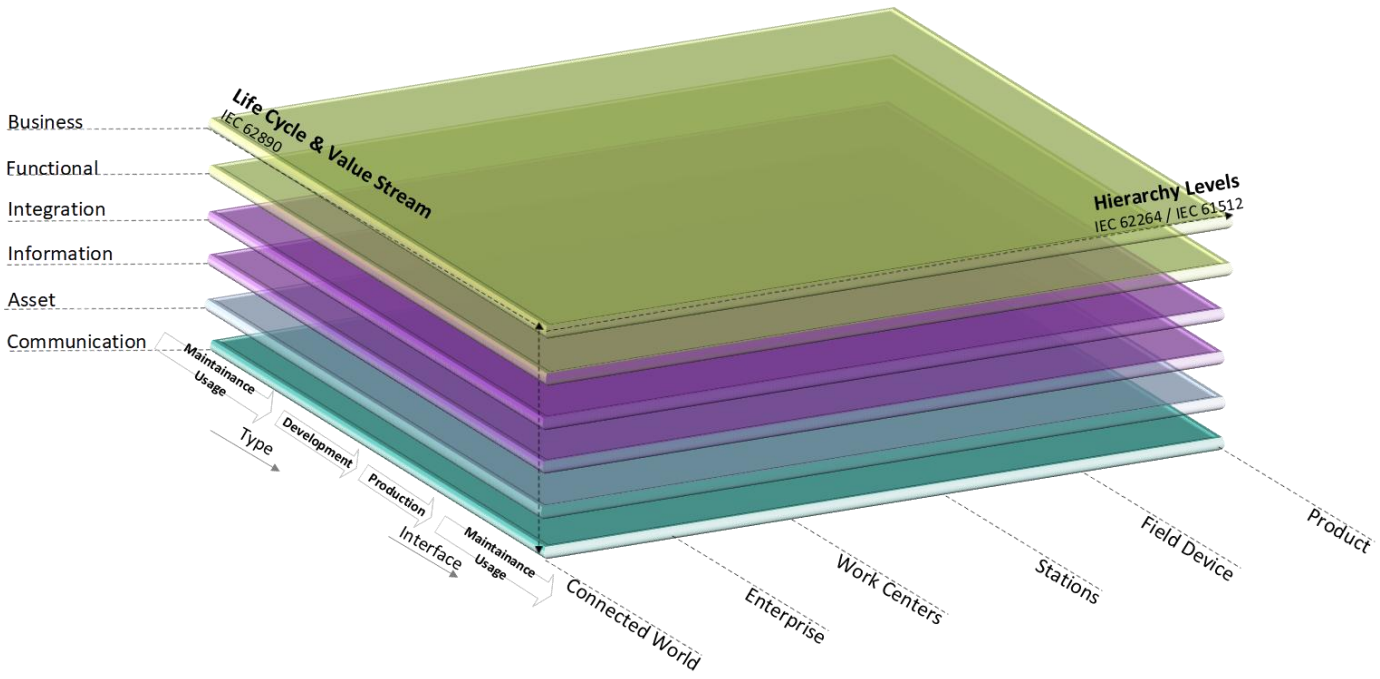
Business Analyst's approach to industrie 4.0

▫ **Whitepaper Brief: Use Cases, are recognized as leap towards technological and economical shift. In this whitepaper, requirements are derived identified from use case of Time Sensitive Networking technology. In next section is described inter-relationships in system design process is described. Here, how Decision Analysis helps stakeholders in logical decomposition is explained. In later section best practices for logical decomposition is explained. Next, checklist to identify relevant stakeholders is explained. In the end, Preparation, Execution, Follow-up phase of elicitation techniques is explained.**

▫ **Keywords: Time Sensitive Networking, Use Cases, Configuration Management Process, Requirements – Definition, Elicitation and Importance, logical decomposition, Decision Analysis, Four Facets – Subject, IT, Usage, Development, multi attribute utility analysis**



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Executive Summary

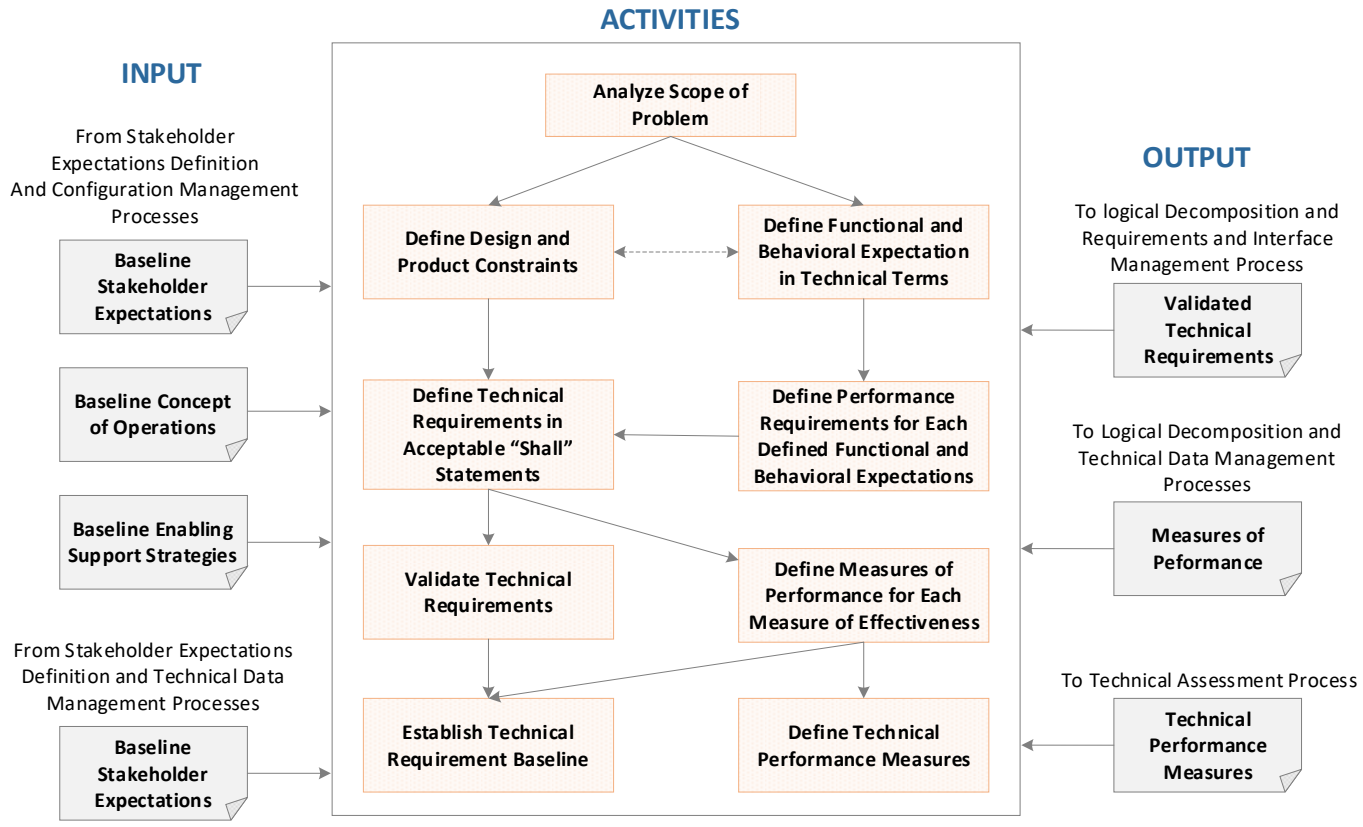
Various studies of the Standish Group state that inappropriate requirements engineering is one of the important reasons for project failures. The significantly higher number of system functions, the tighter integration with other systems, and a more differentiated usage are inevitable in standardization roadmap to industrie 4.0. These challenges signify increasing importance of use case artefacts.

