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Information Services Procurement Library

Information Services Procurement for Large-Scale Migrations

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Developed by consortium:

EXIN – Utrecht – The Netherlands
FAST – München – Germany
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Preface

In 1998 and the beginning of 1999. ISPL, the Information Services Procurement Library was developed by a consortium of 5 companies:

- EXIN – Utrecht – The Netherlands
- FAST – München – Germany
- ID Research – Gouda – The Netherlands
- SEMA – Paris – France
- TIEKE – Helsinki – Finland

The ISPL-project was part of the SPRITE S2 project of the European Commission and was 50% funded by the Commission.

The last years it has become common business practice to procure IT systems and services for a number of reasons, such as:

- the need to focus on core business
- the difficulty to master the growing complexity of systems and services
- the need to operate more cost-efficient
- the difficulty to follow the evolution of technology
- the lack of control over the IS department.

At the same time the need for systematic procedures for the management of procurement processes has been growing.

The Information Services Procurement Library is based on best practices in procurement management. Using ISPL provides benefits for both customers and suppliers. ISPL stresses the customer-supplier relationships, and it provides a better understanding of requirements and the managing of ambitions, expectations and risks through detailed guidance on the acquisition process.

The products of the ISPL-proJect, the Information Services Procurement Library will support procurement managers in their work. Besides books a number of other products are available for all staff interested in, or working as a professional in the field of procurement management.

These products are: training, qualification schemes and examinations on two levels, a best practice database, a tool supporting the procurement process, an ISPL Web-server and a user group (a special interest group of ITSMF-International)

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1 Introduction

Evolution is a constant! The prevailing conditions under which most enterprises currently operate have a tendency to evolve constantly. Reduced protectionism, de-monopolisation of markets, deregulation of international trade, privatisation of state owned companies, increased global competition, cross-border merges, the emergence of new trade blocks, the introduction of common currencies, all contribute towards this increasingly dynamic business environment.

Ideally, IT should empower a business with the services it needs to go out and seek new challenges. One of the current dilemmas of ICT appears to be that in most cases it smothers an organisation's ability to change rather than supporting it. While it is quite reasonable to say that advanced information systems should lead to revolutionary improvements in the flexibility and effectiveness of organisations, organisations still find themselves anchored to their pre-existing information systems. Quite often, these systems are the embodiment of the prevailing cultures and structures of the organisation's past. These systems tend to have an almost tangible monolithic nature that would be a feast to software archaeologists.

At the same time, the maintenance costs, as well as the maintenance backlogs, of these monolithic systems are ever increasing. Change upon change, and patch upon patch, have been applied. Modifications that have quite often resulted in an impregnable forest of applications that are held together by a multitude of scripts in some job-control language. It is also not untypical for such systems to be long past their initially planned span of life.

Meanwhile, the pressure to make profound changes to these systems is mounting. The year 2000 and the introduction of the Euro were already examples of urgent needs to make fundamental changes to pre-existing information systems. Such needs may indeed threaten the very existence of an organisation. The introduction of call-centres, Web-commerce and other forms of E-commerce are typical examples of developments that do not form a direct threat to the organisation as such. They should, however, enable an organisation to explore new forms of business and provide them with the ability to seek out and find new markets.

These challenges have led organisations to initiate a myriad of migration projects. Projects that all aim to better prepare information systems for the times to come. As the number of migration projects increases, the call for proper management of the acquisition of migration services increases as well. The planning of migration projects requires guidance for both customers and suppliers of migration services. The goal of this book is to clarify and improve the relationship between customers and suppliers during all phases of a large-scale migration.

This book is part of the Information Services Procurement Library (ISPL), a best practice library for the management of acquisition processes, that has been developed for use in both the public and the private sector. ISPL can be used in any acquisition concerning services in the IT area, where there is a customer, a supplier (external or internal to the organisation), and some form of a contract formalising the relationship between customer and supplier.

1.1 Target audience

Targets for ISPL are: procurement managers, acquisition managers, programme managers, contract managers, facilities managers, service level managers, and project managers in the IT (Information Technology) area.

To benefit fully, both customers and suppliers should use ISPL. However, even when it is used by only one party, it offers advantage in terms of better planning and management of the service.

1.2 The structure of ISPL

ISPL is structured as shown in Figure 1. Four practical books constitute the basis known as the IS Procurement Management Essentials. These books are on the following subjects: Managing Acquisition Processes, Specifying Deliverables, Managing Risks and Planning Deliveries and there is also a Dictionary. Additionally, a specific book addresses public procurement.
On the basis of these essentials, plug-ins are provided for specific needs and situations. Shortly, three plug-ins are available for which a large market potential is foreseeable. The plug-in domains are: Web engineering services, IT service management services, and Large-scale migration services.

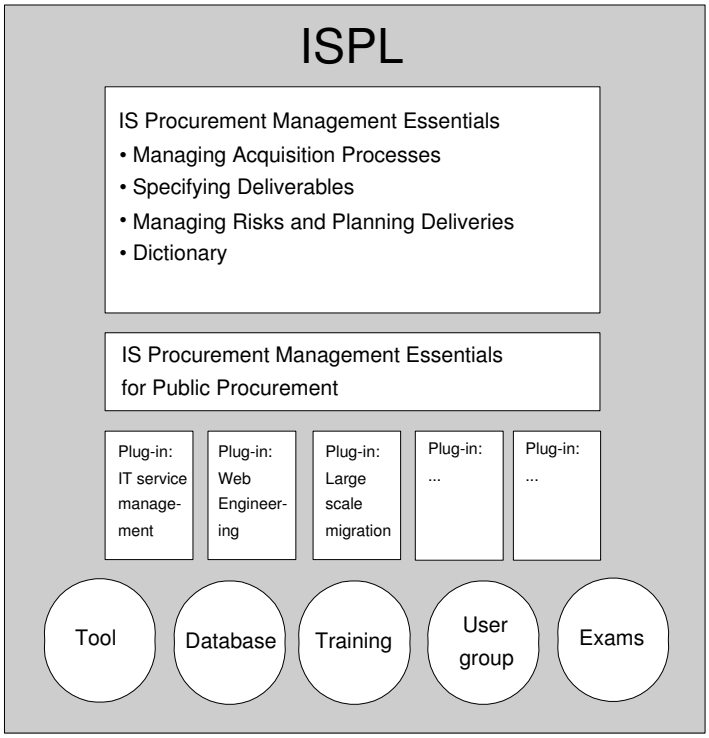

Figure 1 The ISPL Structure

ISPL is not only concerned with books:

- *Qualification schemes and examinations* are provided for two different types of ISPL users: those mastering the ISPL foundation level and those becoming ISPL procurement managers.
- A *user group* has been set up to mobilise suppliers and customers in the area of procurement. This user group is a Special Interest Group of ITSMF International.
- A *database* for best practice information (http://www.marex.fi) is provided to improve procurement practices.
- A *tool* offers a number of templates for documents and offers guidance for risk management and delivery planning.
- *ISPL training* is available to become qualified in ISPL.
- A *Web server* (http://www.fast.de/ispl) provides general and up-to-date information about ISPL.

1.3 The ISPL concepts

This section introduces the reader to the concepts of ISPL and describes the context in which ISPL operates and the key concepts that determine the vocabulary and syntax of an ISPL acquisition process.
Therefore this section should be read at least once by all readers, whatever their role(s).

1.3.1 Organisations and their information systems

Organisations are human system, i.e. structured groups of people possibly using machines (including computers), co-ordinating their efforts towards certain goals. People need information to perform their cognitive processes and organisations need information to allow people to communicate with each other.

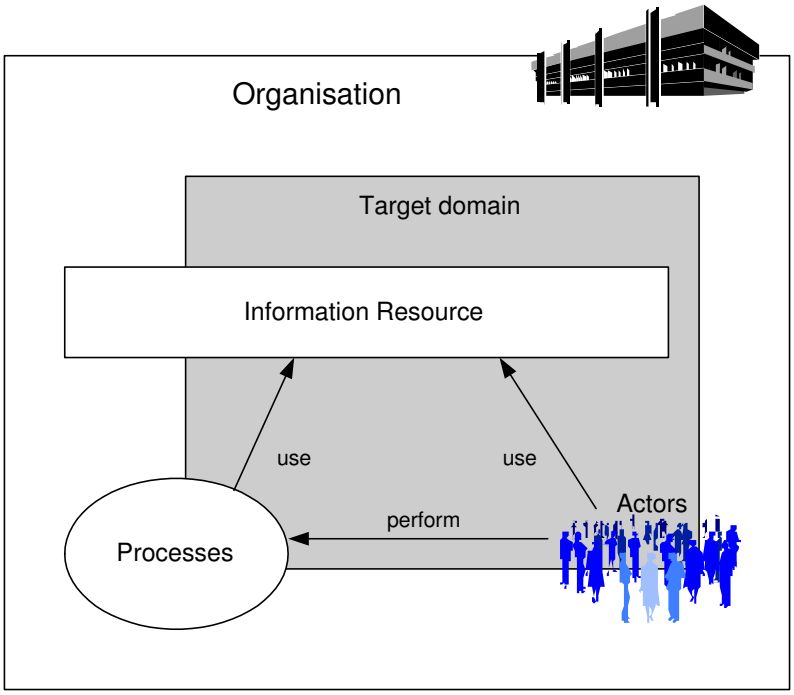

Figure 2 Organisation and target domain

Organisations and their processes

An organisation can be viewed as a set of actors executing processes using (and updating) an information resource (see Figure 2). The information resource is the totality of information that is available within the organisation. This information is relevant to the structure, functioning and evolution of the organisation and its environment (customers, suppliers, market, regulations, etc.).

Processes may be described by different criteria:

- By their goals, constraints and quality characteristics (e.g. deliver a certain product to the customer's satisfaction within a certain time and cost).
- By their results (e.g. delivered product).
- By their activities (or subprocess) (e.g. the delivery process will consist in getting the product out of stock, checking its characteristics and selecting the transportation means).

Ongoing processes support the day-to-day functioning of the organisation, i.e. the fulfilment of its objectives with respect to its environment. They are usually continuous and they contain activities that are repeated regularly during the life of the organisation. They usually remain in the same steady state, or incur only slight changes, for long periods.
Adaptation processes adjust the organisation to its changing environment. An adaptation aims to change the organisation and/or to study and prepare such a change. Each adaptation is a specific process that has a beginning and an end and executes a state transition in the organisation, i.e. it moves the organisation from an initial state to a final state in a certain elapsed time. An adaptation is defined by its initial and final states and the route from one to the other. An adaptation is usually achieved by a project.

Information systems

The information system is defined as that aspect of the organisation that provides, uses and distributes information. It is thus an aspect of a human system, possibly containing computerised systems to automate certain elements.
The computerised system is the automated part of the information system. It may contain one or more computers or peripherals, and software that performs data processing.

