is not a function – we don't say the system "does easy to use" it has "to be easy to use" – a property or attribute. The best verbs are active regular verbs as opposed to passive irregular verbs. Having a verb in a requirement is a necessary but not sufficient condition for a functional requirement.
3. There are many levels of functions in a system. We should attempt to determine all of them.
4. Functions often transform inputs to outputs.
5. If you cannot "ing" it - it is not a function. You can have sensing, loading, etc , but cannot have "safeting".
6. When identifying functional requirements we need to be clear on what is the system of interest.
7. When defining functional requirements we should avoid including performance qualifiers such as:
   - Toast bread quickly
   - Even toasting of bread
8. They should be implementation independent (the choice of the expression "store passengers" is deliberate to avoid the use of "seat passengers" which clearly infers the solution).

Non-functional Requirements are constraints on the system and fall into three categories:

- **Non-functional Performance Requirements** are associated with corresponding functional requirements and define how well a particular function has to perform – they are the constraints on that function. A non-functional performance requirement is therefore an attribute or property measure together with target value. An example of the Non-functional Performance Requirements for the navigation function of the airliner system is shown below

System	Function	Non Functional Performance Requirement
Aircraft	Navigate	Timeliness < 10 seconds update Accuracy ± 1km in 4000km Precision standard deviation < 1km Reliability < MTBF 1000hrs Weight < 56kg etc

- **Non-functional System Requirements** define the constraints that affect the whole system and include:

    - Physical Attributes
        - Style
        - Size
        - Weight
        - etc
    - The ilities
        - Reliability
        - Maintainability
        - Interoperability
        - Deployability
        - etc
    - System Performance
        - Cost
        - Speed
        - Manoeuvrability
        - etc

- Contractual/commercial requirements. For example, the system must be ready for trials by a particular date. These are equally important to capture and understand as they may affect the design and technology to be adopted. Indeed, it may be appropriate to separate this type of Non-functional System Requirement into its own contractual/commercial category. The danger of doing this is that they can be forgotten by engineering.

It is important to note that there are two categories of performance requirements. Those that are associated with a specific function (Non-functional performance requirements) and those that are associated with the whole system (Non-functional system requirements). It is important to (but sometimes difficult to) distinguish between them. In the early stages of system development, particularly if it is an unprecedented system, it may not be clear is a particular performance requirements is at the functional or system level. Faced with uncertainity about whethera particular requirement is Non-Functional System or Non-Functional Performance a good starting point is to categorise it as Non-Functional Performance and test whether it implies any functions. This approach will be discussed in more later.

- **Non-functional Implementation Requirements** define how a system is to be built in terms of specific technology. They are specific requirements from the customer about a solution they require or legislative requirements.

System	Function	Non-functional Implementation Requirement
Toaster	Receive Power	UK domestic 13 amp plug to BS 1363
Dishwasher	Remove Waste	Electric pump
Civil Aircraft	Communicate	Phillips A/C 1267 VHF radio

These requirement types allow for the construction of the holistic requirements model shown in Figure 1. This model is driven by the operational requirements and contains the functional requirements at its heart. It is through the provision of the functionality that the operational requirement is delivered. The non-functional requirements describe the expectation levels of the customer and constrain the functionality.

As an aside having defined the categories and structure of the Holistic Requirements Model it is easy to see the problems with conventional requirements documents. In practice the expressed written requirements are organized around operational, performance, contractual etc. requirements. This selection of "sections" naturally leads to an emphasis on the non-functional requirements. Moreover, the constraining non-functional requirements typically reflect the current state of knowledge and therefore may be present in great detail or may even be absent. Finally, the functional requirements and even operational requirements are often not expressed but implied through the non-functional performance requirements. This is not surprising since customers are interested in performance and attributes: they are not really interested in how a system works but how well it works. In conclusion the requirements document is confused and unstructured. Moreover any analysis that follows results in a design specification that is also confused and unstructured.

Process

Systemic Textual Analysis is a three step process as shown in Figure 2.