Use cases are instruments to build a bridge from the driving challenges facing the manufacturing industry to the corresponding possible technical solution. Use cases help to understand how a system contributes to the achievement of the user's goals and produces the desired results. The added value of use cases lies in the integration of established requirements engineering techniques into an agile approach. Use cases thus offer many advantages even in agile projects.

The 'modern' understanding of the term 'use case' derives from the document 'Concept Use Case 2.0' [5] published in 2011. It describes a scalable, agile technique for developing requirements with which incremental system development can be controlled. The importance of use cases was recognized and evaluated very early on by the Platform industrie 4.0.

The value of a consolidated set of use cases for standardization is as follows,

- **Consolidation of the industrie 4.0 vision**: the use cases describe the basic principles of traditional and future value creation processes in the manufacturing industry, and systematically postulate additional possibility made possible by digitalization. Consolidation of terms and concepts, by means of the use cases one can agree on basic terms and concepts and explain them in an application on context in their interrelationships.
- **Justification of a general need for standardization**: through the use cases, fundamental gaps in standardization which are to be closed can be identified. However, certain potentials can already be exploited through the consistent application of existing standards and specifications.
- **Formulation of requirements for standardization requirements** – and not solutions are identified via the use cases. Measures initiated via the use cases thereupon for the further development or new development of standards and specifications can then be consistently linked to the corresponding requirements.

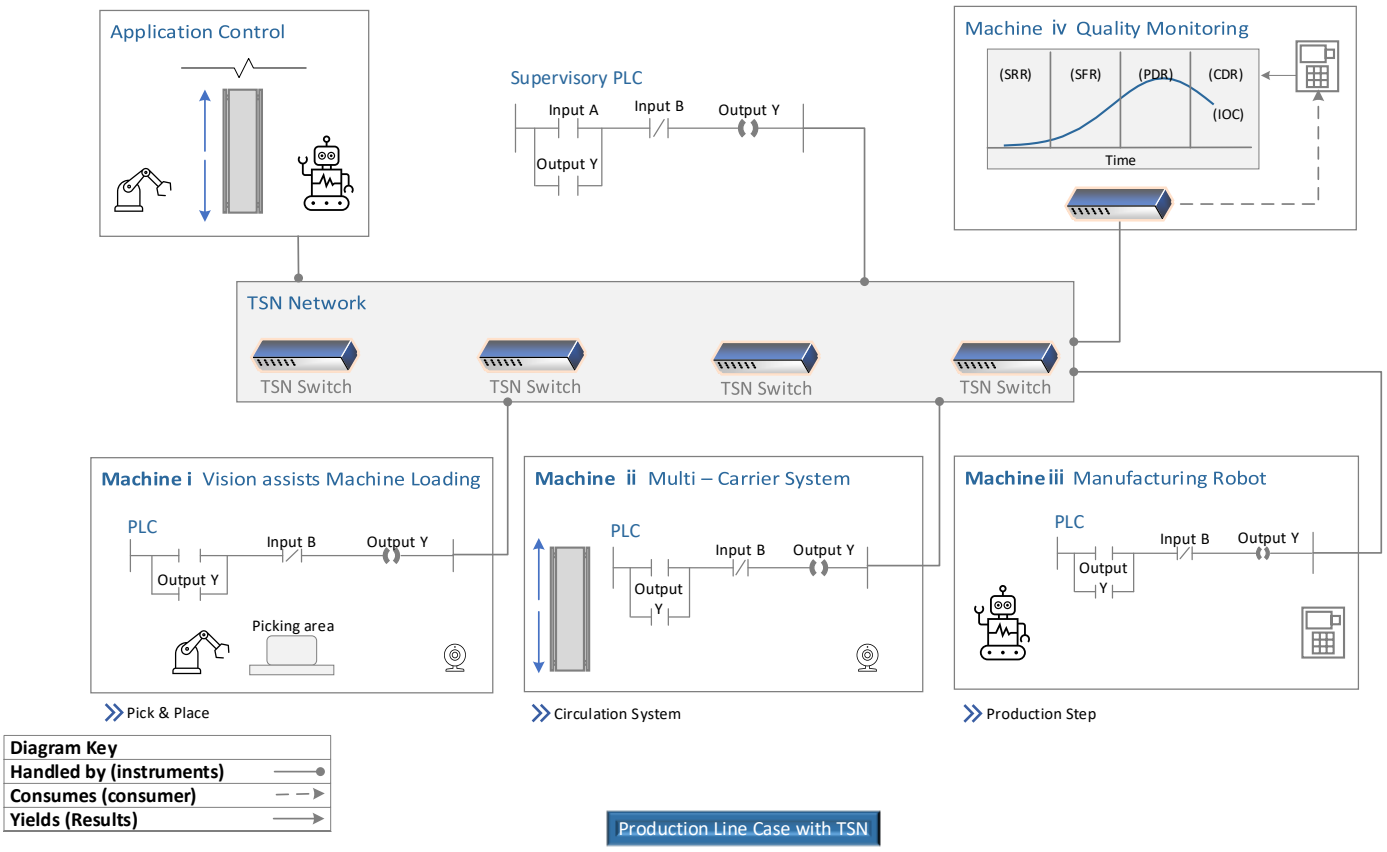


Requirement definition Best Practices Process Flow Diagram

Introduction

Tsino-German standardisation cooperation on industrie 4.0 (i4.0)/Intelligent Manufacturing (IM) initiated the study on communication technologies. Potential topics were identified, including wireless communication, co-existence management, Wireless Industrial Application (WIA), and Time-Sensitive Network (TSN) profiling for industrial automation.

The two countries recognize use cases as drivers for the market adaption of technologies like Time Sensitive Networking (TSN). Both Economical and technological use case must be articulated on a global scale. Use cases would ensure that TSN technologies develop at low cost based on joint global standards. Both China and Germany choose to focus on production line. The main criteria for these use case here is a TSN network that connects different machines from various vendors. In industrie 4.0 context, this means that both centrally as well as ad-hoc flexible machine configurations in Time Sensitive networks are necessary.