Services

A service is a process that is executed by one person or organisation for another.
More particularly, in the public sector, the word service is used for those processes that represent an economic value not related to the production of material goods. The EC Service Directive provides a classification of services [EEC92].
Within ISPL, two types of service, which correspond to the types of processes presented above, are addressed: the *projects* and *ongoing services*.

Projects

A project is a process contributing to a change of an organisation to fulfil its needs (correction, enhancement, improvement, automation, introduction or inclusion of a new computerised system, etc.). This includes:

- System development
- System maintenance
- System design
- Reverse engineering
- Process re-engineering
- System installation
- Various sorts of studies

The initial state of a project is the organisation existing at the beginning of the project, plus the knowledge available at the beginning of the project regarding this organisation and its future versions.
The final state of a project is the organisation existing at the end of the project, plus the knowledge acquired at the end of the project regarding this organisation and its future versions.
During the life of an organisation there will typically be several adaptations enacted by several projects, e.g. one or more change analysis studies[1], and one or more system description, construction, and installation

[1] Projects solely resulting in improved knowledge and documentation about the existing system or the design of a future system are also considered

projects.
ISPL provides the means to define flexible initial and final states of projects and contains examples of typical initial and final states.

1.3.2 Acquisitions

The acquisition process (or acquisition for short) is the process of obtaining a system or a service, or any combination thereof, to achieve some goal contributing to the business objectives.

Target domain

Where an organisation has some business needs regarding some of its processes, the affected part is called the target domain (see Figure 2). The target domain is the part of the organisation which is affected by a service (ongoing service and/or project). The target domain may be a company, public administration department or part of either entity. Business needs may derive from a business strategy (e.g. develop a strategic application) or result from requests of target domain stakeholders (e.g. improve the ergonomics, functionality or maintenance of a computerised system) or be caused by external constraints (e.g. changes in statutory requirements).
With the integration of computerised systems and business processes the acquisition of services related to information systems has become a complex task.

Acquisition goal

The acquisition goal is defined by a consistent set of system and service requirements that satisfy the selected business needs of the target domain. Examples of acquisition goals are: an improved business process, a new organisational structure, a new computerised application, an improved computerised system operation service, etc.
The acquisition goal is used to drive the acquisition process, which starts with the formulation of an acquisition strategy.

Acquisition strategy and plan

The acquisition strategy will determine the number and the kinds of services and contracts that are needed to achieve the acquisition goal; their sequencing constraints; the types of customer-supplier relationships and the approach to manage the risks.
Decomposing an acquisition into a set of smaller acquisitions (called 'procurements') is on one hand a way to manage risks, while on the other hand it allows for more competition and avoids lock-in with one supplier.
The acquisition plan documents the acquisition strategy, defines the organisation and co-ordination of the various procurements and schedules the main decision points of the acquisition process.

Customer-supplier relationship

The acquisition process is managed within customer-supplier relationships. The customer is the person or organisation responsible for the acquisition goal and who has decided to contract out services. The customer may or may not be the target domain organisation. In the latter case the customer will act on behalf of the target domain organisation or its owner.
The supplier is the person or organisation that provides a service to the customer. Complex acquisitions may involve more than one supplier, each one being responsible for a subset of services. Suppliers in their turn may have sub-contractors providing them with some services; see Figure 3. In these circumstances, the supplier acts as the customer to the sub-contractors.

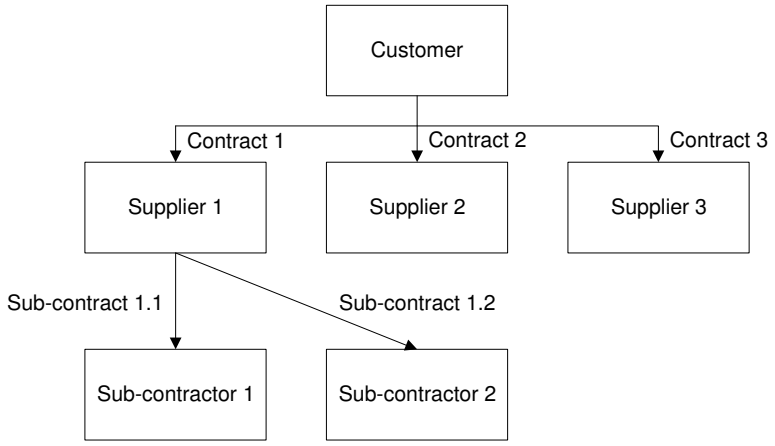

Figure 3 Acquisition with multiple customer-supplier relationships

Contract

A contract is a binding agreement between two parties for the supply of services or products enforceable by law or a similar internal agreement wholly within an organisation, . Several contracts may be required for the acquisition of the services needed by an organisation.

Procurement

Procurement is the process of preparing a contract and obtaining the services that are defined within this contract.
Figure 4 shows that a contract may be concerned with the procurement of several projects and ongoing services.

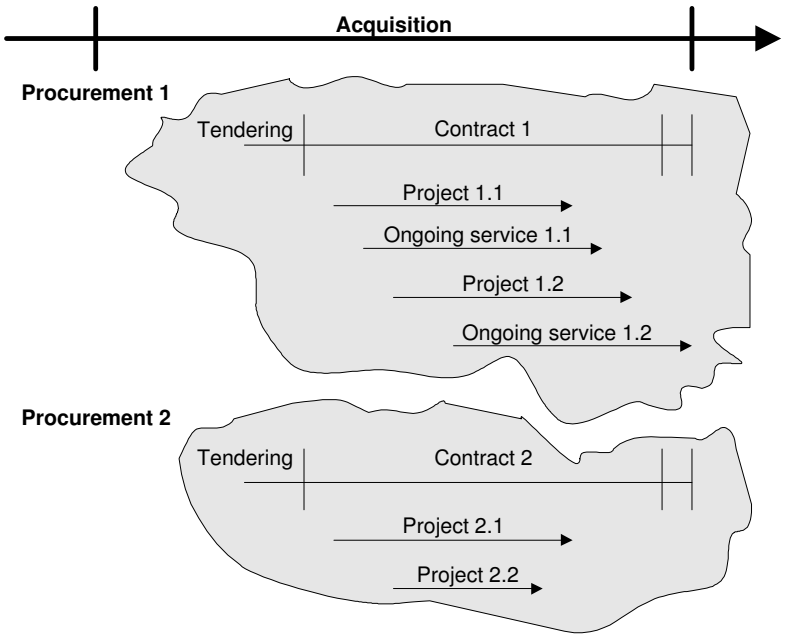

Figure 4 The relationship between acquisition, procurement, project and ongoing service

Acquisition process model

The acquisition starts as a customer process and then includes customer-supplier processes possibly involving several suppliers and several contracts. The first customer activity is the acquisition initiation. This entails refining the acquisition goal on the basis of the business needs, producing the requirements of the needed services and systems, elaborating the acquisition strategy and planning the acquisition on the basis of an analysis of the situation and the acquisition goal.
The acquisition strategy is elaborated within a risk management framework. A risk is the possibility of exposure to the adverse consequences of future events.
Risk management is a systematic approach to reducing the probability of risks and limiting the impacts of risks.
An important result of the acquisition initiation is the decomposition of the overall acquisition into a set of procurements, each one being concerned with a subset of the systems and services.

For each contract, the procurement process is a sequence of three processes:

- The tendering process:
  Aims to select a supplier and a proposal for the considered services and to agree a contract with the chosen supplier defining the deliveries and responsibilities of both parties. The tendering process includes the following subprocesses: preparation of request for proposal, response preparation, supplier selection and contract preparation. These subprocesses do not need to be executed in the sequence of Figure 5: they may overlap in time, and there may be iterations of groups of these subprocesses.

- The contract monitoring process:contract monitoring process
  Aims to monitor the services defined in the contract, i.e. to ensure that the services conform to the requirements specified in the contract. This process may be viewed as a decision process: at various points in time, decisions are made by the customer and the supplier regarding the delivered services, costs, schedules and other contractual matters. An important type of decision is the customer's acceptance of a system delivered by the supplier.
  Co-ordination of different contracts needs to be achieved.

- The contract completion process:
  Aims to terminate the contract. It checks that all deliveries have been completed successfully and that the obligations of both parties have been fulfilled and completes all outstanding issues (e.g. payment, transfer of ownership, warranty) before closing the contract.

The acquisition completion seeks the formal completion of all the acquisition contracts. It represents the end of all the services provided the acquisition as well as the internal activities within the customer organisation that are specific to the concerned acquisition. The acquisition manager (often the customer contract authority) should check that all the contracts have been concluded successfully and that the acquisition goal as a whole has been achieved.

Acquisition organisation

At some point, the acquisition includes suppliers personnel. Customer and supplier personnel play different roles within the organisation.

A contracted service is undertaken by an organised team of people called a service organisation. The service organisation delivers results that should satisfy the requirements issued by the customer (see Figure 6). When the delivered service is a project, the service organisation may be called a project organisation. Three levels are usually considered (in small acquisitions the same person may be in charge of more than one level).

- The service execution function provides the required service to the customer, e.g. business process engineering, computerised system operation, network maintenance, software development. For this

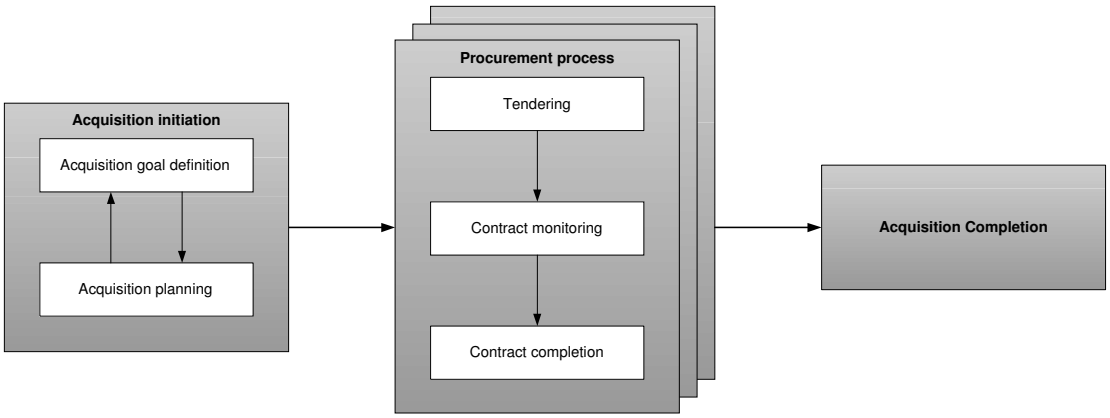

Figure 5 The acquisition process model

purpose it uses resources (skills, knowledge, products, etc.) from the supplier and sometimes from the customer.