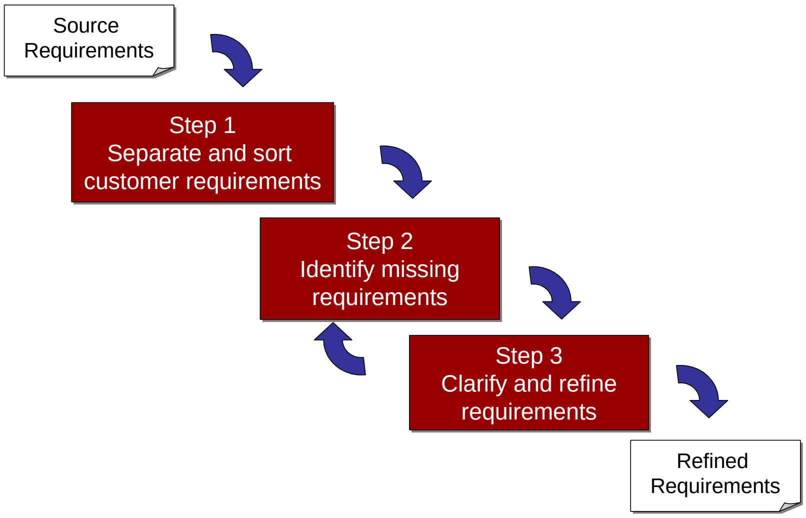

Figure 2: Systemic Textual Analysis Process

The following will describe these steps in more detail and illustrate the tool with an example analysis of the Intelligent Washing Machine Requirement given in Appendix A. Note that this requirements document, while based on a set of real requirements, has been modified to illustrate Systemic Textual Analysis.

Step 1: Separate and Sort Requirements

- The team takes each expressed requirement and categorises them according to the Holistic Requirements Model. Expressed requirements are often conjunctions of several requirements and it is necessary to decompose these into their atomic elements. For example one of the requirements for the Intelligent Washing Machine is

2.9 The machine will wash, rinse and spin-dry (1600 rpm is desirable) the clothing as appropriate to load and type

While the "customer" wrote this as one requirement it is in fact a conjunction of several and as such needs decomposing into its atomic requirements as:

2.9.1.1 The machine will wash the clothing
2.9.1.2 The washing will be performed as appropriate to load and type
2.9.1.3 The machine will rinse the clothing
2.9.1.4 The rinsing will be performed as appropriate to load and type
2.9.2 The machine will spin-dry the clothing
2.9.3 The spin-drying will be performed as appropriate to load and type
2.9.4 The desired spin-dry performance is 1600rpm

Each of these atomic requirements can now be categorised. Which in this case gives?

Requirement 2.9		Requirement Type
2.9.1	The machine will wash the clothing	Function
2.9.2	The washing will be performed as appropriate to load and type	Non-Functional Performance
2.9.3	The machine will rinse the clothing	Function
2.9.4	The rinsing will be performed as appropriate to load and type	Non-Functional Performance
2.9.5	The machine will spin-dry the clothing	Function
2.9.6	The spin-drying will be performed as appropriate to load and type	Non-Functional Performance
2.9.7	The desired spin-dry performance is 1600rpm	Non-Functional Performance

The analysis undertaken in step 1 needs to be organised and captured in some way and I recommend the use of the pro-forma shown in Figure 3. The format of this pro-forma is such that it helps to identify where requirements are missing. While this pro-forma, especially and electronic version can be used for any subsequent requirements management better software based packages exist for this ongoing task

Figure 4 shows the outcome of step 1 for the Intelligent Washing Machine Requirements. There are a few points to note about Figure 4.

- Part of the requirements document provides background information about the proposed system. This should be captured as "context"

- While some background information is provided there is no clearly expressed operation requirement. This is actually typical and in such cases the approach should be develop one. This itself is not easy and is balance between succinctness and capturing the essence of the problem. It is important, however, in such situation to find a way of validating the "derived" operational requirement.