Production Line Case with TSN

These use cases typically come with the following requirements:

- **OT Personnel is charge of production**: this avoids additional cost of specialists, e.g. network operator.
- **Stepwise commissioning of machines to be supported**: start with partial network in operation.
- **Downtime must be minimised to increase overall Equipment Effectiveness**: limit the effects of failures, avoid side effects caused by components not needed in production and minimise dependencies between connected machines.
- **Production rate must be met**: begin design with sequence of actions with time constraints
- **Multiple application must be supported on a single network**: integrate formerly dedicated connections; eliminate discrete cabling, additional interfaces, installation and associated error sources.
- **Make machine data accessible for Smart Manufacturing**: avoid reprograming machines to get access to useful data

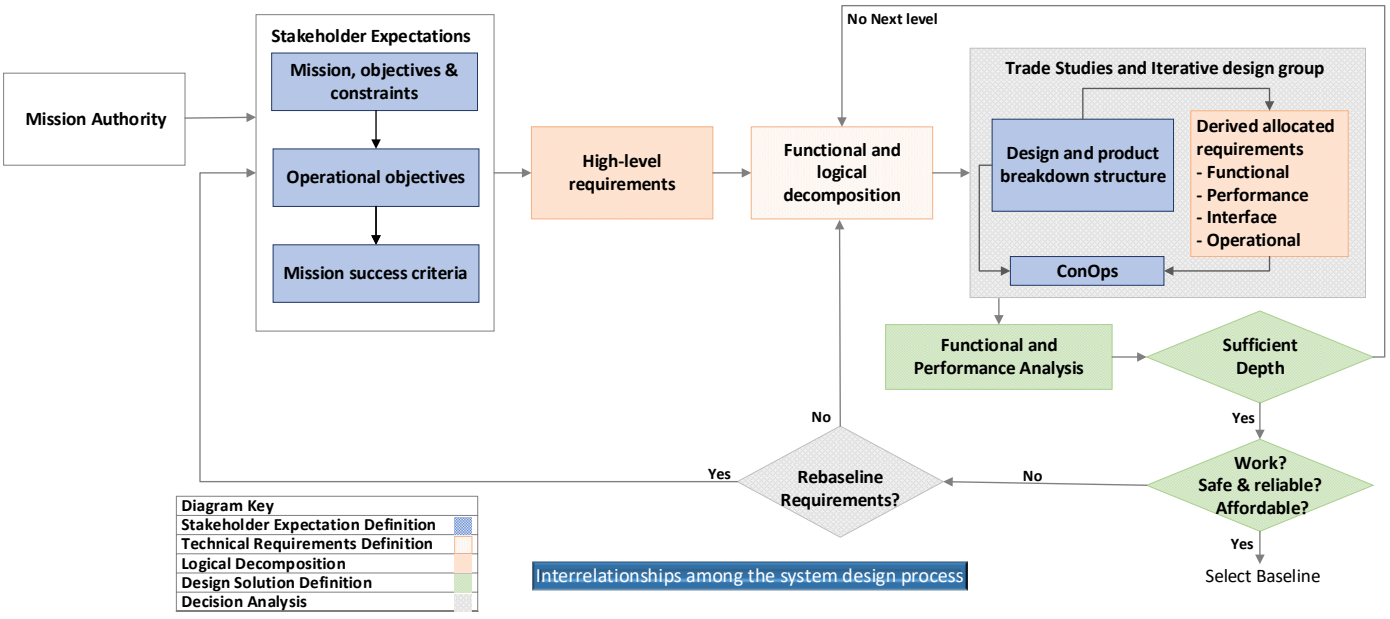
This industrie 4.0 educational whitepaper aims support you with importance and purpose of requirement definition, with easy reference for execution, follow-up, and preparation phase for requirement elicitation techniques.

Several Industrial Projects signifies that insufficient requirement definition triggers inconsistent, incomplete and incorrect requirements specifications and is responsible for number of problems. Without consistent, complete, correct requirement specification, how will verification & validation at any of testing level – component testing, integration testing, system testing, and UA testing be successful? It won't be, right? Moreover, at every testing level demands iterative review, this will be again a failure.

Stakeholder's needs, interests their expectations of outcome are specified as baseline requirements. Performance measures from data, functional and behavioural perspective is the result of low-level decomposition. At start of system design process, mission success criteria is established. Mission success criteria is fulfilment of six types of requirements,

- **Functional** Requirements: that describe what functions needs to do to accomplish the mission objectives.
- **Performance** Requirements: that describe how well the system needs to perform the functions.
- **Constraints**: Requirements that cannot be traded with respect to cost schedule or performance.
- **Interface** Requirements: that describe conditions under which functional and performance shall be fulfilled.
- **Environment** Requirements: that describe environmental conditions like user acceptance testing.
- Other Requirements: Human factors, reliability requirements, safety requirements.

Once favourable design decisions are made high level requirements are broken down for functional and logical decomposition. If the low-level requirements meet the operational objectives, only then product is allowed for Initial User testing, otherwise the requirements baseline is reconsidered.



Definition of technical and social requirements is hence important for multi attribute utility analysis.

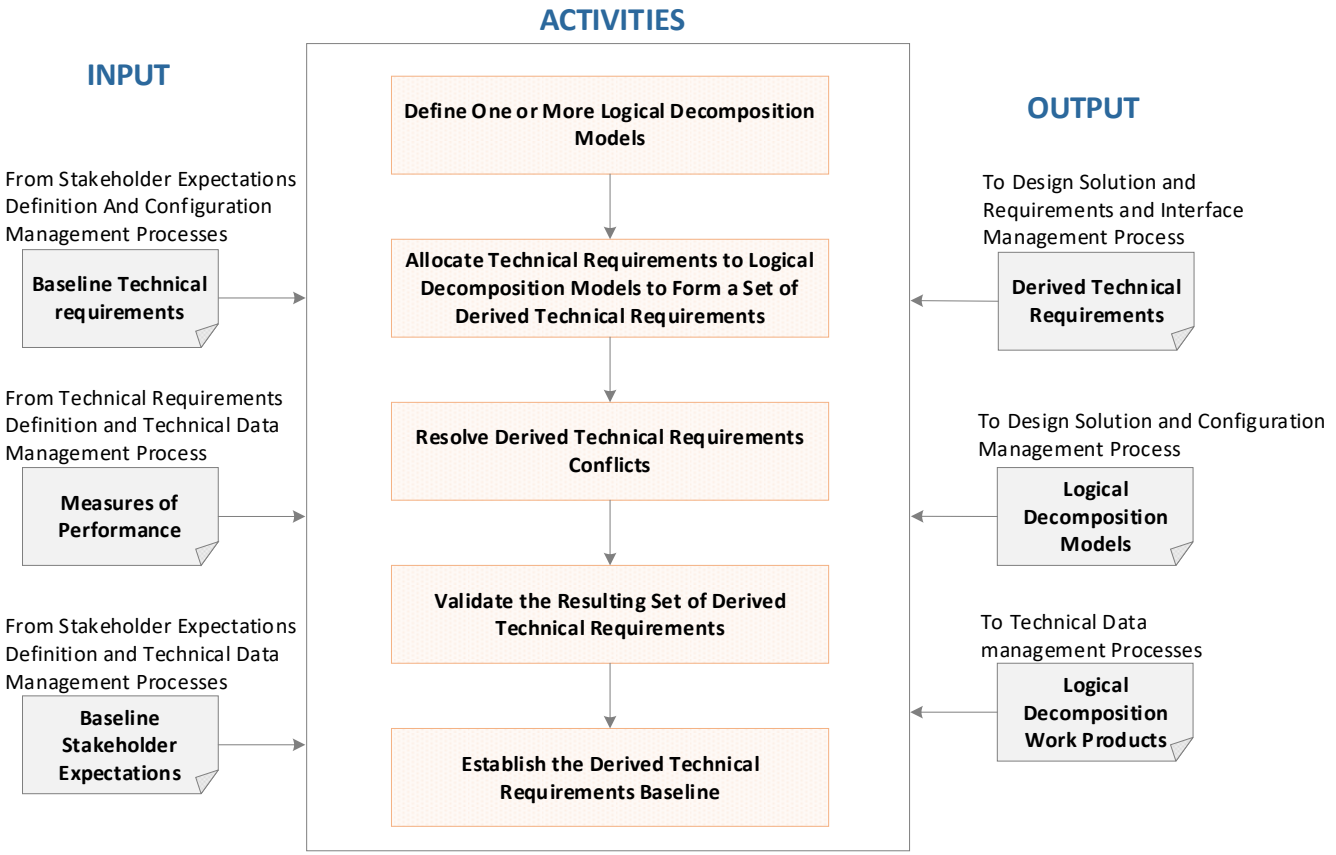
The aim of formulating strategic roadmap is to ease forthcoming research and collaborative initiatives, between the German Labs Network Industrie 4.0 (LNI 4.0) and the Chinese Alliance of Industrial Internet (AII). It is a standard approach to tailor criteria with more than one perspective to then develop functional and even implementation objectives. For each view, relations with management (**Project view**), relations with users (**User view**), relations with documents and reports (**Product view**), relations with method definition (**Process view**), relations with producer market position support (**Provider View**), relations with Database data system, operating system (**Technical View**), Follow-up costs, purchase price (**Economic View**) criteria must be jointly agreed. The parties responsible, the techniques and processes that are necessary to achieve the goal of requirements engineering and requirements management must comply with these criteria. Only when every process and every technique has been defined and all involved people are able to follow these constraints deployment of logical conditioning be performed.