- The service management function plans and monitors the service. It organises the team, allocates resources to the tasks and makes sure that the required quality is achieved within timescales and budget.
- The acquisition management function controls the acquisition and its various contracts. It is responsible for the service and system requirements that are documented in the request for proposals, tender responses and contracts. It controls whether requirements are met by the services and systems and takes the appropriate measures when they are not. In complex acquisitions, this level may be split into acquisition management and contract management and the various contracts may involve different people in their management.

The delivery plan

A specific contract monitoring process is represented as a sequence of decision points. A decision point is a milestone where the customer, possibly together with the supplier, makes decisions on the services involved. A decision point is characterised by the decisions that are made, the roles involved in these decisions and the deliverables that are exchanged. Input deliverables serve as preconditions or as a basis for the decisions and output deliverables, i.e. decision point reports.
The delivery plan defines the contractual customer-supplier relationship during contract monitoring. It consolidates all service delivery plans and project delivery plans for one contract and in particular emphasises the interdependencies between the plans.
The delivery plan defines the sequence of decision points of the contract monitoring process. Several versions of the delivery plan are produced during the tendering process. A delivery plan is given to potential suppliers in a request for proposal and returned as a response to the tender. It is one of the bases for supplier selection and forms an integral part of the contract.

1.3.3 Roles in acquisitions

Two key roles are identified within the customer and the supplier organisation which are relevant in every instance where a customer and a supplier interact. These are the contract authority and service authority:

- A contract authority is:
  The person, or persons with the power to resolve or conclude an open issue with regard to a specific contract. One contract authority represents the customer organisation and another represents the

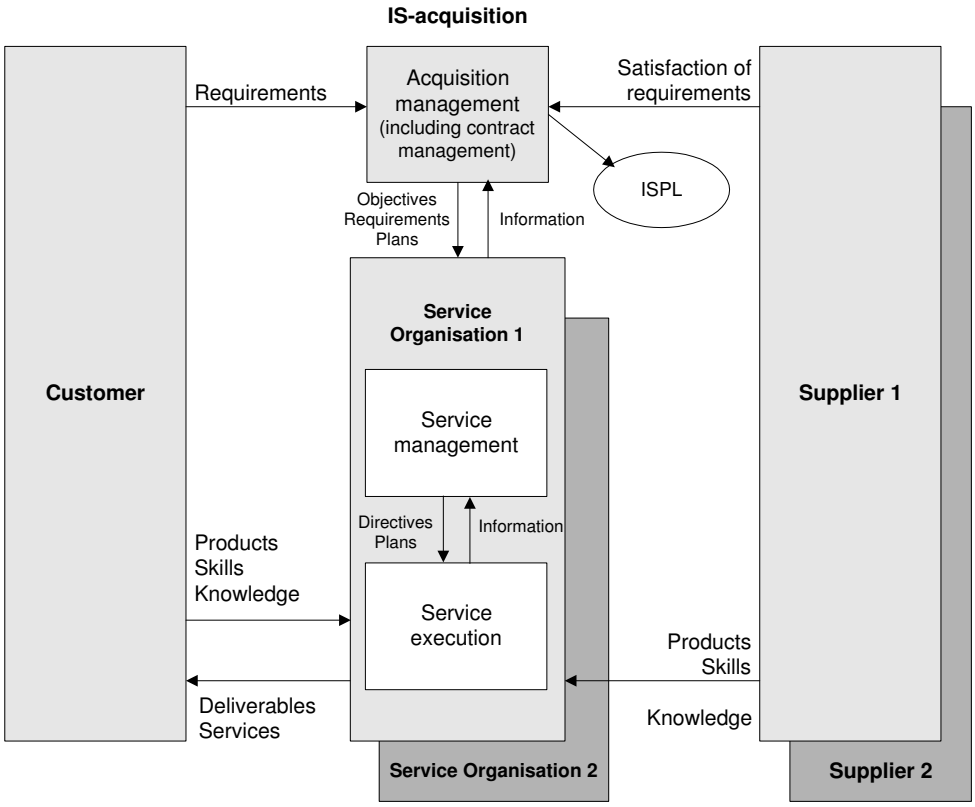

Figure 6 Structure of an acquisition organisation

supplier organisation. It is not necessary, or necessarily desirable, that the same person acts as the contract authority throughout the acquisition process.

- A service authority is:
  The person, or persons with the power to resolve or conclude an open issue with regard to a specific service. Again, one service authority represents the customer organisation and another represents the supplier organisation. It is not necessary, or necessarily desirable, that the same person acts as the service authority throughout the acquisition process.

The behaviour of these key role types is affected by either the imposition of external directives or constraints, or by the provision of appropriate expertise. That is, there are a number of further role types whose role is to either provide input with regard to the organisational direction or to provide a particular expertise needed within the acquisition process. These are summarised as organisational authorities and operational expertise, which are found in both the customer and supplier organisations:

- An organisational authority is:
  The person or group of people with the power to resolve or conclude an open issue with regard to the strategic requirements of the organisation. Therefore, at one level any decision made by a contract authority may be affected by a number of organisational authorities within his/her organisation. The implication of this is that a decision can be imposed upon the contract authority by one of the organisational authorities. Examples of organisational authority are: senior management, financial authority, legal authority, quality management authority.

- An operational expertise is:
  The person or group of people performing a task or acting as an opinion maker based upon their expertise, skills or knowledge with regard to a specific topic. When performing their work, the service authorities make use of various skilled resources within their organisations, that is, they make use of operational expertise. Examples of operational experts are: business experts, information system experts, technical experts, user experts, quality assurance experts, configuration management experts, system operation experts, network management experts, etc.

The roles are represented graphically in Figure 7.

Although there is a degree of symmetry regarding the types of experts needed by the supplier and customer, the requirements for these types of experts may be different for the customer and supplier organisations. The roles identified by ISPL are meant to represent the authorities and responsibilities within an acquisition and also the skills and knowledge provided. In a particular acquisition each of the roles may be performed by a single person or a group of persons (the operational experts is generally provided by a group of persons e.g. the project team). Sometimes, a single person performs several roles, e.g. a person managing the supplier's work may thus perform the service authority role and at the same time participate in the work by providing operational expertise.

1.3.4 Risk management and delivery planning

Risk management

Risk management contains the following subprocesses (see Figure 8):

- Risk analysis: identifies, analyses, evaluates, assesses, estimates the risks.
- Risk management planning: plans the risk management actions.
- Risk monitoring: tracks, controls, monitors the risks and the risk management actions.

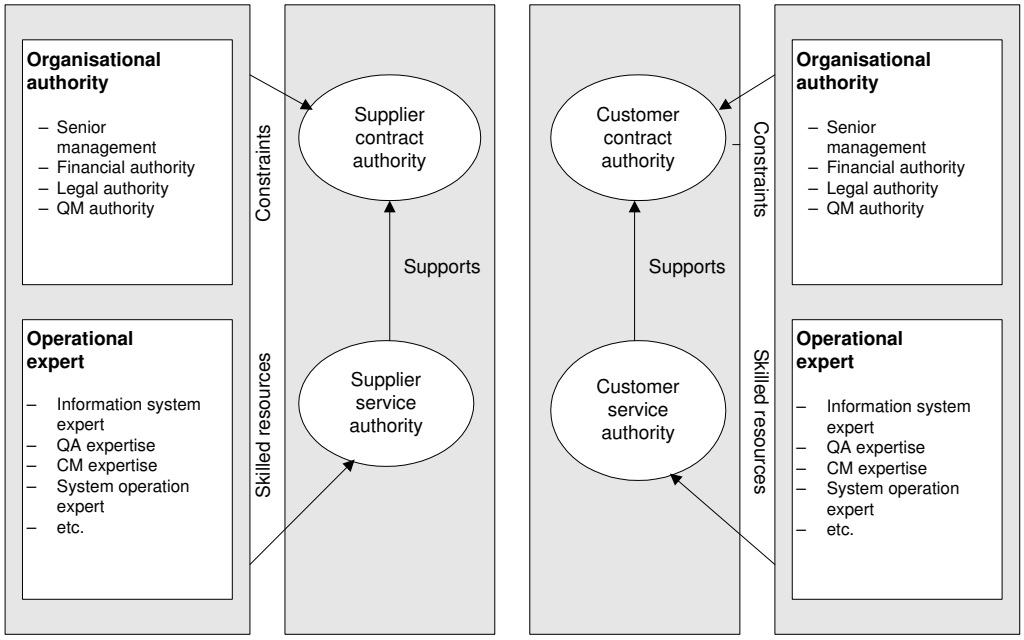

Figure 7 The roles in acquisition

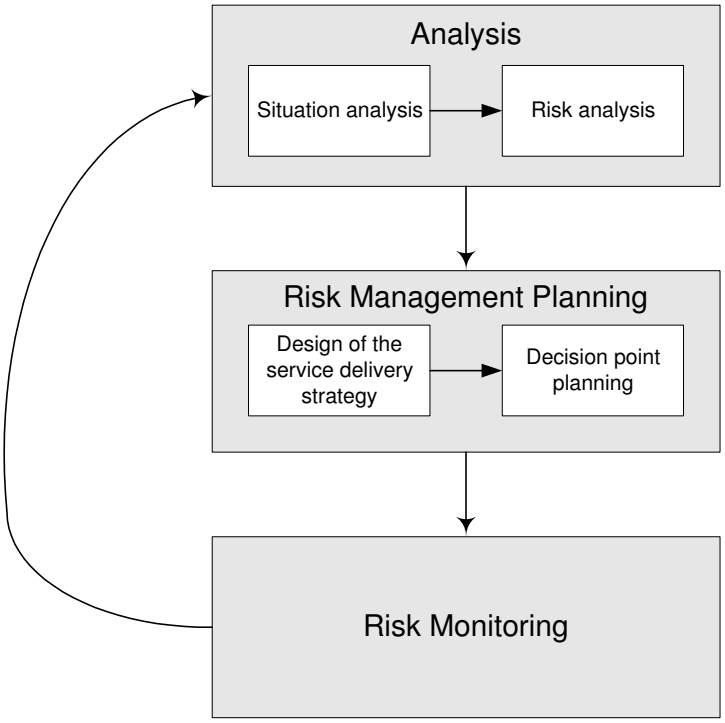

Figure 8 Risk Management Process

Delivery planning

Delivery planning consists of several techniques that lead to the creation of the delivery plan within a risk management.
A project delivery plan is a plan for a single project performed within a procurement. It defines the situation, the initial and final states of the project, the project delivery strategy, the sequence of decision points and the deliveries during contract monitoring. One or more project delivery plans may be contained within each delivery plan.
A service delivery plan is a plan for a single ongoing service or a set of related ongoing services performed within a procurement. It defines the situation, the service delivery strategy, the sequence of decision points and the deliveries during contract monitoring. One or more service delivery plans may be contained within each delivery plan.
The overall delivery plan consolidates all service delivery plans and project delivery plans for one contract, especially emphasising the interdependencies between the plans.

