

# Business or Mission Analysis

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The starting point of engineering any system-of-interest (SoI) is understanding the socio-economic and technological context in which potential problems or opportunities reside. Then, the enterprise strategic goals and stakeholder needs, expectations, and requirements represent the problem or the opportunity from the viewpoint of business or enterprise decision makers while also taking into account the views of users, acquirers, and customers.

Mission Analysis (MA) is part of the larger set of concept definition activities - the set of systems engineering activities in which the problem space and the needs of the business or enterprise and stakeholders are closely examined. This occurs before any formal definition of the (SoI) is developed but may need to be revisited through the life cycle. In fact, the activities of Concept Definition determine whether the enterprise strategic goals and business needs will be addressed by a new system, a change to an existing system, a service, an operational change or some other solution. The MA activity focuses on the identification of the primary purpose(s) of the solution (its "mission"), while Stakeholder Needs and Requirements activity explores what capabilities stakeholders desire in accomplishing the mission and may include some detail on the performance of certain aspects of the solution. MA is often performed iteratively with the Stakeholder Needs and Requirements activity to better understand the problem (or opportunity) space, as well as the solution space.



## **Contents**

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Purpose and Definition

Principles and Concepts

    Mission Analysis and Concept of Operations

    Mission Analysis as Part of Enterprise Strategy  
    Development

Process Approach

    Activities of the Process

    Mission Analysis Artifacts

    Methods and Modeling Techniques

Practical Considerations

References

    Works Cited

    Primary References

    Additional References

## **Purpose and Definition**

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The purpose of MA is to understand a mission/market problem or opportunity, analyze the solution space, and initiate the life cycle of a potential solution that could address the problem or take advantage of an opportunity. MA is a type of strategic or operations analysis related to needs, capability gaps, or opportunities and solutions that can be applied to any organization that evolves its strategy for its business objectives.

MA, in some domains called market analysis or business analysis, is the identification, characterization, and assessment of an operational problem or opportunity within an enterprise. The definition of a mission or business function in a problem space frames the solution, both in terms of the direct application to the mission or business function, and in terms of the context for the resulting solution.

MA is used to define needed (or desired) operational actions, not hardware/software functions; that is, it is focused on defining the problem space, not the solution space. MA begins with the business vision and Concept of Operations (ConOps) (IEEE. 1998), and other organization strategic goals and objectives including the

mission (or business function). The primary products of MA are Business or Mission Needs, which are supported by preliminary life-cycle concepts—including a preliminary acquisition concept, a preliminary operational concept (OpsCon), a preliminary deployment concept, a preliminary support concept, and a preliminary retirement concept. Business or Mission Needs are then elaborated and formalized into Business or Mission Requirements. The preliminary operational concept includes the operational scenarios for the mission and the context in which the solution will exist.

MA may include mathematical analysis, modeling, simulation, visualization, and other analytical tools to characterize the intended mission and determine how to best achieve the needs/objectives. MA evaluates alternative approaches to determine which best supports the stakeholder needs (among both materiel and non-materiel solution alternatives, also known as product solutions and service/operational solutions). Thus, MA defines the problem space and analyzes the solution space alternatives using quality attribute constraints driven by the enterprise objectives.

## **Principles and Concepts**

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### **Mission Analysis and Concept of Operations**

MA and the terms ConOps and OpsCon are broadly used in U.S. and UK defense and aerospace organizations to analyze and define how a system is intended to operate, as well as how the major operations or operational scenarios are intended to be performed. They take into account the strategic, operational, and tactical aspects of the identified scenarios. ANSI/AIAA G-043A-2012 (ANSI 2012) identifies that the terms ‘concept of operations’ and ‘operational concept’ are often used interchangeably but notes that an important distinction exists because each has a separate purpose and is used to meet different ends. The ConOps is at an organizational level, prepared by enterprise management and refined by business management:

*The ConOps, at the organization level, addresses the leadership's intended way of operating the organization. It may refer to the use of one or more systems (as black boxes) to forward the organization's goals and objectives. The ConOps document describes the organization's assumptions*

*or intent in regard to an overall operation or series of operations within the business in regards to the system to be developed, existing systems, and possible future systems. This document is frequently embodied in long-range strategic plans and annual operational plans. The ConOps document serves as a basis for the organization to direct the overall characteristics of future business and systems. (ISO/IEC 2011)*

The ConOps informs the OpsCon, which is drafted by business management in the Mission Analysis activity and refined by stakeholders in the Stakeholder Needs and Requirements activity:

*A system OpsCon document describes what the system will do (not how it will do it) and why (rationale). An OpsCon is a user-oriented document that describes system characteristics of the to-be-delivered system from the user's viewpoint. The OpsCon document is used to communicate overall quantitative and qualitative system characteristics to the acquirer, user, supplier and other organizational elements. (ISO/IEC 2011)*

It should be noted that the OpsCon has an operational focus and should be supported by the development of other concepts, including a deployment concept, a support concept, and a retirement concept.

In order to determine appropriate technical solutions for evolving enterprise capabilities, systems engineering (SE) leaders interact with enterprise leaders and operations analysts to understand:

- the enterprise ConOps and future mission, business, and operational (MBO) objectives;
- the characterization of the operational concept and objectives (i.e., constraints, mission or operational scenarios, tasks, resources, risks, assumptions, and related missions or operations); and
- how specific missions or operations are currently conducted and what gaps exist in those areas.

They then conceptually explore and select from

alternative candidate solutions. This interaction ensures a full understanding of both the problem space and the solution space. The alternative candidate solutions can include a wide range of approaches to address the need, as well as variants for an approach to optimize specific characteristics (e.g., using a different distribution of satellite orbit parameters to maximize coverage or events while minimizing the number of satellites). Analysis, modeling and simulation, and trade studies are employed to select alternative approaches (NDIA 2010).

The notions of mission analysis, ConOps and OpsCon are also used in industrial sectors, such as aviation administrations and aeronautic transportation, health care systems, and space with adapted definitions and/or terms, such as operational concepts, usage concepts and/or technological concepts. For example, “mission analysis” is the term used to describe the mathematical analysis of satellite orbits performed to determine how best to achieve the objectives of a space mission (ESA 2008).

In commercial sectors, MA is often primarily performed as market analysis. Wikipedia defines market analysis as a process that:

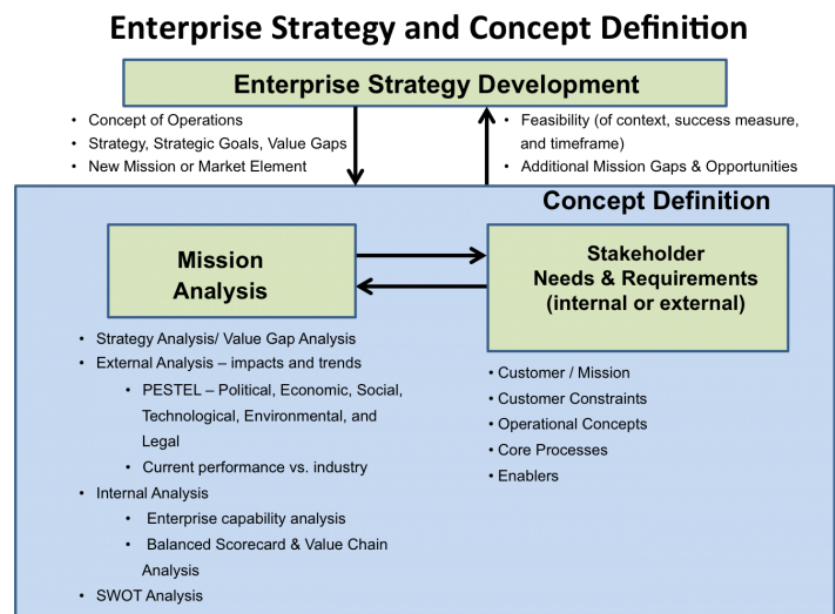
*. . . studies the attractiveness and the dynamics of a special market within a special industry. It is part of the industry analysis and this in turn of the global environmental analysis. Through all these analyses, the chances, strengths, weaknesses, and risks of a company can be identified. Finally, with the help of a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis, adequate business strategies of a company will be defined. The market analysis is also known as a documented investigation of a market that is used to inform a firm's planning activities, particularly around decisions of inventory, purchase, work force expansion/contraction, facility expansion, purchases of capital equipment, promotional activities, and many other aspects of a company. (Wikipedia Contributors, 2012)*