Purpose of logical decomposition

The Logical Decomposition Process is used to:
- Improve understanding of the defined technical requirements and the relationships among requirements (eg. Functional, behavioural, temporal)
- Transform the defined set of technical requirements into a set of logical decomposition models, their associated set of logical decomposition models and their set of derived technical requirements for input into system design process.

An impediment to logical decomposition process is Design decision analysis. It is essential to make available documentation, of stakeholder's needs, interests, their expectation of outcome, documentation on how stakeholders evaluate competitive alternatives, course of action during Trade-offs. With this information it can be checked easily whether logical decomposition to low level requirements has same outcomes as of which they derived from. Components of decision analysis includes,
- Alternatives
- Criteria
- Value Judgements
- Decision maker (individual or group) preferences

Logical Decomposition ensures, sub-components, classes, code is scripted such that high level requirements defined by stakeholders are satisfied. Below is process flow for best practices for logical decomposition.



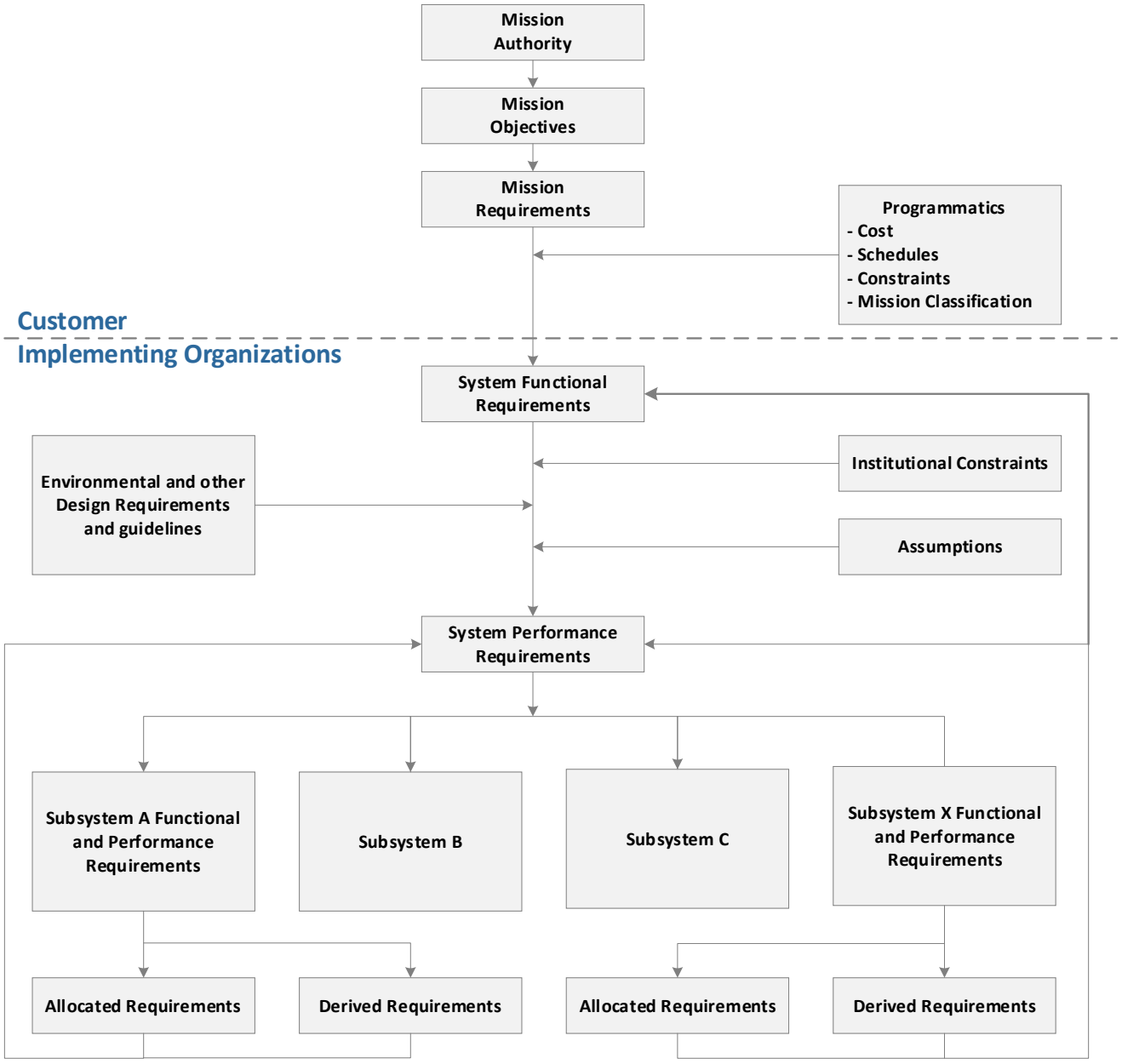
Logical Decomposition Best Practices Process Flow Diagram

After decision Analysis, concept selection can be facilitated using Pugh Matrix, Utility analysis. You can use the system modelling languages to decompose and define the system in more detail, ex. Timing diagram and state diagrams. Often times the challenge is to prioritization of requirements. The spectrum of prioritization techniques spans from simple, single-criterion classification to elaborate analytic prioritization approaches, such as AHP (Analytical Hierarchy Process) [Saaty 1980], Cost-Value-Analysis [Karlsson and Ryan 1997], or QFD (Quality Function Deployment) [Akao 1990].