1.3.5 The situational approach

In ISPL, the risk mitigation strategy selection is performed using a flexible problem-solving approach called the situational approach.

This aims to improve the effectiveness of the acquisition process by tailoring it to each problem situation. A tailored acquisition process is one that maximises the chances of achieving an acquisition successfully, while minimising the risks and costs.

> In the situational approach, risk mitigation strategy and delivery plans are adapted to the situation, its complexity and uncertainty, and contribute to the mitigation of risks.

In a situational approach, the properties of a situation must be assessed, their likely consequences estimated and appropriate strategies proposed (see Figure 9). These strategies help to mitigate the risks inherent in the situation.

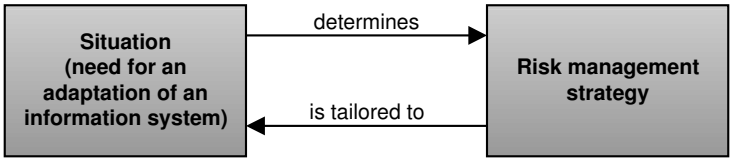

Figure 9 Risk mitigation strategy depends on the situation

Situation analysis and Risk analysis

The properties of the situation that are relevant in identifying the risks are called situational factors.

> Situational factor values are related to the complexity and the uncertainty associated with the business (target domain) and the service organisation (service domain). The value for each situational factor is generally one of three levels: low, medium or high complexity or uncertainty.

The values attributed to each of the situational factors are used to identify risks. The probability and the impact of the risks are then estimated.

The service delivery strategy

Services tend to be complex; hence careful planning is needed to ensure a successful outcome. Plans are necessary to manage services and to predict their costs, but in order to design a suitable plan it is necessary to determine an appropriate strategy.
The service delivery strategy is the intended approach to achieve the objectives of a service, while effectively managing risks inherent in the situation.

> The strategy for a specific service guides the design of plans and the selection of methods used for that service.

Strategy options

ISPL provides recommendations (heuristics) for the selection of strategy options depending on the characteristics of the situation. These represent the experience of best practice and can be used either to determine a strategy or to assess whether the strategy is adapted to a situation.
The concepts presented above are summarised in the picture of Figure 10.

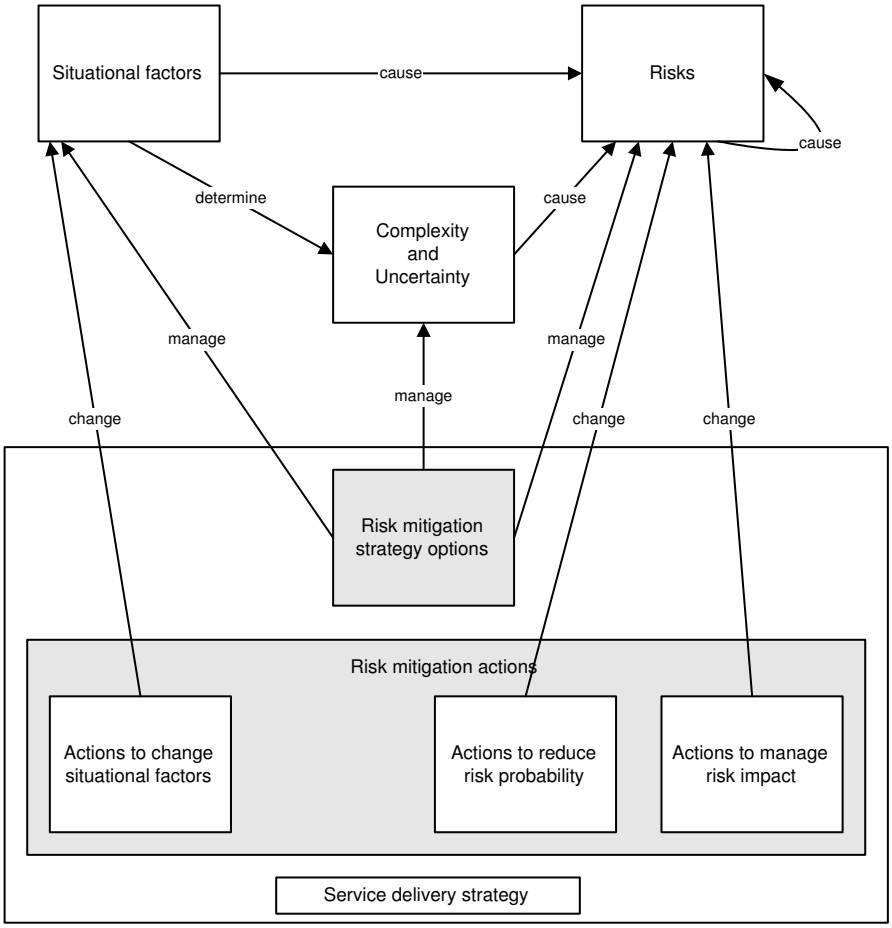

Figure 10 Main concepts used in risk management

Sequence of decision points

The sequence of decision points for a particular service depends on the chosen service delivery strategy. For projects, ISPL proposes templates of decision point sequences for different strategy options. These templates may serve as examples to be re-used when designing the delivery plan for a particular project.

> ISPL focuses on decisions and deliveries but does not directly prescribe the activities to be performed nor the techniques to be used. This preserves the competitive advantage of a supplier's particular processes and methods.

1.3.6 Deliverables

A deliverable is a product that is exchanged between the supplier and the customer to fulfil a defined purpose within an acquisition.
Deliverables need to be well-defined and unambiguous.
ISPL classifies deliverables into various types and defines a set of properties for each of the deliverable types. These properties are used to characterise the deliverables that are required regardless of a specific method.

Figure 11 shows the types of deliverables (and their subtypes):

- Contract domain deliverables which are used to define and control the contractual process of a procurement.
- Service domain deliverables which are used to plan and control service execution.
- Target domain deliverables which are systems or documents related to the target domain.

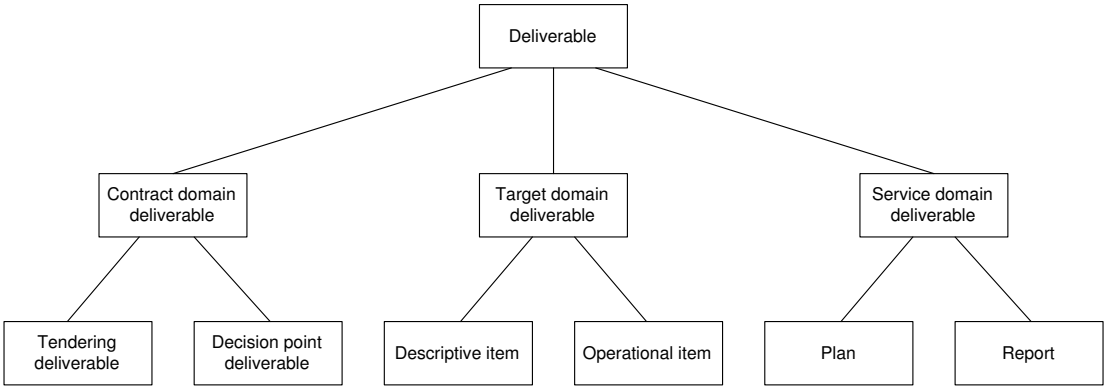

Figure 11 Deliverable types

1.3.7 Project processes and plans

This section presents specific considerations relative to projects.
An alternative view of a project compared to the hierarchical control view (see Figure 6), regards the organisation as a set of processes co-operating to achieve the project objectives.
Such a view is used in organisational modelling and it corresponds to the processes found in the ISO Life Cycle Processes Standard [ISO95]. Some of these processes are particularly relevant to the customer-supplier relationship since they directly affect deliverables and are used to define strategy options.

Processes within projects

The following processes exist project execution level:

- Development:
  Aiming at developing the required deliverables.
- Quality assurance:
  Consisting of all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality [ISO94].

At the project management level, these two processes are respectively development control and quality control.

Another process directly affecting the deliverables is configuration management. This is a discipline which applies technical and administrative direction and surveillance to identify and document the functional and physical characteristics of a configuration item, control changes to those characteristics, record and report change processing and implementation status and verify compliance with specified requirements [IEE90].
For a complete list of processes, the reader should refer to the ISO Life Cycle Processes Standard [ISO95].

Development

The development of a system to customer requirements involves three processes: a description process, a construction process and an installation process.

- Description process:
  Aims to design a system satisfying requirements using descriptions; descriptions may be based on natural language, models or prototypes.
- Construction process:
  Aims to realise and test a system that is considered an artificial artifact not yet in operation.
- Installation process:
  Aims to make the system operational, i.e. to implement the use of the system by the target domain organisation.

The word system means to refer to the organisation, information system, computerised system, set of processes or parts of these.
A system may be realised through a series of versions: the development of each version follows a typical life cycle of which a simple representation is given in Figure 12. This figure shows the different states of a system version and the possible transitions.

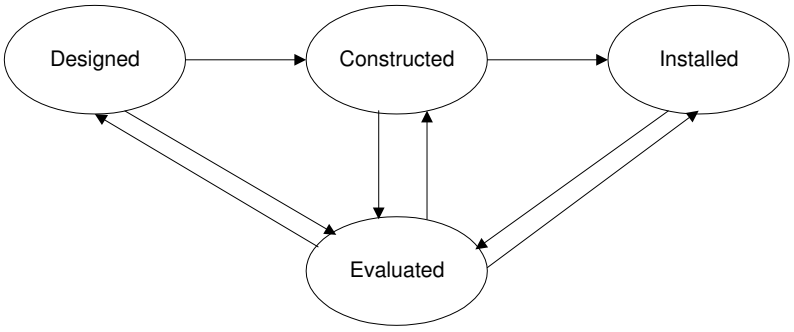

Figure 12 Life cycle of a system version

For simplification, the 'evaluated' state incorporates the results of testing, verification and validation. For more information the reader is invited to refer to the ISO Software Life Cycle Processes Standards [ISO95].

Some IS development methods propose a process model (e.g. waterfall model) based on a sequence of phases corresponding to design, construction and installation. These phases form the basis for planning projects. Unfortunately, these phase models have proven impracticable in complex and uncertain situations. In most projects, the three processes are actually executed in parallel, with peaks of activity within each process.
The sequencing constraint between design, construction and installation holds only for a component version but not for the whole project.
Effective planning and control of projects require some flexibility in defining the development process most suitable for a given situation.

