GICHD

QUICK REFERENCE

GUIDE TO SYSTEMS ENGINEERING

FOR HUMANITARIAN INFORMATION MANAGEMENT

The Geneva International Centre for Humanitarian Demining (GICHD) is an international expert organisation based in Switzerland that works to eliminate mines, explosive remnants of war and other explosive hazards. By undertaking research, developing standards, and disseminating knowledge, the GICHD supports capacity development in explosive ordnance-affected countries. It works with national and local authorities to help them plan, coordinate, implement, monitor and evaluate mine action programmes. The GICHD also contributes to the implementation of the Anti-Personnel Mine Ban Convention, the Convention on Cluster Munitions, and other relevant instruments of international law. The GICHD follows the humanitarian principles of humanity, impartiality, neutrality, and independence.

Guide To Systems Engineering For Humanitarian Information Management, GICHD, 2021

ABOUT THIS QUICK REFERENCE

This Quick Reference can be used as an Aide Memoire when deploying a new information management system as well as when upgrading or improving an existing system. It supports GICHD's Systems Engineering Guide for Humanitarian Information Management, which provides tools that will improve the success of IM systems deployed in support of mine action, peace monitoring, disaster risk reduction and other conflict and post-conflict humanitarian initiatives.

Systems engineering (SE) is a well-established method for improving the likelihood of success of technologically risky projects. Systems engineering seeks to understand the big picture, and to identify the cause-and-effect relationships between the various elements of any overall system. It also recognises the importance of understanding the short- and long-term consequences of any action, as well as the associated risks and costs. SE is a structured and all-encompassing design and management process, which considers both the business and the technical interests of stakeholders throughout the life cycle of any proposed system.

KEY TERMINOLOGY

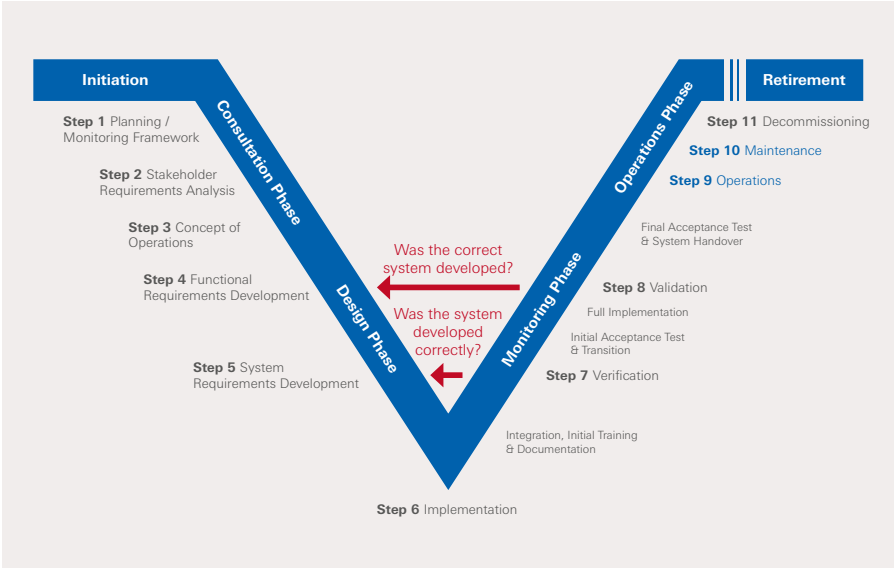
A number of words used in this guide have specific meanings. They include:

- Concept of operations: the overall high-level concept of how the system will be used to meet stakeholder expectations, and that serves as the basis for subsequent definition documents and provides the foundation for long-range operational planning activities.
- Engineered system: a system designed or adapted to interact with an anticipated operational environment to achieve one or more intended purposes while complying with applicable constraints.
- Stakeholders: people and organisations that have an interest in a system, or may be affected by that system. These might include internal and external users, data contributors, donors and direct / indirect beneficiaries, including communities, governments and civil society organisations.
- System: a combination of interacting elements organised to achieve one or more stated purpose.
- Systems engineering: a transdisciplinary and integrative approach to enable the successful realisation, use, and retirement of engineered systems, using systems principles and concepts, and scientific, technological, and management methods.

An exhaustive and updated list of terminology related to the Systems Engineering Body of Knowledge is available at: https://www.sebokwiki.org/wiki/Category:Glossary_of_Terms.

SYSTEMS ENGINEERING PROCESSES

The technical and management processes that enable systems engineering to be so effective are summarised in the figure and table below. In general, these processes aim to ensure a system's requirements are developed according to well-defined needs, and that the system remains effective throughout its design lifetime. These classical processes resemble the sequential approach that is now commonly referred to as waterfall methodology, in contrast to a more iterative approach referred to as agile methodology. The SE 'V' diagram, which is associated with the waterfall methodology, is often used to depict the key processes from the planning & monitoring phase to the disposal phase.



Systems engineering process, the SE 'V' diagram

Step-by-step summary of SE processes

NAME OF PROCESS		RESULT / DESCRIPTION
Step 1	Planning & monitoring process	Theory of change and results-based monitoring framework, co-developed with and accepted by key stakeholders, to guide the systems design and implementation.
Step 2	Stakeholder consultation & user requirements analysis	Comprehensive set of use cases, which describe the specific functional needs of each user group in non-technical, user-oriented language.
Step 3	Enterprise-level ConOps process	Concept of operations, based on high-level organisational requirements, to describe how the various subsystems of a system will work to achieve the desired results, and how various stakeholders will interact with the system.
Step 4	Functional requirements definition (FRD) process	FRD documentation, developed by the project team, which describes the system in a technologically agnostic manner. FRD should provide hardware and software vendors, and system integrators, with a clear picture of organisational needs so that they can propose their solutions.
Step 5	System requirements definition (SRD) process	SRD documentation, developed by the project team, which technically defines the system criteria needed to satisfy the functional requirements of each user group. SRD should also include a monitoring plan and an acquisition & operation budget. Developed by the project team, in consultation with subject-matter specialists as well as commercial / non-commercial solution providers.
Step 6	Implementation & integration process	Configuration of the selected system architecture in accordance with the SRD, by the project team, as well as initial training, system-user documentation, and setting of baseline metrics for plan.