Requirement decomposition, allocation and validation

For advancing science in any industry, for incubating research requires favourable condition, an environment, test lab that fosters the inputs, the procedures, and outcomes. Logical decomposition is facilitated by creative thinking about requirement decomposition.

- Requirements are arranged in a hierarchical structure starting with highest level requirements
- These high-level requirements are traced to Functional and Performance requirements and distributed across system
- These are then further decomposed and assigned among the elements and sub-systems. This complete set of design to requirements is achieved.
- At each level of decomposition (system, sub-system, sub-component etc) the total set of derived requirements are verified against the stakeholder's expectations or higher-level parent requirements.



Requirement Decomposition Allocation and Validation

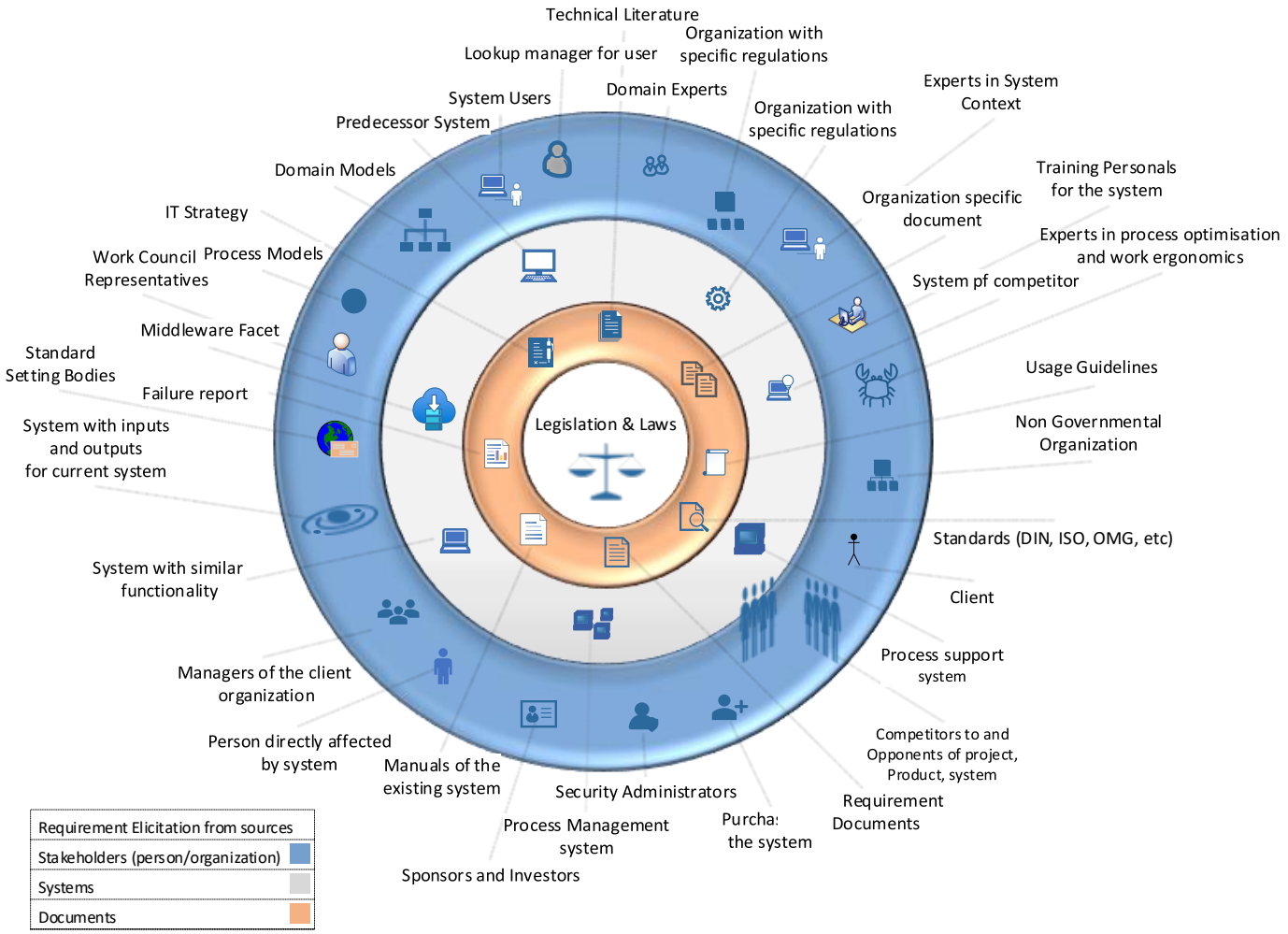
To trace precisely, stakeholder's objectives, interests and values to low level requirements an activity called as Requirement Elicitation is initiated by Analysts.

Requirement elicitation identifying stakeholder's needs

From the definition of Requirements Engineering, it is important to 'knowing the relevant requirements', 'achieving a consensus among the stakeholders about these requirements' and 'understanding [...] the stakeholders' desires and needs' this also is the objective of requirements elicitation and conflict resolution.

In any development plan, time and effort for elicitation activity and conflict resolution activity should be considered. An elicitation activity should provide information about, elicitation objective, the desired result quality, the selected sources, and selected elicitation technique. Conflict resolution activity should provide information about, involved requirements, the involved sources, selected conflict resolution techniques, about achieved result.

IDiS is the national stakeholder group in Germany with SMART standards. The IDiS network is made of representative from industry science and associations from a wide number of sectors. IDiS gives standards users the opportunity to actively participate in current European and International developments on SMART standards and supports DKE and DIN in representing national interests in the international standardisation community. Use cases are possible methodology for the structured elaboration of requirements from the implementation point of view to build a bridge between market requirements, possible solutions and resulting standardisation requirements. For identifying relevant requirement sources elicitation techniques should be used. The new/innovative or a existing requirements can be elicited from three relevant sources, documents, stakeholders and systems. Below is Robertson's stakeholder map considering four-context facet – Subject, Usage, IT, Development during elicitation of requirement. Typical stakeholder groups are,



Elicitation Techniques in context of industrie 4.0

Based on requirements stated by business, LNI supports industry with test case scenario R&D. At present 30+ test labs are available to implement test case. The test results are again used for standardisation of the platform. Utility management at times of Decision makers are no longer part of the organization is a challenge. Also is, practical application of the content described in use cases in operational business environment.

Challenge is because, requirements elicitation and information from individual or group of stakeholder is missed or realised later. When one's understanding of requirement contradicts with others, conflict arises. Conflicts can be classified into Data conflicts, value conflict, interest conflict, relationship conflict and structural conflict. Proper stakeholder management ensures the requirements elicited are reviewed and approved by stakeholders.