1.3.8 Ongoing service processes and plans

This section presents specific considerations relative to ongoing services.

Ongoing services normally involve three different processes:

- Service installation: which can be considered as a project.
- Service execution: which is the execution of the ongoing service.
- Service retirement: which can be considered as a project.

Service execution refers to the ongoing process delivered by the supplier to the customer, whereas, service installation and service retirement are unique, one-time processes, carried out as projects.
The nature of the service installation may differ considerably from one service to another. Important issues are the state of knowledge of current systems and services and their history, and the stage at which staff transfers occur (if these occur at all).
Completion of a service execution is normally done by means of a separate project, called service retirement. The objective of service retirement is to relinquish the supplier's responsibility for the service execution. If the supplier has to hand back direct control and responsibility for the service to the customers (or to another supplier that will take over the service), it must be done with a minimum disruption to service levels. Sometimes, however, the service will simply be discontinued as it is no longer required.

1.4 The structure of this book

This book aims to provide insight into the procurement of projects dealing with large-scale migrations. Chapter 2 defines the scope of this book more precisely, by defining what is meant by a 'large-scale migration'.

An overview of the acquisition process for large-scale migrations is provided in chapter 3. The ensuing four chapters home in on specific aspects of the acquisition process. In chapter 4 we focus on the description of the initial and final states of projects. Chapter 5 is concerned with risk analysis in a migration context. It bases itself on an analysis of the factors that characterise the current situation, potential risks associated to this situation and factors, as well as their probability and impact. Mitigation of these risks in terms of actions and project strategies is discussed in chapter 6. Finally, chapter 7 is concerned with the identification of decision points to re-evaluate the progress of migration projects, the status of risks, and their mitigation.

2 Large-Scale Migrations

Thus far this book has referred to the concept of *large-scale migrations*, and it has done so in the absence of a proper definition. This chapter starts by providing a remedy for this omission. Is the re-engineering of the specifications of an information system a large-scale migration? Can regular maintenance of an information system be seen as a form of migration? Was making a system year 2000 compliant a form of migration? How about the gradual introduction of a new component-based architecture, along with the introduction of new business functionality? This chapter aims to flesh-out what is meant by large-scale migrations.

First, the scope of large-scale migrations is better clarified, together with a brief discussion of the role of the customer in a migration. Then a detailed study is made of the possible causes for migration and their origins, which is accompanied by a classification of some of the typical types of migrations one may find in practice.

2.1 Scope

A first issue that needs clarification is the limitation of this plug-in to *large-scale* migrations. ISPL itself is primarily targeted at large projects. For smaller projects, the formal procurement processes described in the library should be interpreted more loosely. Nevertheless, also for smaller projects, ISPL is expected to be a useful *repository* of procurement knowledge, if only as a check-list for managers to perform a thorough risk analysis and determine appropriate strategies. The limitation of the LSM plug-in to large-scale migration should be regarded in the same light as the focus of ISPL on larger projects. In the remainder of this book, the term 'migration' shall be employed as an abbreviation for 'large-scale migration'.

To arrive at a proper definition of migration, a better understanding of the aspects involved will prove useful. The following definitions help demarcate the scope of large-scale migrations:

Business system A business system is essentially a set of actors that perform certain processes, while making use of some technological infrastructure.

Information system An information system is that aspect of the business system that provides, uses and distributes information. In other words, it is an aspect of a business system, possibly containing computerised systems that automate certain activities.

Computerised system A computerised system is defined as the automated part of an information system. In other words, those parts involving a computerised actor. It may contain one or more computers or peripherals, as well as software to perform the actual data processing.

Human system A human system in this context is defined as the non-automated part of the business system.

The migrations considered by this plug-in are limited to computerised systems only. This includes both the requirements, design, as well as the actual implementation of the computerised system. The LSM plug-in is not concerned with migrations of manual procedures, business processes, organisational structures, etc. Note, however, that the migration of a computerised system may quite well affect the human system using

the computerised system. This implies that this plug-in does have to take the effects of migrations on the human system (e.g. human actors) into consideration.

The precise definition for migration as used in this plug-in is:

> *Making large-scale changes to pre-existing computerised systems, without fundamentally changing the functionality provided to the computerised system's environment.*

This definition of migration does allow the *internal* functionality of a computerised system to be changed fundamentally. For example, when (only) migrating to a component based architecture, the internal functionality of the computerised system will change dramatically. The functionality offered to the environment, however, will not change.

The above definition does exclude projects that deal with fundamentally new functionality. For example functionality that aims to support new business processes. One may argue that this is too limiting. Especially when one realises that a possible approach in dealing with some of the risks related to e.g. commitment and resource limitations, may very well be to combine a migration project with a project that does provide fundamentally new functionality. This book will most certainly discuss this approach as a strategic option to be considered when doing a migration projects. At the same time we also claim that limiting this book's scope to 'pure' migration still provides useful results, and even more, allows us to focus in more detail on the specific procurement issues related to migration.

It is interesting to note that the large-scale migration projects as considered by this plug-in, are always examples of *projects*. Due to its large-scale nature, these migrations always involve significant changes that need to be made to the pre-existing situation, which requires these migrations to be conducted in the form of a project. This should not be mistaken with a situation in which a computerised system continuously evolves in numerous small steps to continually meet new requirements. The latter (ongoing) situation could be classified as an *evolution service*, which is more of an *ongoing-service* than a *project*. Some large-scale migration projects may actually aim to make a computerised system more flexible, in the hope to let further changes be no more than *evolutionary services*.

2.2 The role of the customer

Customer-supplier relationships are important to ISPL. It is therefore essential to have a proper understanding of who exactly the customer is. When considered at a first glance, most migration projects would consider to have some organisation's IT department as their customer. In most situations, however, one would expect there to be some business rationale for the migration project. Who else, but the business, is ultimately paying for the migration? When there is no business rationale, one may actually question the sensibility of the whole project. This business rationale may find its roots in considerations such as:

- increased time-to-market for new forms of products due to an increased flexibility of IT support, i.e. IT does not block important business initiatives,
- reduction of the total-cost-of-ownership (i.e. all maintenance related costs incurred while keeping a computerised system operational),
- improved reliability/availability of the system,
- continuity of system (and the business depending on the system).

Therefore, the customer of a migration project will in most cases not just be an IT department, but will include the business and their business stakes as well. This implies that the role of business management needs to be taken into account as well when considering migration projects.

It is also important to realise that it will hardly ever be the case that the effects of a migration will go unnoticed by the user community. The changes of migration are most likely to show through to the users somehow. This may even be as subtle as a change in the overall performance of the system. This implies

that not just business *management* is involved (directly or indirectly) by a migration, but the *business* actors, which includes the user community, as well.

In the remainder of this book, whenever we refer to business actors, or business management we potentially refer to any of the actors/managers of the customer, i.e. both from the customer's regular business units as well as the customer's IT department.

2.3 Causes for migration

Migrations may have a multitude of causes. What all migrations have in common is that there are some 'perceived problems' in the current situation, which are somehow related to the computerised system. Each of these perceived problems is a *cause*(s) that eventually gives rise to the migration project. The problem itself needs to be perceived by some party involved, who will then be the most likely candidate to become the *problem owner*, and/or the *sponsor* of the migration project.

For migration projects it is also very important to clearly identify whether the problem owner is a representative from the *business* side or from the *IT* side. This information will have a profound influence on the kind of management commitment that can be expected for the migration project (see the situational factors "*Attitude of business actors*", and "*Attitude of business management*"). Year 2000 related migration projects form interesting cases where organisations were not always in the clear regarding the question whether this was an IT problem or actually a business problem. This latter discussion is obviously intertwined with the above discussion of: *who is the customer of the migration project?*

By zooming in on a computerised system and both its development and management contexts, a better understanding can be gained of the variety of migration causes and their origins. Some of migrations may be caused by problems that are 'life threatening' to the information system or the organisation as a whole. Obvious examples have been the approaching year 2000, and the introduction of the Euro. A first step is to separate causes that are related to the computerised system itself from causes that are related to the service infrastructure that is used to maintain the system and keep it in operational service. The elements of the service infrastructure may be used in the development/maintenance of the computerised system (tools, repositories, compilers, techniques, methodologies, etc.), as well as the day-to-day operations of the system (performance tuning and monitoring tools, system administration tools, etc).

In Figure 13, a framework is provided depicting this dichotomy for migration causes, together with some additional refinements which will be discussed in the remainder of this section.

Migrations that are (solely) caused by problems related to the service infrastructure will generally not (directly) lead to a change in the functionality provided by the computerised system. Examples of such causes are:

- Changes in the compilers and programming languages used. For example, moving from Cobol to C++. This usually leads to a migration project involving code conversions.
- Changes of the modelling tools/techniques used. This may result in a migration of past design specifications to the new tools.

When homing in on the computerised system itself, a further distinction can be made by viewing the system from different perspectives. In the ISPL book on Specifying Deliverables [FV99d], three views are identified from which a computerised system may be considered:

Data view This view pertains to the representation of the information resources handled by the information system, and any static or dynamic dependencies of the information they represent.

Function view The function view is concerned with the functions performed by the computerised system, how they support and interface with manual work, their use of the data retained in the computerised system and the interfaces to this data.

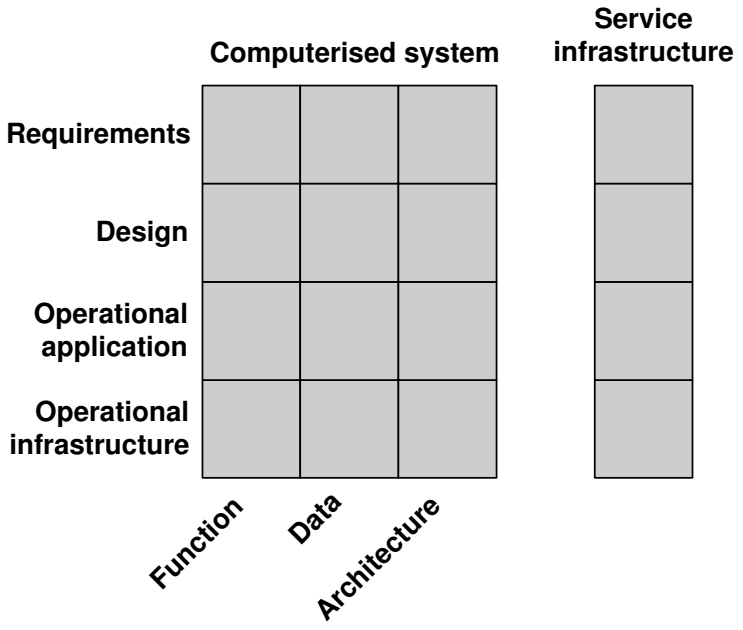

Figure 13 Classification of causes for migration

Architecture view This view covers the functional, logical, and physical architecture of the computerised system. It is concerned with processing units, their locations, connections, and the distribution of data and functions.