Anywhere these notions are used, it is evident that they are based on fundamental concepts, such as the operational mode (or state of the system), scenario (of

actions), the enterprise level ConOps and the system level operational concepts, functions, etc. For more explanations about the ConOps and operational concept, refer to *Systems and Software Engineering - Requirements Engineering* (ISO/IEC 2011); useful information can be found in Annex A, "System Operational Concept," and Annex B, "Concept of Operations" (ISO/IEC 2011).

## Mission Analysis as Part of Enterprise Strategy Development

Periodically, most enterprises re-evaluate their strategy with respect to their mission, vision, and positioning to accomplish their goals. Figure 1 shows the interactions of the enterprise strategy development and the concept definition, including the MA and Stakeholder Needs and Requirements activities that are involved in an iterative manner to fully develop the strategy and define future capabilities and solutions.



**Figure 1. Enterprise Strategy and Concept Development (Roedler 2012).** Used with permission of Garry Roedler. All other rights are reserved by the copyright owner.

As the enterprise evolves the strategy, it is essential to conduct the supporting MA or strategic analysis for each element of the enterprise to determine readiness to achieve future objectives. This analysis examines the current state to identify any problems or opportunities related to the objective achievement and aids the enterprise in fully understanding and defining the problem space. The analysis examines the external environment and interfaces in search of impacts and

trends, as well as the internal enterprise to gauge its capabilities and value stream gaps. Additionally, a strengths, weaknesses, opportunities, and threats (SWOT) analysis may be performed. As the problem space is defined, the stakeholder needs are defined and transformed into stakeholder requirements that define the solutions needed. These requirements include those that address customer and mission needs, the future state of core processes and capabilities of the enterprise, and the enablers to support performance of those processes and capabilities. Finally, MA is engaged again to examine the solution space. Candidate solutions that span the potential solution space are identified, from simple operational changes to various system developments or modifications. Various techniques are applied to analyze the candidates, understand their feasibility and value, and select the best alternative.

## **Process Approach**

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### **Activities of the Process**

It is necessary to perform the following major activities and tasks during the MA process:

1. Review and understand the enterprise mission, vision, and ConOps.
2. Identify and define any gaps and opportunities related to future evolution of the strategy:
  1. Examine the current state to identify any problems or opportunities related to the objective achievement, including any deficiencies of the existing system.
  2. Analyze the context of the actual political, economic, social, technological, environmental, and legal (PESTAL) factors, while studying sensitive factors such as cost and effectiveness, security and safety improvement, performance improvement or lack of existing systems, market opportunities, regulation changes, users' dissatisfaction, etc. External, internal, and SWOT analysis should be included as well. For the technological considerations, an appropriate architecture framework representation, such as the U.S. Department of Defense Architecture Framework (DoDAF) operations view (DoD 2010), the Zachman Framework (Rows 1 and 2)

(Zachman 2008), and The Open Group Architecture Framework (TOGAF) Architecture Development Method (ADM) (The Open Group 2010) Phases A and B should be included within the concept definition when performing mission analysis and stakeholders needs and requirements.