Alexander's Onion model, Stakeholder Database, stakeholder map are recommended for proper stakeholder management. Requirement Elicitation is hence a step to understand stakeholder's interests, needs, turn these values into requirements.

During system design process, It is important for analyst to act for himself, and say "I" instead of "We" or "One" and carefully document in stakeholder schemata, the necessary details like, responsible person, his/her statement of interpretation, priority. It is important to understand the motivation and rationale of the questions. To know the "why" for stakeholder's interests, as an analyst, you must ask "why you ask it and what it means to you?". Secondly, 'Always express personal reactions, and hence abstain from interpretation". The formulation of high-quality use cases is very time consuming however, use cases always pursue a purpose on a specific topic. Nature of use cases is such, to capture the specifications, so avoid generalizations, allow standardization process take care of generalizations.

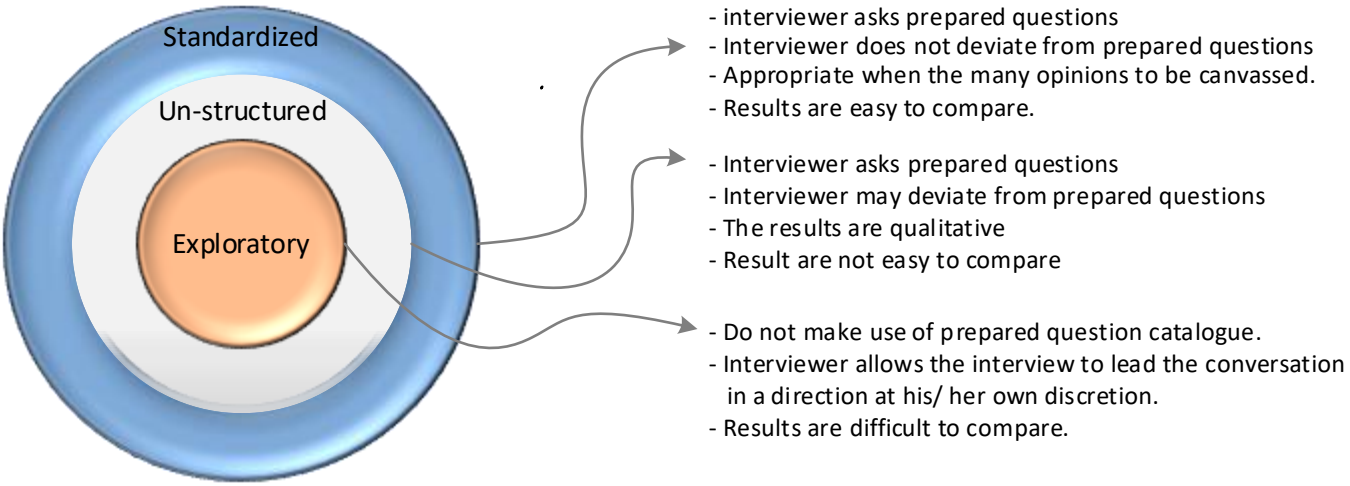
Code	Technique
1.0	Elicitation technique
1.1	Gathering technique
1.1.1	Questioning Technique
1.1.1.1	Interview Technique
1.1.1.2	Questionnaire
1.1.2	Requirement Workshop
1.1.2.1	Field Observation
1.1.2.2	Apprenticing
1.1.2.3	Contextual Inquiry
1.1.3	Collaboration Technique
1.1.3.1	Crowd Based Requirement Engineering
1.1.3.2	Observation Technique
1.1.4	Artefact Based Technique
1.1.4.1	System Archaeology
1.1.4.2	Perspective Based Reading
1.1.4.3	Resue of Requirements
1.2	Design and Idea Generating Technique
1.2.1	Brainstorming
1.2.2	Analogy Technique
1.2.3	Prototyping
1.2.4	Scenario and Story Based (KJ Method)
1.3	Thinking Goals
1.3.1	Thinking in Abstraction Levels
1.3.2	Thinking in terms of Problems and Goals
1.3.3	Avoidance of Transformation effects
1.3.4	Thinking in terms of Models
1.3.5	Mind mapping
1.4	Example of structuring elicitation technique: Attribute

Creativity arises not by command, but by chance. Creativity is most likely to occur when all four of the following preconditions are met.

+ Chance and therefore time
+ Knowledge of Subject matter
+ Motivation
+ Safety and Security

Elicitation Technique #1: Interview

The Goal of Conducting an interview in Requirement Engineering is to elicit requirements and content Information for system to be developed from stakeholder or group of stakeholders. There are three kinds of interview Standardised Interview, Exploratory Interview, Unstructured Interview



Checklist for preparation, execution and follow-up phases of a interview

Preparation
Checklist for interviews
+ Explicitly define the goal of the interview
Interview Participants
+ Choose the participants based on the goal of the interview
+ Invite all participants in due time
+ Communicate the goal and rationale of interview to participants
Interview location
+ Choose a location for the interview that provides an undisturbed environment and accommodates all participants
Interview Questions
+ Use open as well as closed interview questions
+ Write all questions with as concrete to context as possible.
+ Avoid leading questions.
Preparation of the interviewer
+ Familiarize yourself with interview partners
+ Learn the terminology of participants
+ If several interviewers are involved, establish a common understanding of the interview questions among them
Execution
Opening
+ At the beginning sum up the goal and rationale of the interview for the interviewees
+ If possible, provide additional information beyond that provided in the invitation
+ Start the interview with an introductory question
Work Element
+ Ensure that the elicited information is correct by summing it up for the interviewee and clarifying unclear issues.
+ Create models and/or scenarios during the interview in to get immediate feedback from the interviewee
+ Pay attention to non-verbal communication of interviewees.
+ Document the results of the interview.
Finalization:
+ Sum up the elicited knowledge
+ Express your gratitude and point out to interviewees the importance of their contributions
Follow up
+ Finalize interview minutes
+ Document elicited requirements
+ Revise the created models and scenarios
+ Collect open issues in a to do list
+ Distribute the results to interviewees
+ Ask interviewees to check and confirm the results
+ Identify requirements conflicts in the results of interview and resolve them using resolution techniques.

Elicitation Technique #2: Workshop

There is an internationally agreed collection of 50 use cases for smart manufacturing (IEC 63282-2). The use cases have comparable level of detail are largely complementary to each other are 5-7 pages long, and methodology and template follow IEC 62559. Such results are accomplished using workshop as elicitation technique. If a workshop is conducted well it is very successful technique for requirements elicitation.