Please note that these perspectives are *not* biased towards a particular modelling paradigm. For example, in the case of a computerised system developed using the object-orientation paradigm, these three perspectives can still be discerned. When using an object-oriented paradigm, the functional and logical architecture of the resulting computerised system will indeed differ considerably from a computerised system developed using a different paradigm.

Some examples of causes for migrations which originate from these three views are, respectively:

- Data view:
  - A country which has had a high inflation rate for a number of years may decide to introduce a 'new' currency unit in order to reduce the number of digits required to represent amounts.

    When Italy was still using the Lire, they have made such a conversion once to remove some digits.
  - From an IT perspective the introduction of the Euro was a problem that was caused by a change in the requirements of the data view as well as the function view. To be more precise, it is a change to the currency types used in the information/computerised system, and conversion routines between currencies.
  - The year 2000 problem is obviously a problem that can be traced back to the use of the date datatype in computerised systems.
  - Companies may use product-codes to identify their products. When such a company introduces more and more products, sooner or later they will run out of product-codes. The resulting problem is not unlike the year 2000 problem in that it requires the storage format of a datatype to be extended with extra space.

  - An interesting problem that basically leads to a (incremental) migration of gigantic proportion is the introduction of IPv6, the new standard for IP addresses.

    Traditionally computers on the internet are identified using a four byte code. For example: 194.134.145.30. The Internet Engineering Task Force has defined a new standard for IP numbers, including a transitioning scheme from the old IP numbers to the new IP numbers. Since IP numbers are used to identify computers, the migration to IPv6 is due to a problem in the data view of the computerised system. In this case the computerised system actually consists of the entire internet.

- Function view:

  - Due to the penetration of graphical user interfaces (GUI), business actors tend to expect to have access to computer functionality via a GUI rather than via a character based user interface (CUI).

    The lack of GUI functionality may cause business actors to start to dislike using the computerised system, which is a direct cause for a migration (a so-called GUI-fication).
  - The introduction of the Euro also brought about the need for some new specific functionality to maintain consistency with historic amounts denoted in the 'old' currencies.
  - From an IT perspective the introduction of the Euro was a problem that was caused by a change in the requirements of the data view as well as the function view. To be more precise, it is a change to the currency types used in the information/computerised system, and conversion routines between currencies.
  - More and more organisations want to make their services available through the World-Wide-Web. This requires their pre-existing computerised systems to offer 7x24 hours on-line functionality to the new World-Wide-Web interfaces, while most of these systems may still be geared towards batch-processing.
  - There is a growing tendency for organisations to better tailor their products to specific customer needs. This requires them to introduce more flexibility in the process/work flows used in the production/delivery of the products. In numerous pre-existing systems, these work-flows are hardcoded into the application software.

- Architecture view:

  - As a result of numerous minor changes and patches in the past, the code may have evolved to a stage in which it is hard to maintain. It may then be necessary to clean the code (e.g. remove dead code), and re-modularise it to improve maintainability.
  - When the use of a computerised system grows it may turn out that the current architecture does not scale up very well, in which case a migration to a new architecture may become necessary.
  - The need for more flexible architectures has triggered organisations in moving the architectures of their computerised systems towards component-based, object-oriented or service-oriented architectures.
  - Due to several reasons an organisation may decide to replace a key element of the infrastructure of their computerised system, such as a database management system, a workflow management system, or the middleware that is used.

In addition to the three perspectives, there is a second axis that can be used to classify the different causes for migration projects. This axis is concerned with the type of deliverables produced during the development life-cycle of a computerised system. In ISPL, the deliverables pertaining to the target domain are classified as either being a *descriptive item* or an *operational item*:

Descriptive item A deliverable which captures knowledge about the computerised/information system.

Operational item A system, or a component, that is, or will be, installed as part of the target domain. In ISPL, the *target domain* is defined as that part of the business system which is affected by a project or an ongoing-service.

These two classes can be refined one step further, leading to:

Descriptive items:

Requirements A documented representation of essential conditions that an (operational) computerised system has to satisfy. These usually follow from the human system.

Design A definitive description of a system for the purpose of developing or validating the computerised system.

Operational items:

Operational application Operational items that are specific to the solution of an application problem. These items are specific to the processes of the surrounding business system, as opposed to the operational infrastructure, which is more generic. The precise characteristics of the operational application are determined by the design of the information system.

Examples of such operational items are:

Application software, physical data, manuals, work instructions, training programs and trained business actors.

Operational infrastructure Operational items that are needed for the computerised system to be operational, but are not considered to be specific to the processes of the surrounding business system. This may include:

Facilities, hardware, system software and manuals.

The resulting hierarchy of deliverables pertaining to the target domain is depicted in Figure 14.

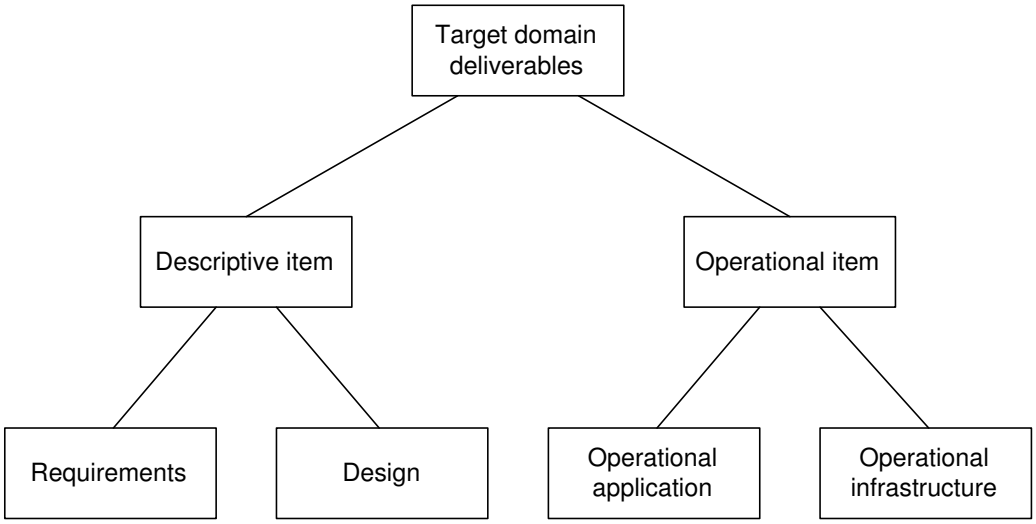

Figure 14 Hierarchy of target domain deliverables.

Some examples of migration projects that have causes that fit into the above classes are:

- Requirements:
  - The earlier example of the Euro is due to a change in the requirements (of the data view and function view).

  - The example of the product-code extensions used above is also an example of a migration due to a change in the requirements.
  - For many computerised systems that have been in existence for a longer period of time, the precise requirements for these systems may have become fragmented and outdated. For different reasons, one may decide to remedy this situation and re-establish a consistent set of requirements.

- Design:
  - Similarly to the requirements of long-lived systems, the design of these may be incomplete, inconsistent, or partially missing. At some stage one may decide, for instance to start a large-scale migration, that this situation should be rectified and that the designs should be made consistent with the actual situation.

- Operational application:
  - Due to numerous modifications, patches, etc., the code of the operational applications may have become ill-structured and ridden with dead code. At some point in time one may decide to reverse these forces of entropy, and strip the sources from dead-code and improve its overall structure.

- Operational infrastructure:
  - As a result of performance problems, one may choose to replace an infrastructure element that does not perform well enough by one that does perform. This may be as simple as replacing the element, but in most cases this will require a migration of the application software that is dependent on this element to the new environment. For instance, when replacing hardware and operating system this will usually be the case.
  - Due to an expiring hardware and/or software contract of some element of the operational infrastructure, this element may have to be replaced, and as a result further changes to the computerised system may have to be made (similarly as the previous example).

2.4 Typical initial & final states

The state of the existing computerised system at the beginning of a migration project is called the *initial state*. Analogously, the state at the end of the migration project is the *final state*. The initial and final states may be defined as a list of existing descriptive and operational items. If no description of the initial state exists, or is of bad quality, additional effort will have to be invested in analysing the current systems in order to arrive at such a description.

In this section a discussion is provided of some typical migration classes one may encounter in practice. Using the framework as depicted in Figure 13, these migrations are clustered into five main classes of migrations based on their causes. The identified main classes are:

- Requirements
- Design
- Operational application
- Operational infrastructure
- Service infrastructure

For each of the migration types, the following items are listed:

- A short description of the type of migration.

- The typical cause for the migration. In other words, the perceived problem in the initial state that needs to be remedied.
- The essence of the migration, i.e. the key elements that will be effected most by the migration. These elements make up the key difference between the initial state and the final state.
- The types of elements from the initial state that are necessary/usual inputs to the migration project.

  Whenever an element listed as input is actually an optional element, the expression "$[t]$" will be used to express that elements of type t serve as an optional (in most cases preferable) input to the migration.
- The types of elements that are affected by the project. In other words, elements that one would expect to be changed in the final state when compared to the initial state.

When a migration changes some descriptive or operational element, other elements may have to be changed accordingly. When expressing which types of elements will be affected by a migration project certain dependencies between the types may be identified. In other words, when elements of one type are changed, it is likely that elements of the other type will have to be changed as well. For example, if the specification of a system is modified, one would expect the actual source code to be modified accordingly.

These dependencies will be used in this book to avoid having to provide an exhaustive list of all types of elements in the final state that could possibly be effected by a migration class. In Figure 15, the dependencies between the types of elements for the final state of a migration project are depicted as a hyper-graph. If there is an arrow from one type (or set of types) to another, it is expected that when elements from the first type(s) are changed by a migration, elements from the second type(s) will be affected as well. It should be noted that these dependencies represent the 'worst-case' situations. When, for example, changes are made to the hardware used, then this does not *always* have to lead to changes of the application software. The dependency graph aims to be on the safe side.