3. Define the mission, business, and/or operational problem or opportunity, as well as its context, and any key parameters, without focusing on a solution.
3. Examine and evaluate the solution space:
  1. Identify the main stakeholders (customers, users, administrations, regulations, etc.).
  2. Identify high level operational modes or states, or potential use cases.
  3. Identify candidate solutions that span the potential solution space, from simple operational changes to various system developments or modifications.
  4. Identify existing systems, products, and services that may address the need for operational or functional modifications.
  5. Deduce what potential expected services may be needed. The Sol is a potential and not yet existing product, service or enterprise. Additionally, the solution could be an operational change or a change to an existing product or service.
4. Perform appropriate modeling, simulation, and analytical techniques to understand the feasibility and value of the alternative candidate solutions. Model or simulate operational scenarios from these services and use cases, and enrich them through reviews with stakeholders and subject matter experts.
5. Define basic operational concept or market strategy, and/or business models.
  1. From previous modeled operational scenarios and operational modes, deduce and express the usage of operational concepts, or technical concepts.
  2. Collect and enrich needs, expectations, scenarios, and constraints.
  3. Validate the mission of any potential Sol in the context of any proposed market strategy or business model.
6. Evaluate the set of alternatives and select the best



alternative.

1. Perform a trade study of the alternatives to discriminate between the alternatives.
7. Provide feedback on feasibility, market factors, and alternatives for use in completion of the enterprise strategy and further actions.
8. Define preliminary deployment concept, preliminary support concept, and preliminary retirement concept.

## **Mission Analysis Artifacts**

This process may create several artifacts, such as:

- recommendations for revisions to the enterprise ConOps;
- preliminary operational concept document or inputs;
- mission analysis and definition reports (perhaps with recommendations for revisions of the mission);
- a set of business needs;
- preliminary life-cycle concepts (preliminary operational concept, preliminary deployment concept, preliminary support concept, and preliminary retirement concept);
- system analysis artifacts (e.g., use case diagrams, context diagrams, sequence/activity diagrams, functional flow block diagrams);
- trade study results (alternatives analysis);
- market study/analysis reports; and
- a set of business (or mission) requirements (often captured in a business requirement specification).

## **Methods and Modeling Techniques**

MA uses several techniques, such as:

- use case analysis;
- operational analysis;
- functional analysis;
- technical documentation review;
- trade studies;
- modeling;
- simulation;
- prototyping;

- workshops, interviews, and questionnaires;
- market competitive assessments;
- benchmarking; and
- organizational analysis techniques (e.g., strengths, weaknesses, opportunities, threats (SWOT analysis), and product portfolios).

## Practical Considerations

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Major pitfalls encountered with mission analysis and marketing analysis are presented in Table 1.

**Table 1. Major Pitfalls for Mission Analysis.** (SEBoK Original)

Pitfall	Description
Wrong level of system addressed	When delineating the boundaries of the Sol and defining the mission and purpose of the system at the very beginning of systems engineering, a classic mistake is to place the system-of-interest at the wrong level of abstraction. The level of abstraction can be too high or too low (sitting respectively in the upper-system or in a sub-system). This is the consequence of the principle stating that a system is always included in a larger system and of confusing the purpose and the mission of the Sol.
Operational modes or scenarios missing	In commercial products or systems, the lack or insufficient description of operational modes and scenarios (how the Sol will be used, in which situations, etc.) is often encountered.

Proven practices with mission analysis and marketing analysis are presented in Table 2.

**Table 2. Mission Analysis Proven Practices.** (SEBoK Original)

Practice	Description
Models of operational scenarios	Using modeling techniques as indicated in sections above for operational scenarios in any kind of Sol (including commercial systems).
Models of the context	Consider the context of use as a system and force oneself to use modeling techniques for main aspects of the context (functional, behavioral, physical, etc.).

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**SEBoK v. 2.6, released 20 May 2022**

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This page was last edited on 18 May 2022, at 08:31.