Checklist for preparation, execution and follow-up phases of a workshop

Preparation
Defining the workshop goal
+ Define the **goal** of the workshop explicitly
Defining expected results and a work procedure
+ Define the intended results explicitly + Define a procedure for attaining the workshop goal and producing the expected results + Sum up the work procedure in an **agenda** + Reserve time for regular breaks
Selecting and inviting the participants
+ Pay attention to the workshop goal when selecting participants + Ensure that each **facet** of the four context facets, needs to be represented by participant + Invite all participants in due time + Agree upon the workshop goal with the participants
Workshop location
+ Provide a suitable room that accommodates all participants and fosters communication + Provide an undisturbed working atmosphere + Provide appropriate technical **equipment** (whiteboard, projector, flipchart, etc)
Moderator and minute-taker
+ Invite an external moderator, if possible + Appoint an external **minute-taker**, if possible
Execution
Opening
+ Present the workshop goal, the expected results, and the agenda at the beginning of the workshop + Let the participants **vote** on each rule
Work Element
+ The moderator takes care that the participants adhere to the agenda + The moderator takes care that the participants observe the conversation rules + The minute- taker is responsible for providing documentation of all intermediate and final results + Pay attention to documenting conflicts identified during the workshop + Try to resolve conflicts using conflict resolution techniques. + Take care that decisions (rationale, alternatives, Chosen alternatives, person responsible) are explicitly documented
Finalisation
+ Ensure that all open issues have been documented + Define a procedure for resolving each open issue + Allow the participants to provide feedback for retrospective (positive, negative, improvements) [KJ Method] + Thank all participants for their contributions and commitment
Follow-up:
+ Consolidate the work results + Ask each participant to approve the workshop minutes + Let each participant approve the consolidated work results

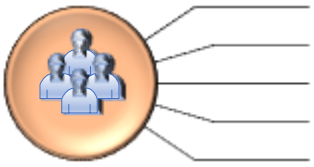
For successful execution Identifying the ‘right’ participants same understanding of Goal, is important.

1. Expertise: Participants must possess the right expertise with respect to the workshop goal
2. Motivation: Participants should be motivated to apply their knowledge and be interested in workshop goals
3. Decision making authority: During a workshop Participants should have authority to make decisions about the requirements for the system.
4. Soft Skills: A workshop always has a social competent, which is especially reflected in the way in which the participants deal with each other. Therefore, all participants should have good social skills.

Elicitation Technique #3: Group Sessions

In focus group panel of stakeholders focus on a chosen item to identify the requirements regarding this item.

Main goal of **Exploratory** focus group is to elicit new requirements for the system.



Prioritisation focus group aims to prioritise already elicited requirements and to identify missing requirements

Comparative focus group session aims to elicit an initial set of requirements based on a competitor's product or a previous version of system.

Checklist for the preparation, execution and follow-up phase of focus group sessions

Preparation:
+ Define the focus item and the goal of the session.
+ Select appropriate participants and provide them with the required information
+ Find an appropriate room offering a creative and communicative work environment and the required equipment
+ Appoint an experienced moderator and a minute-taker
+ Invite the participants, communicating the focus item, goal, data, time, and location of the focus group session
Execution:
+ Welcome the participants and open the session with a brief introduction
+ Manage the discussion so that every participant contributes
+ Avoid discussions that are too heated and frequent periods of silence
+ At the end, thank the participants and invite them to review material provided later on.
Follow-Up
+ Check the protocols and other recordings created for requirements, conflicts, conflict resolutions, and open issues
+ Let the participants validate the elicited requirements and information

Elicitation Technique #4: Observation

Observation as elicitation technique is ideal to gather information about the stakeholder's actual behavior; to elicit dissatisfiers; to analyse usability requirements; to collect data about the user's context. During observation, it is important not to wrongly interpret the behavior of system also called simplification bias.

Three Observation techniques are through, Field observation, Apprenticing, Contextual inquiry.

Checklist for the preparation, execution, and follow-up phases of an observation

Preparation:
+ Define the observation goal
+ Define the aspects that shall be observed
+ Define the desired results
Execution
Observation guidelines:
+ Try to earn the trust of the stakeholders who are being observed
+ Pay attention to details of the stakeholder's activities
+ Document your impressions immediately.
+ Check the objectivity of your results.
+ Validate that your observations are authentic
Documentation forms:
+ Make suitable use of different documentation forms, i.e. textual documentation, video recordings, and audio recordings.
Follow-up
+ Process your recordings to make them understandable for other people
+ Link the elicited requirements to the respective recordings.
+ Align the processed observation results with the stakeholders who have been observed.

Elicitation Technique #5: Perspectives Based Reading

Modern methods from the field of artificial intelligence, specifically in this case natural language processing (NLP), are the basis for strong improvements in the language understanding of machines in various domain. For this purpose, pre-trained language models (e.g., BERT) are used, which are trained on a wide variety of texts. Pre-training the models gives them a basic understanding of domain from which the texts and the information they contain originate. Likewise, when requirement elicitation needs to be done from documents, to only understand perspectives of authors, and analysis of their ideas, is recommended.

Checklist for the preparation, execution, and follow-up phases of perspective-based reading

Preparation:
+ Define goal(s) and desired results. + Define the perspectives based on the goal. + Select the documents to be analysed based on the defined goals and perspectives + Select the stakeholders for the different perspectives and inform them in due time.
Execution:
+ Select an approach for reading the documents: Either sequential reading or top-down reading. + Establish traceability between text passages and elicited requirements.
Follow-up:
+ Consolidate and integrate the elicitation results obtained by reading the documents from the different perspectives + Pay attention to potential conflicts in the elicited requirements and resolve using conflict resolution techniques

Elicitation Technique #6: Brainstorming Session

Like most creativity techniques, the crucial point of brainstorming is the separation of finding ideas from the analysis of ideas. Many different variants have evolved over time, e.g. brainstorming paradox, method 6-3-5, brainwriting. Checklist for the preparation, execution and follow-up phases for a brainstorming session.

Preparation:
+ Define the subject or problem: + Select the stakeholders under consideration of the context facets. + If required, focus the brainstorming on one context facet. + Appoint a room and a time + Invite the participants + Provide visualisation media + Appoint a moderator and a minute-taker
Execution – Brainstorming rules
+ Quantity over quality + Free association and visionary thinking are explicitly desired + Taking on and combining expressed ideas is allowed and desired. + Criticising other participant's ideas is forbidden even if an idea seems to be absurd + Questions for clarification are allowed + Even at longer-lasting deadlocks do not abort immediately – overcome at least two longer-lasting deadlocks + Wait until the brainstorming comes to a natural end
Follow – up
+ Assign each idea to a category. + Discard unusable ideas + Define how to proceed with the usable ideas + Create the minutes to document the ideas and the procedures for further processing of the ideas.

Osborn checklist
+ Put to other uses? ..... New ways to use as is? Other uses if modified? + Adopt?..... What else is like this? What other ideas does this suggest? + Modify? ..... Change meaning, colour, motion, sound, odour, taste, form, shape? Other changes? + Magnify? ..... What to add? Greater Frequency? Stronger? Larger? Slower? Split up? Less Frequent? + Substitute? .....Who else instead? What else instead? Other place? Other time? + Rearrange? ..... Other layout? Other sequence? Change pace? + Reverse?..... Opposite? Turn it backward? Turn it upside down? Turn it inside out? + Combine?..... How about a blend, an assortment? Combine purposes? Combine Ideas?