Systemic Textual Analysis			
Project:			Date:
Author:			Issue:
Requirements			**Comments**
Context:			
Operational Requirement:			
Non-functional System Requirements:			
Non-Functional Implementation Requirement	**Functional Requirement**	**Non Functional Performance Requirement**	

Figure 3: The Systemic Textual Analysis Pro-forma

<table>
<tr><th colspan="4">Systemic Textual Analysis</th></tr>
<tr><td colspan="3">Project: Intelligent Washing Machine</td><td>Date:</td></tr>
<tr><td colspan="3">Author:</td><td>Issue:</td></tr>
<tr><td colspan="3">Requirements</td><td>Comments</td></tr>
<tr><td colspan="3">Context:
Studies demonstrate that there are an increasing number of single persons with relatively high disposable incomes. Their lifestyle and priorities are such that they wish to minimise domestic chores. An opportunity therefore exists for an intelligent washing machine that is capable of automating much of the current manual functionality associated with washing domestic items.</td><td></td></tr>
<tr><td colspan="3">Operational Requirement:
To automatically clean domestic items without damage</td><td></td></tr>
<tr><td colspan="3">Non-functional System Requirements:

minimise domestic chores
complement our existing top of the range model
should be a “lifestyle statement”
attractive and distinctive.
sell between 50,000 to 75,000 per annum
selling price must be in the region of £550 - £650 (including VAT).
standard size (595x580x850)
take a standard 5kg load
easy to use
average useful life of the machine is to be 7 years
first year failure rate is to be less than 10%
the noise level at any point in the operational cycle shall not exceed 91.5db
vibration levels should not exceed 0.5g rpms and 3.2g peak
energy efficiency should be grade A
must conform to UK and EU safety standards.</td><td></td></tr>
<tr><td>Non-Functional Implementation Requirement</td><td>Functional Requirement</td><td>Non Functional Performance Requirement</td><td></td></tr>
<tr><td></td><td>Determine Load Make up</td><td></td><td></td></tr>
<tr><td></td><td>Determine mixed loads</td><td></td><td></td></tr>
<tr><td></td><td>Determine best cleaning cycle</td><td></td><td></td></tr>
<tr><td></td><td>Inform user of extreme loads</td><td></td><td></td></tr>
<tr><td></td><td>Inform user of current status</td><td></td><td></td></tr>
<tr><td>Standard Single phase 230V 50 Hz ac</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Appropriate temperatures to fabric type</td><td></td></tr>
<tr><td></td><td>Inform user of wash cycle</td><td></td><td></td></tr>
<tr><td></td><td>Override washing cycle</td><td></td><td></td></tr>
<tr><td>Wash</td><td></td><td></td><td></td></tr>
<tr><td>Rinse</td><td></td><td></td><td></td></tr>
<tr><td>Spin</td><td></td><td>1600rpm spin speed</td><td></td></tr>
<tr><td>Currently Available Detergents</td><td></td><td></td><td></td></tr>
<tr><td>Domestic Water</td><td></td><td></td><td></td></tr>
</table>

Figure 4: Outcome of Step 1 for the Intelligent Washing Machine Requirements

Step 2: Identify Missing Requirements

The Systemic Textual Analysis pro-forma is organised in such a way to highlight where there are missing requirements. This is based upon implications of the Holistic Requirements Model shown in Figure 5.

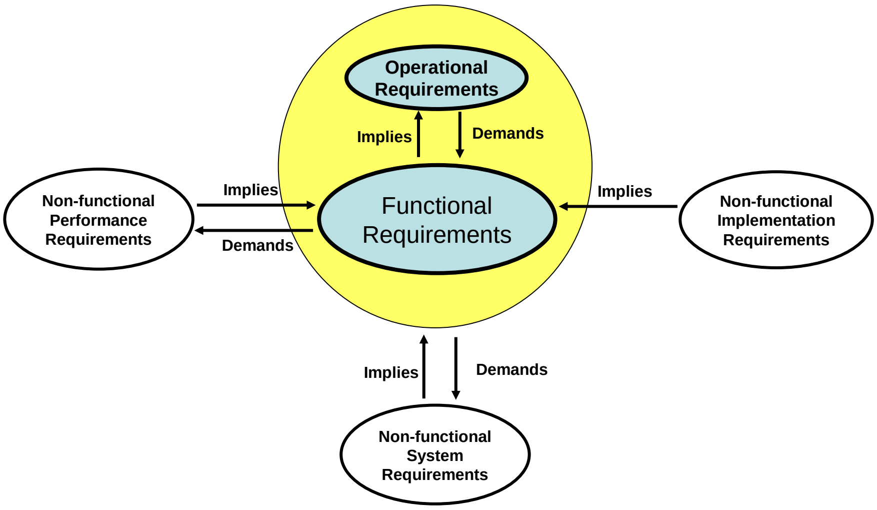

Figure 5: The implications of the Holistic Requirements Model

Figure 6 tells us that if the customer has expressed a Non-functional Performance Requirement this will imply certain functionality. For example requirement 2.7:

2.7 It will operate at appropriate temperatures and wash cycles most suitable for the fabric type, which are determined by the machine.

contains the Non-functional Performance requirement:

Appropriate temperatures most suitable for the fabric type

This implies the Functional Requirement to "Heat Water". In other words we can use the relationships of the Holistic Requirements Model to derive requirements. This relationship works both ways - that is an expressed Functional Requirement demands a number of Non-functional Performance Requirements. For example requirement 2.2:

2.2 The machine must be easy to use and will be capable of determining the load make up and fabric characteristics and thence the best cleaning cycle.

contains the Functional Requirement

determine the load make up

This requirement begs the question "how well do we need to determine the load make up?" The answer of course is a set of Non-functional Performance Requirements – (which are not easy to derive in this case but at least we have recognised the need to think out this issue).

Non-functional Implementation Requirements also imply Functional Requirements. For example requirement 2.5

2.5 The machine will use domestic water and currently available detergents.

contains the Non-functional Implementation Requirement:

2.5 The machine will use currently available detergents.

This requirement implies, at the highest level, the functional Requirement:

Manage Detergent

This can be further decomposed into:

Manage Detergent Load Detergent Dispense Detergent Mix Detergent and Water

Having derived these Functional Requirements we now need to consider their associated Non-functional Performance Requirements.

The layout of the pro-forma is such that the examples described above result in “gaps” as shown in Figure 6.

“Gap” Missing Requirements

Non-Functional Implementation Requirement	Functional Requirement	Non Functional Performance Requirement
	Determine Load Make up	
	Determine mixed loads	
	Determine best cleaning cycle	
	Inform user of extreme loads	
	Inform user of current status	
Standard Single phase 230V 50 Hz ac		
		Appropriate temperatures to fabric type
	Inform user of wash cycle	
	Override washing cycle	

“Gap” Missing Requirements

Figure 6: Gaps in the partially complete pro-forma

Further Functional Requirements can be derived from a consideration of the Operational Requirement. The Operational requirement contains the definition of major purpose of the system. This can be used to logically develop unexpressed functionality. The assumption here is that the customer has expressed an Operational Requirement. As a general statement this is not generally the case although they may provide sufficient information to deduce one. Indeed, as stated earlier, the Intelligent Washing Machine requirement does not provide a clear concise Operational Requirement. However, it does give enough for the development of a provisional version such as:

To automatically clean items without damage

This provisional Operational Requirement should be verified or confirmed by the "customer". Not-withstanding that it does provide a mechanism for generating further functionality by asking the question:

What does the system have to do to automatically wash items without damage?

An important point to note here is the choice of the word "system" rather than "machine". This is deliberate and its purpose is to encourage the team to think about the system functionality rather that the equipment functionality. There is an unwitting tendency for humans to focus on the "thing" the object, in this case the machine rather that the system which often includes the human user. For example if we say the system comprises the human user and the machine then one of the functions is to load the system. This ostensibly is a human activity (function) which needs to be provided for in the machine – that is most machines have a door! If we were to take a machine centric view - that is treat the system as the machine - it is highly likely that loading would be ignored!

In essence the structure and relationships of the Holistic Requirements Model provides a framework for undertaking a type of "detective work" to develop and derive missing and implied requirements. These should be added to the STA pro-forma. An important point to note here is traceability of requirements. It should be made clear which requirements have been derived and which have come from the original source requirements.

Figure 7 shows the lower half of systemic textual analysis pro-forma for the Intelligent Washing Machine following steps 2. The items in ***bold italics*** are those that have been derived.

Non-Functional Implementation Requirement	**Functional Requirement**	**Non Functional Performance Requirement**
	Determine Load Make up	
	Determine mixed loads	
	Determine best cleaning cycle	
	Inform user of extreme loads	
	Inform user of current status	
Standard Single phase 230V 50 Hz ac	***Supply Power*** ***Receive Power*** ***Distribute Power***	
	Heat Water ***Measure Water Temperature***	Appropriate temperatures to fabric type
	Inform user of wash cycle	Continuously
	Override washing cycle	
Wash	***Clean Items***	
Rinse	***Remove excess cleaning Agents***	
Spin	***Remove cleaning Fluids***	1600rpm spin speed
Currently Available Detergents	***Manage Detergents*** ***Load Detergent*** ***Dispense Detergent***	

	Mix Detergent & water	
Domestic Water	***Supply Water*** ***Receive Water***	
	Load Dirty Items	
	Unload Cleaned Items	

Figure 7: Output of Step 2 of Systemic Textural Analysis.