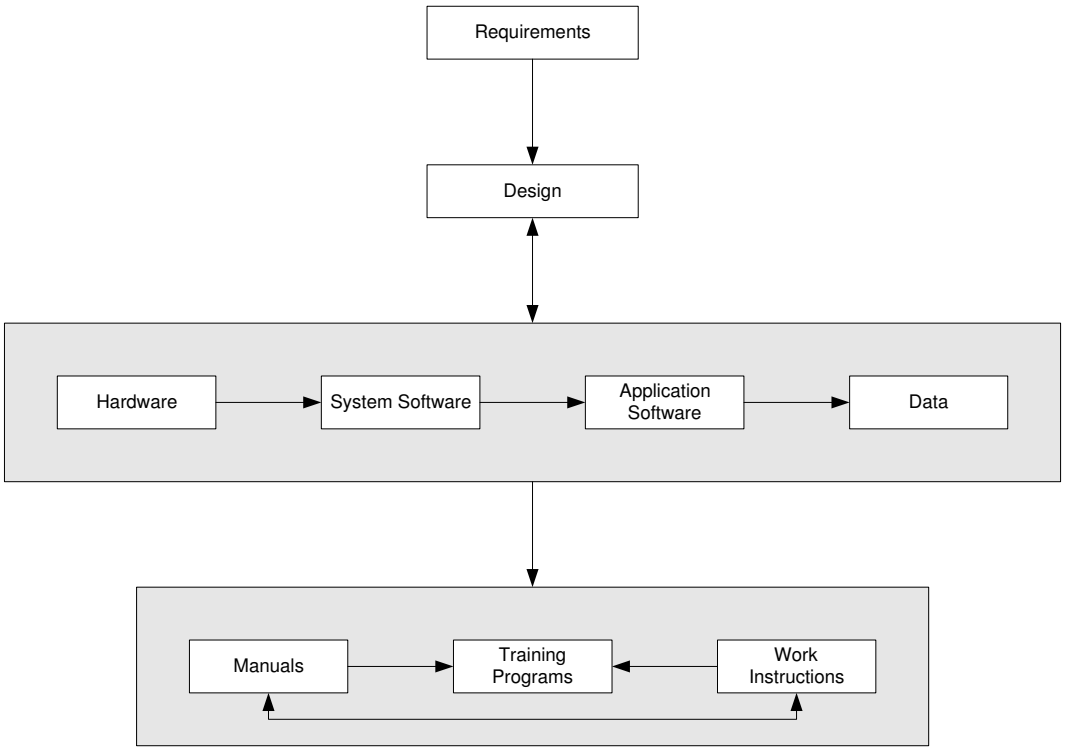

Figure 15 Migration dependencies

2.4.1 Causes in the requirements

Euro conversion	
Description:	Preparing an information system to deal with the Euro, and in particular with the dual currency situation as will be in place between 1999 and 2003.
Cause:	A Euro conversion project will obviously find its cause in the introduction of the Euro, which is not IT related. However, when limiting the scope to IT, one could say that a Euro conversion project is caused by changed *requirements* on the data view and function view of the information system. Data view as money amounts need to be stored in another format, and function view as currency conversion functionality needs to be added.
Essence:	The essence of change will be the currency datatype in the data view, and conversion routines in the function view.
Input:	Data and function view of: application software, [requirements], [design].
Affected:	Data and function view of: application software.

Year 2000	
Description:	Making a pre-existing computerised system year 2000 compliant.
Cause:	Migrations dealing with the year 2000 were caused by deficiencies related to the date datatype in the data view. In most cases, the original requirements of the systems missed the requirement that the system should be year 2000 compliant. The cause for these migrations can therefore be traced back to a change (removal of an omission) in the requirements.
Essence:	The essence of change will be the date datatype in the data view.
Input:	Data view of: application software, [requirements], [design].
Affected:	Data view of: application software.

GUI-fication	
Description:	The process of adding a graphical user-interface front-end to a pre-existing application.
Cause:	In order to provide pre-existing applications with a modern look and feel, quite often the desire to add graphical front-end functionality arises. This desire results in a mismatch between the current requirements from the human system with regards to the computerised system and the requirements as they were used initially.
Essence:	User-interface functionality of application software.
Input:	Application software, [design].
Affected:	Application software.

2.4.2 Causes in the design

Design recovery/reverse engineering	
Description:	The process of deriving descriptive items that form appropriate descriptions for a pre-existing set of operational items.
Cause:	These migration projects typically start out from a situation in which there are operational items while there is no, or inadequate, documentation covering requirements and design specifications. In other words, the migration is caused by a lack of appropriate descriptive items.
Essence:	The essence of change is the design of the computerised system.
Input:	Operational infrastructure, application software, [design].
Affected:	Design.

Redesign	
Description:	The process of redesigning the computerised system starting from the initial requirements of the information system.
Cause:	This is a broad type of migrations. Migration projects of this type typically have an initial state in which there is some problem related to the way the information system currently performs. A problem that can be traced back to the *design* of the system. For the human system this would typically lead to a business process re-engineering project. In the case of the computerised system, a redesign is likely to be more appropriate.
Essence:	The design in general.
Input:	[Design], requirements.
Affected:	Design.

Database redesign	
Description:	The process of redesigning the database specific parts of the computerised system, starting from the initial requirements of the information system.
Cause:	This is a broad type of migrations. These migrations typically have an initial state in which there is some quality or performance problem related to the elements in the data view of the computerised system. A problem that can usually be traced back to the design of the database.
Essence:	Data view of the design.
Input:	Data view of: application software, [design].
Affected:	Data view of: application software.

Componentisation/modularisation	
Description:	The process of splitting up pre-existing (monolithic) application software into a set of components/modules.
Cause:	Migrations like these are commonly caused by inflexible software design, leading to increased maintenance costs of the existing application software.
Essence:	Architecture view (from design to operational items).
Input:	Architecture view of: application software, [design].
Affected:	Architecture view of: application software.

2.4.3 Causes in the operational applications

Redevelopment	
Description:	The process of developing and selecting new operational items by starting from the existing high level designs, while using (if possible) pre-existing system components.
Cause:	This is a broad class of migrations. Migration projects of this type typically have an initial state in which there is some problem related to the *application software* as it is currently in use. A problem that requires a replacement of most of the existing application software (and possibly parts of the operational infrastructure).
Essence:	Application software in general.
Input:	Application software, design, [requirements].
Affected:	Application software.

Reengineer (see also redesign and redevelopment)	
Description:	Reengineer

Database reengineering (see also reengineering)	
Description:	Database reengineering

Reduction of data redundancy (see also database reengineering)	
Description:	Reduction of data redundancy

Re-documentation	
Description:	The creation of new/missing documentation, or improvement of pre-existing documentation pertaining to the operational application.
Cause:	During the lifetime of an application, the quality and adequacy of the different forms (user manuals, operating manuals, training materials, etc.) of documentation pertaining to the application may degrade. For different reasons, it may have become necessary to remedy this. A re-documentation project is likely to be combined with some other migration project. Note that the aim of a re-documentation project is *not* the reverse engineering of the design! In practice a re-documentation project may actually require the execution of a reverse engineering project to obtain up-to-date designs.
Essence:	Manuals.
Input:	[operational application], [operational infrastructure], [design], [manuals].
Affected:	Manuals.

2.4.4 Causes in the operational infrastructure

Retargeting	
Description:	The process of transforming, rehosting, or porting the existing operational items to a partially new operational infrastructure. These migrations are usually concerned with major modifications in the operational infrastructure. For example, changes in the run-time environment, changes of database management system used, etc.
Cause:	This is a broad class of migrations. Migrations like these are usually caused by a perceived problem with operational system that can be traced back to deficiencies in the *operational infrastructure*.
Essence:	The operational infrastructure in general.
Input:	Operational infrastructure.
Affected:	Operational infrastructure.

Database migration (see also retargeting)	
Description:	Database migration

Hardware migration (see also retargeting)	
Description:	Hardware migration

Operating system migration (see also retargeting)	
Description:	Operating system migration

Re-furbishing	
Description:	This is, again, a broad class of migrations. A complete overhaul/change of the entire operational infrastructure of the computerised/information system.
Cause:	Migrations of this class may be due to several causes related to the existing infrastructure. They may be related to flexibility, reliability, performance, etc.
Essence:	Architecture view of: operational infrastructure, design.
Input:	Architecture view of: operational infrastructure, [design]
Affected:	Architecture view of: operational infrastructure.

Decentralise/downsize (see also re-furbishing)	
Description:	Decentralise/downsize

Centralise/upsize (see also re-furbishing)	
Description:	Centralise/upsize

2.4.5 Service infrastructure

Repository conversion	
Description:	Conversion of a pre-existing repository filled with new models, sources, documentation, etc., to a new repository.
Cause:	There may be several reasons to make changes to the service infrastructure. This may be due to a change of development/servicing paradigm, end of contract with supplier, etc. When such changes are made, for example, changing one of the modelling or monitoring tools, pre-existing information stored in a repository may have to be migrated to the format of the new tool.
Essence:	Service infrastructure, repository contents.
Input:	Service infrastructure, repository contents.
Affected:	Service infrastructure, repository contents.

Language conversion (see also repository conversion)	
Description:	Language conversion

3 Acquisition Process

In the case of a migration project, the acquisition process (or acquisition for short) is the process of obtaining a migrated set of descriptive and/or operational items. Note that the aim of a migration project does not necessarily have to be the delivery of a migrated *system*. For instance, in the case of a *design recovery* project the aim is not to deliver a migrated set of operational items (a migrated system), but rather to derive a set of descriptive items that properly describe the currently operational system.

The acquisition process is managed within the whole complex of customer-supplier relationships. It starts as a customer process and then includes customer-supplier processes, in some cases involving several suppliers and several contracts. The customer's aim is to migrate some of their operational/descriptive items. Therefore, the first customer activity is acquisition initiation. It entails refining this draft goal on the basis of business needs, producing the requirements of the desired migration project.

An important result of this initiation process is the decomposition, if necessary, of the overall acquisition into a set of procurements. A procurement is a process of preparing a contract and obtaining the deliverables and services that are defined within this contract. Each procurement is concerned with a sub-set of the items to be migrated. The acquisition process comprise of acquisition initiation, the procurement process, and acquisition completion. The initiation process consists of goal definition and the acquisition planning. For each contract, the procurement process is a sequence of three processes: tendering, contract monitoring and contract completion, as shown in Figure 16.

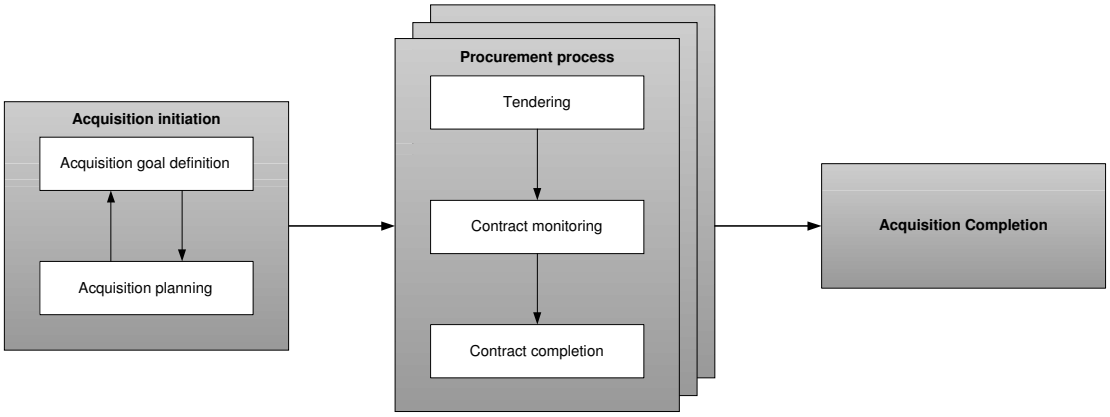

Figure 16 The acquisition process model.