Elicitation Technique #7: Prototype

Prototyping is an umbrella term and refers to the creation of various types of early samples or models built to gain live experiences with a concept or process. The purpose of prototyping in requirements elicitation is the simulation of the new system and the exploration of requirements by stimulation of agreement and objection or clarification and amendment. Checklist for applying prototypes for elicitation

Preparation:
+ Decide whether the prototype shall be created during or after elicitation
+ Before creating the prototype, define usage scenarios for the prototype and decide which requirements shall be implemented in the prototype
+ Determine whether the prototype shall be realised as a software prototype, a paper prototype, or a mock-up
+ In case of a software prototype, define what kind of prototype to implement (throwaway vs. evolutionary, horizontal vs. vertical prototype)
+ Identify a suitable implementation technology for the prototype (such as a tool environment for prototyping)
+ Preferably use schematic prototypes as far as possible
Execution:
+ Let the stakeholders execute the usage scenarios with the prototype.
+ Allot enough time for the stakeholders to try out the prototype.
+ Capture the stakeholder's feedback during and after prototype usage.
Follow-up
+ Analyse the recorded results of the prototype demonstration,

Elicitation Technique #8: KJ Method

Checklist for preparation, execution, and follow-up phases of applying the KJ method for requirements elicitation

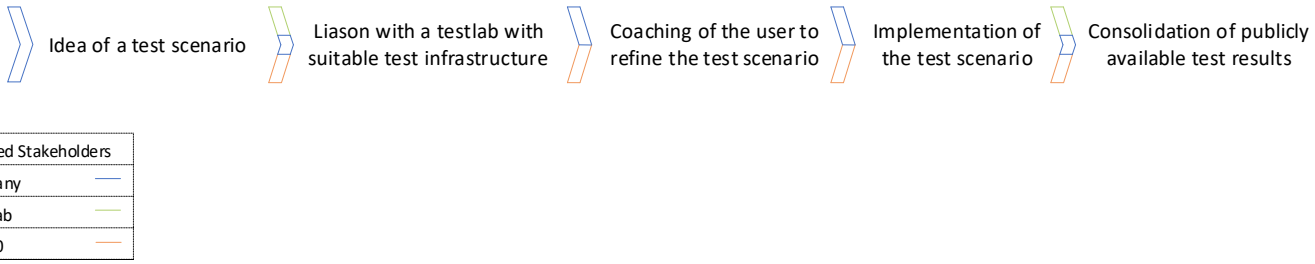
Preparation
+ Define the goal of the elicitation session
+ Appoint a room and a time, appoint a moderator
+ Select and invite the participants
+ Provide pin boards for visualisation and arrangement of the cards
+ Provide a sufficient amount of cards and markers
+ Create a sample card
+ Observe the rule of only one idea per card
Execution
Introduction
+ Explain the goal to the elicitation session to the participants
+ Present the rules and the sample card
Interrogation
+ Distribute markers and an approximately equal number of cards to each participant
+ Let the participant write down their ideas (approximately 10 mins)
Presentation and explanation
+ Number the unsorted cards sequentially and use the same numbering to reference the cards in the minutes
+ Let the participants explain and complement cards whose meaning is unclear or ambiguous.
Grouping
+ Let the participants group the cards by subject
+ Do not remove card with double or similar ideas but pin them up on top of each other instead.
+ Let the participants define a heading for each group of cards
+ Let the participants analyse relationships among the card within each group as well as among the groups.
Follow-up
+ Document the results of the elicitation session
+ Define together with the participants how the results shall be further processed
+ Distribute the minutes to the participants and collect their feedback on the minutes

Checklist for improving checklists
+ Are all the statements in the checklist relevant for the considered issue?
+ Have any aspects have been identified during the application of the checklist that should be included in the checklist?
+ Are there incomprehensible questions or statements in the checklist?
+ Are there any ambiguities?
+ Does the checklist contain redundant aspects?

Conclusion Summary

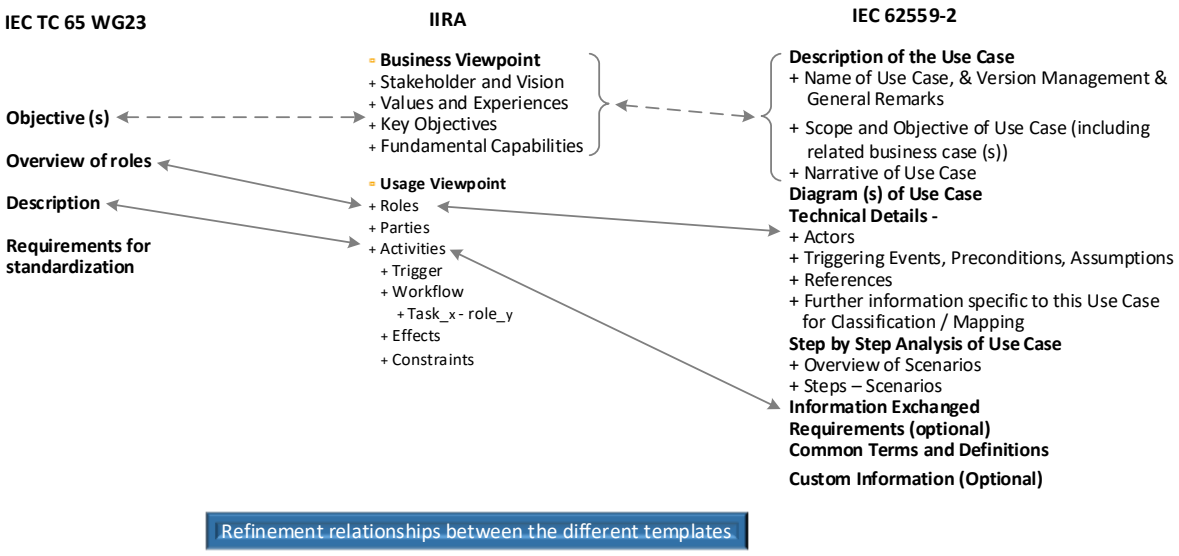
The German Labs Network Industrie 4.0 (LNI 4.0) and the Chinese Alliance of Industrial Internet (AII) (IEC SG 12- Task Force 3), defines all essential elements of standardisation (requirements, comments, formulas, tables, etc) and describes relationship between these elements, provisions normative requirements in a requirement management system. Utility Model i.e the service-oriented needs, data, usability needs to be captured, so make machine-readable standards, readily available.

LNI 4.0 network, supports commercialization of multi-level algorithms. 30+ Test Labs of LNI network, design solution space, develop design alternatives, analyse trade studies, drive down to lowest level, and initiate standardisation. LNI 4.0 and AII, supports companies to choose an architectural concept that is robust to changing utility for decision makers.



To achieve TSN requirements, LNI 4.0 and AII provide guidance and testing abilities for these time-sensitive applications. The focus for application is on following characteristics.

- Dynamic E2E stream allocation for 'plug & product"
- Exposure of stream diagnostics
- Leveraging of existing production line networking technology for real time
- Support for minimum viable solution



Refinement relationships between the different templates

We at IGT, bring to you seasoned experts, to understand 'why' from the stakeholders, help you evaluate requirements better. We at IGT help you with test plan, test scenarios to cover test cases, from functional, data and behavioural perspective, reach us at, IGT Infoglobaltech : - infoglobaltech - contact us;
website link for Labs Network Initiative : - LNI 4.0 - Labs Network Industrie 4.0 (lni40.de)