Step 3: Clarify and Refine Requirements

There is almost universal agreement that a good requirement should be:

- Clear and unambiguous
- Consistent with itself and other requirements
- Complete
- Verifiable

This means wherever possible requirements should:

- be defined one at a time avoiding conjunctions that result in multiple requirements
- avoid let out clauses
- use simple direct sentences
- identify the stakeholder who wants each requirement
- focus on stating what the result is to be provided
- define verifiable criteria
- define the level of compliance sought through Should, Shall, Must, and Will.

The last bullet point in the list is rather important, primarily because we probably all have a different interpretation of the words and their meaning yet use the words interchangeably. A common usage is given below in Table 1.

Compliance level	Definition
Must	Indicates either a mandatory requirement that originates in the laws of the land, or an inevitable consequence due to the laws of physics
Shall	Indicates a mandatory requirement
Should	Indicates a desirable requirement
May	Indicates either an optional requirement, or a statement relating to how mandated requirements can be achieved
Will	Indicates either a statement of intent, or a statement relating to something outside the scope of the product being developed, but that is relevant to the product

Table 1: Requirement Compliance Level Definition

While Table 1 is useful reference, it should never be assumed that customers or suppliers work to the same definitions. Every Requirements Document must contain the definition of requirement compliance that has been used.

Step 3 therefore demands that the individual requirements identified in step 2 should now be examined one at a time checking:

- is it correct? (is it asking for something possible?)
- is it complete? (is it a sentence?)
- is it clear? (is it unambiguous in simple direct language?)
- is it consistent? (with the other requirements)
- is verifiable? (is there a way in which we can demonstrate that we have met this requirement?)
- is it reasonable? (customers often use “must” when “should” is appropriate for technical or cost reasons).

In answering these questions we may need to seek clarification from the customer. We should avoid making assumptions, but if there is no choice clearly document the assumption. The requirement should be, if necessary, rewritten to have positive outcomes to the above questions. The outcome should be a clear, concise, consistent set of requirements. This is illustrated with the Intelligent Washing Machine in Figure 8.

Systemic Textual Analysis			
Project: **Intelligent Washing Machine**			Date:
Author:			Issue:
Requirements			**Comments**
Context: Studies demonstrate that there are an increasing number of single persons with relatively high disposable incomes. Their lifestyle and priorities are such that they wish to minimise domestic chores. An opportunity therefore exists for an intelligent washing machine that is capable of automating much of the current manual functionality associated with washing domestic items.			
Operational Requirement: To automatically clean domestic items without damage			
Non functional System Requirements: The machine will minimise domestic chores The machine will compliment our existing top of the range model The machine should be a “lifestyle statement” The machine must be attractive and distinctive. The machine should sell between 50,000 to 75,000 per annum The selling price of the machine shall be in the region of £550 - £650 (including VAT). The machine shall be of standard size (595x580x850) The machine shall take a standard 5kg load. The machine will be easy to use The average useful life of the machine will be 7 years The first year failure rate of the machine will be less than 10% The noise level at any point in the operational cycle should not exceed 91.5db The Machine Vibration levels should not exceed 0.5g rpms and 3.2g peak The energy efficiency should be grade A The machine must conform to UK and EU safety standards.			
Non-Functional Implementation Requirement	**Functional Requirement**	**Non Functional Performance Requirement**	
	The Machine shall:		
	Determine Load Make up		
	Determine mixed loads		
	Determine best cleaning cycle		
	Inform user of extreme loads		
	Inform user of current status		
Standard Single phase 230V 50 Hz ac	***Supply Power*** ***Receive Power*** ***Distribute Power***		
	Heat Water ***Measure Water Temperature***	Appropriate temperatures to fabric type	
	Inform user of wash cycle	Continuously	
	Override washing cycle		
Wash	***Clean Items***		
Rinse	***Remove excess cleaning Agents***		
Spin	***Remove cleaning Fluids***	1600rpm spin speed	