NAME OF PROCESS		RESULT / DESCRIPTION
Step 7	Verification process	Initial acceptance test which provides objective evidence that each system element fulfils its specified system requirements (according to the measures of performance criteria).
Step 8	Validation process	Final acceptance test, which provides objective evidence that the system, after sufficient test usage (qualification period), fulfils all stakeholder requirements specified in the concept of operations (according to the measures of effectiveness criteria).
Step 9	Operation process	Full-scale deployment and adoption of the system.
Step 10	Maintenance process	Sustained performance of the system through installation of software updates, replacement / upgrade of hardware, retraining of users, updating of documentation, etc.
Step 11	Decommissioning process	Safe retirement of the system at the end of its life, either through redeployment into a different environment, or demobilisation (secure archive and equipment disposal).

Following the step-by-step approach described above will ensure you design, deploy, and operate an effective system. For a more robust discussion about each of these processes, consult the sections indicated, as well as the INCOSE Systems Engineering Handbook.

PROJECT TEAM COMPOSITION

The capacity to implement the aforementioned SE technical and managerial processes comes from the project team. It is important to aim for diverse representation in the team, and although every project will have a unique team composition, there are certain roles and responsibilities that are common in almost every project. The following table summarises the inactive and active players in most humanitarian information management system projects – of course, one person may serve in more than one role, and larger projects will justify more team members than smaller projects.

	ROLE	RESPONSIBILITIES / ACCOUNTABILITY	NOTES
inactive	Sponsor	The person responsible for committing funding and resources to a project to meet specific strategic objectives.	The sponsor (e.g. donor, grants officer, finance director) is a key stakeholder, but not an active member of the project team.
inactive	Programme manager	The person responsible for initiating, evolving, and closing projects.	The sponsor may be supported by a more technical manager to assist with fund administration, monitoring and evaluation. **May be an active member of the team.**
inactive	Steering committee (SC)	The senior managers of the host organisation responsible for enabling the project team, ensuring policy compliance, and promoting adoption of the new system.	Composed of a chairperson and managers from Operations, IT, Communications, HR, Admin / Finance, and other relevant units from within the host organisation (and, optionally, external stakeholders). Most SC members will not be active members of the project team, but essential to its success.
active	Project lead	The person responsible for (1) planning, assessing and controlling the project, (2) obtaining a product or service in accordance with the organisation's requirements, and (3) eliciting, defining and analysing the stakeholder and system requirements.	Combines the SE roles of systems engineer, project manager and requirements manager, and is accountable for overall project success.

	ROLE	RESPONSIBILITIES / ACCOUNTABILITY	NOTES
active	Solution designer	The person responsible for defining and analysing the system architecture, and for planning, procuring, and leading the configuration of management activities.	Can also combine the SE roles of configuration manager and procurement manager.
	Monitoring specialist	The person responsible for planning and leading the verification and then the validation activities.	Combines the roles of verification lead and validation lead.
	Infrastructure manager(s)	The person(s) responsible for ensuring that the organisation is provided with the necessary facilities, tools, and communications and information technology assets consistent with business needs.	Typically, one or two infrastructure managers from the host organisation's IT, IM/GIS, and/or Operations units.
	Implementation team members	The persons authorised to implement the project under the direction of the other team members.	Technical specialists who are assigned tasks by the project lead, solution designer, monitoring specialist, and infrastructure manager(s). Examples include GIS officers, IT specialists, project support officers, etc.

SE Project Management Roles & Responsibilities

Consider these various core roles and responsibilities when building your project team, and if necessary, modify the team's composition based on the complexity of your proposed system. Finally, recognise the importance of establishing some form of project governance, such as a steering committee, at the earliest stages. In addition to ensuring broad institutional ownership, a well-structured form of governance will help the team navigate the various challenges that are inherent in deploying their system and empower the project lead to be as successful as possible.

DOCUMENTATION CHECKLIST

The system design and implementation documentation should include some or all of the following components:

- **Concept of operations**, providing a high-level description of the system;
- **Functional requirements definition**, containing the functional and non-functional requirements as well as use cases / user stories identifying the implementation of the required business logic;
- **System requirements definition,** that may include a:
  - **Detailed deployment plan** for each subsystem of the overall solution being deployed or integrated;
  - **Data migration plan** with the data structure for the legacy and new systems, as well as the data field mappings and migration test cases;
  - **Work breakdown structure work plan** with task scheduling and resource assignments;
  - **Budget** with contingencies for life-cycle costing;
- **Verification acceptance criteria** (quantitative measures of performance) based on operational technical requirements;
- **Validation acceptance criteria** (qualitative measures of effectiveness) based on stakeholder requirements;
- **Security and risk management plan**, with specific and general strategies to achieve the performance criteria established by the system requirements;
- **Recommendations for future enhancement**, to capture any desirable research, development and functionality that was identified during the design process but that was excluded in the current system requirements;
- **System user guide** for front-end users and administrators;
- **Data management and system management guides** for administrators;
- **Continuity of operations plan** for incident responders and administrators.

Geneva International Centre for Humanitarian Demining (GICHD)
Maison de la paix, Tower 3, Chemin Eugène-Rigot 2C
PO Box 1300, CH – 1211 Geneva 1, Switzerland
info@gichd.org
gichd.org