Currently Available Detergents	***Manage Detergents***
	    Load Detergent
	    Dispense Detergent
	    Mix Detergent & water		

Domestic Water	***Supply Water*** ***Receive Water***		
	Load Dirty Items		
	Unload Cleaned Items		

Figure 8: Refined Requirements for the Intelligent Washing Machine

What Goes Wrong: The limitations of SMA

Sources requirements document contains requirements for multiple systems: Many source requirements documents often contain requirements for the prime system that is to be developed and requirements for other systems. Indeed, this is to be expected and encouraged but unless approached with a clear mind can cause confusion and ultimately the miss-allocation and miss-interpretation of requirements. A classic example is the "customer" requiring a "good warrantee" for a product. A perfectly reasonable requirement, ambiguous but reasonable. However, this is not a requirement on the product, the product does not provide a warrantee, the product cannot do "warrantee" or be "warranteable". The warrantee is provided by the manufacturer and is a requirement on their business. It can, however, be interpreted and lead to a derived reliability requirement. If there are many requirements for other associated systems (typically, support, sales, realization, technology development, project and enterprise) consideration should be given to undertaking a STA for the other systems?

Endless debates about performance requirements: Performance requirements can potentially be classified using the HRM as either Non-functional Performance or Non-functional System. During the early stage of system development it can be difficult to determine whether a particular performance requirement is Non-functional System or Non-functional Performance. This is typically because it is either not adequately defined or due to a lack of understanding at this early point about system functionality (the Functional Requirements). In such instances the starting point to try categorising such requirements as Non-functional Performance and testing whether this categorization leads to the derivation of any new functionality. If it does then the categorization was correct. If a single function cannot be identified then it is better to categorise the performance requirement as Non-Functional System. In some instances the performance requirement implies many functional requirements. In this instance the Functional Requirements should be captured but the performance requirement categorised as a Non-functional System Requirement.

Success Criteria

The following list represents a set of criteria that have been found to be useful when undertaking a STA. Ignore them at your peril!

- Team size between 5 and 8
- Team constitution covers system life cycle and potential technology
- Use an experience independent facilitator
- Start with a definition of the prime system or system of interest but be prepared to change this as the analysis progresses

Appendix A Source Requirements for an Intelligent Washing Machine

Requirement for Intelligent Washing Machine

1.0 Background

1.1 Studies demonstrate that there are an increasing number of single persons with relatively high disposable incomes. Their lifestyle and priorities are such that they wish to minimise domestic chores. An opportunity therefore exists for an intelligent washing machine that is capable of automating much of the current manual functionality associated with washing domestic items.

1.2 The machine will complement our existing top of the range model and there is an opportunity for the machine to be a "lifestyle statement" and it therefore must be attractive and distinctive.

1.3 The market studies indicate that there is a potential total market of 250,000 machines per annum for this sector (our share is estimated at 20% to 30%) and current spend analysis indicates a selling price in the region of £550 - £650 (including VAT).

2.0 Technical Requirements

2.1 The machine will be of standard size (595x580x850) and take a standard 5kg load.

2.2 The machine must be easy to use and will be capable of determining the load make up and fabric characteristics and thence the best cleaning cycle.

2.3 It will detect mixed loads and where necessary inform the user of extreme loads

2.4 It will continually inform the user of its current status.

2.5 The machine will use domestic water and currently available detergents.

2\. 6 Standard single phase 230V 50Hz electricity supplies will provide the power source.

2.7 It will operate at appropriate temperatures and wash cycles most suitable for the fabric type, which are determined by the machine.

2.8 The user will have the facility to check the wash cycle and override the machine decision.

2.9 The machine will wash, rinse and spin-dry (1600 rpm is desirable) the clothing as appropriate to load and type.

2.10 The average useful life of the machine is to be 7 years and first year failure rate is to be less than 10%

2.11 The noise level at any point in the operational cycle shall not exceed 91.5db

2.12 Vibration levels should not exceed 0.5g rms and 3.2g peak

2.13 The energy efficiency should be grade A

3.0 Legislation

3.1 The machine must conform to UK and EU safety standards.