The aim of this chapter is to provide an overview of the initiation of the acquisition, and its completion. Chapters 4, 5, 6, and 7 provide a more detailed discussion of the risk management and delivery planning processes, involved in contract monitoring.

There are different roles relevant to the acquisition process that can be identified within the customer and supplier organisations: contract authority, service authority, organisational authority and operational expert. The other roles may be performed by a single person or by a group of persons.

3.1 Acquisition initiation

The final result of the initiation process is an acquisition plan (or plan for short) reflecting an acquisition strategy and a clear understanding of required migration, with the migration requirements defining the acquisition goal (or goal for short).

In some situations the initial formulation of the requirements for the migration may not be very precise at the beginning. In practice, the acquisition planning phase will reveal some fuzziness in the goal which necessitates a further analysis of the migration requirements. The feasibility, schedule and costs of the acquisition of the service will influence the scope and the ambition of the goal. There is thus a continuous interaction between goal definition (requirements analysis) and acquisition planning. See also Figure 17.

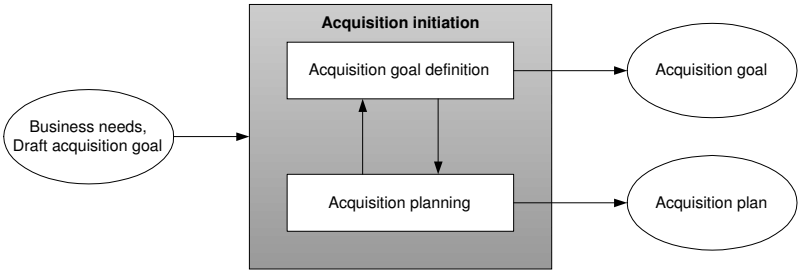

Figure 17 Acquisition initiation: products and activities.

A good plan is the most important success factor of an acquisition. However, even a good plan is susceptible to change and the goal itself might be reviewed during the acquisition process. The customer must therefore ensure thorough version management of the goal and plan during the whole acquisition process.

3.1.1 Acquisition goal definition

Acquisition initiation cannot be executed as a linear sequence of activities. The following list of activities for the definition of the goal and for planning may help achieve these tasks.

Acquisition goal definition consists of four activities:

- Defining the target domain.
- Refining the definition of the goal in terms of migration requirements.
- Analysing costs and benefits.
- Analysing stakes and stakeholders.

The inputs to these activities are the business needs for the migration. The result of this step is a detailed goal description.

Define target domain

The target domain is defined as that part of an organisation which is to be affected by the migration. For a migration project it is necessary to define the borders of the area impacted by the migration as precisely as possible, i.e. dependencies on other projects, items and systems, the effects on business processes, etc. An incorrect definition of the target domain might have adverse consequences such as:

- proper interfaces to other systems/items are not identified,
- not all the actors affected by the acquisition are identified,

- the costs and benefits of the acquisition are not properly estimated,
- not all relevant risks are identified.

If the target domain is complex, it is worthwhile decomposing it into sub-domains. The sub-domains may then be used to decompose the acquisition into smaller and more manageable parts.

Refine the definition of the acquisition goal

The definition of the goal must identify the necessary deliverables and services and describe the requirements of the migration. These requirements must be sufficient:

- to determine the costs, benefits and risks of the acquisition,
- for the planning of the acquisition,
- for the writing of a request for proposal document,
- for potential suppliers to make their proposals.

In practice it may be difficult to evaluate at what point the level of precision is sufficient. When the goal needs to be more clearly defined, it is recommended to perform some pilot or other experiments to obtain more insights in the requirements (and in particular the initial state) for the migration project.

Analyse costs and benefits

Costs and benefits might already have been drafted in the draft acquisition goal. If necessary, they are analysed and documented further here.

The benefits of a migration project depend mainly on the business criticality and business value of the items to be migrated. Benefits should preferably be evaluated in financial terms or other quantifiable terms using metrics. All benefits must be identified including those that cannot be quantified. The identification of benefits may also be based on analogies of migrations in similar organisations.

The costs of a migration will depend, along with other factors, on the precise requirements for the migration (in particular on the initial state) and the acquisition strategy used. It is important to identify all costs related to the acquisition and not only those related to the hardware and software part of the migration. Other examples of costs are: acquisition management, project and service management, external audits, and quality assurance.

Analyse stakes and stakeholders

Stakeholders are those actors affected by the acquisition and who either make it a success or a failure. They must be identified and their stakes elicited. The benefits of the acquisition must be clarified and advertised. If an actor perceives no benefit he is likely to have a negative attitude towards the acquisition.

For every stakeholder (every person or group involved in the acquisition) the benefits, opportunities, but also the threats have to be documented. A mistake that is made often is, that the external or internal suppliers are not considered to be stakeholders. The suppliers have in general at least a financial interest in the acquisition, and also the suppliers should be defined as stakeholders.

Over the last years contracts have set-up between customer-organisations and suppliers, where the payment received by the supplier is made dependent on the extra profit the organisation earns by the delivery of the product or service by the supplier. In this case it is very clear that the supplier is not only a supplier, but also a very important stakeholder as well.

In addition, an analysis may be done to identify the strengths, weaknesses, opportunities and threats of the acquisition to each actor (a SWOT analysis). This is an important input to risk analysis as will be discussed in the next chapter.

3.1.2 Acquisition planning

This step aims to define an acquisition strategy adapted to the situation, plan the main decision points of the acquisition, and establish the acquisition organisation.

Input to this step are the set of items to be migrated together with the migration requirements. The result is the acquisition plan including the acquisition strategy. A set of activities have to be performed to reach the goal of this step:

1. determine overall project and service executions scenarios,
2. analyse risks,
3. design acquisition strategy within the risk management framework,
4. plan the main decision points, and
5. set up the customer organisation within the acquisition.

Determine migration scenarios

The customer has to plan the deliveries of the migration project at a global level according to the goal defined in the previous step. These global provisions plan scenarios depend on the priorities and dependencies between the deliverables. The priorities may be:

Strategic, e.g. migrating to a more flexible architecture may enable faster time-to-market of new product offerings.

Financial, e.g. redeveloping a pre-existing system may reduce the cost of maintenance.

Political, e.g. the marketing department has a stronger position than others, therefore their requests for a migration to a faster platform are considered more important.

The dependencies may be:

Technical, e.g. an operating system migration may be necessary before doing a year 2000 conversion.

Functional, e.g. doing a Euro conversion of a central administrative system requires the (temporary) introduction of currency conversion routines between the central system and decentral systems (which have not been converted to Euro yet).

Related to reuse, e.g. the development and selection of reusable components (e.g. standard functionality offered by a new platform) should precede the actual migration of the systems.

Several plan scenarios may be generated, which will be evaluated and used in the design of the acquisition strategy to ensure that the main priorities and dependencies are taken into account in the plan.

Analyse risks

The current situation must be analysed to identify the risks involved in the acquisition. The methodology presented in this book approaches risk mitigation by mainly focussing the mitigation efforts on the causes of the risks. The underlying idea is that it is better to prevent an accident from happening than to repair any damages caused by an accident.

What is a risk?

A risk is defined as the possibility of exposure to the adverse consequences of future events. One can talk about a risky situation when the situation is complex or uncertain and contains some alternative options to choose from, and where some choices may present greater benefits than others.

What are situational factors?

Situational factors are those properties of a project that generate risks, and which can be used to determine the most appropriate strategy for the mitigation or containment of these risks. The best approach is to eliminate the sources of the risks wherever possible. The situational factors in a migration acquisition process have their origin in the initial situation of the descriptive items, operational items, and organisational context of the items to be migrated. Technical constraints such as tools to aid in the migration process, or the technology platform used for a system that needs to be migrated, provide additional factors that should be taken into account.

The next chapter gives a check-list of situation factors and guidance to estimate them. Some of those situational factors may not be relevant during the acquisition initiation where only the most strategic issues are considered: they will likely become relevant when planning specific project executions in more detail during tendering processes. Sometimes situational factors can only be estimated under certain assumptions, e.g. availability of the development technology, capability of the project team. The situation will change over time and assumptions might have to be changed also, e.g. the capability of the project team should be assessed again when the technology used in each project approach is chosen, or technical difficulties may have come to the fore that are related to the technology platforms. Therefore, risk analysis should be *re-iterated regularly* during the course of the acquisition.

Design acquisition strategy

A risk management plan should reflect a risk management strategy that represents choices between different options to reduce the probability and impacts of risks. In this book, the design of a risk management strategy is considered key to the design of the acquisition strategy.

A risk management context is characterised by the set of options available for the management of risks. Not all options are open to the customer contract authority. Some of them may be constrained by regulations and policies at the organisation level. For example, public administrations must enforce national and international regulations for public procurement, see the ISPL book on Public Procurement [FV99a].

Table 1 presents the different types of options for the acquisition strategy. Guidance on the different options is given in the following text. The table indicates the levels for which options may be open for choice: organisation, acquisition, and contract. An 'x' indicates that the choice of option is made at that level in many organisations, while an 'o' indicates that the choice may be made at that level in some organisations.
Usually, a management level can take decisions regarding an option if the consequences of its decisions have no impact outside its scope of action. For example, a project can take decisions on an option only if the consequences of these decisions do not affect other projects. If it turns out that it is necessary to make decisions on an option, while not being on an appropriate level to do so, it is probably the symptom of a major problem in the acquisition.

With the plan scenarios and the risk analyses as input, several strategy scenarios may be produced, each one resulting in a set of selected options. The customer has to choose among the options, based on:

- the efficiency of the option,
- the cost (and difficulty) of the option and
- the delay in obtaining the results.

In the remainder of this subsection, different options are explained and some guidance on selection of options is provided. The customer contract authority must check that the selected options are sufficient to mitigate the various risks, and that they are consistent with each other. Usually an option addresses several risks.

	Risk management option	Management level			
		Organisation	Acquisition	Contract	Project
1	Change situational factors	x	x	o	o
	Change or refine requirements	x	x	x	x
	Strategy regarding standards	x	x		
2	Internal or external suppliers	x	x	o	o
	Types of tendering	x	x		
	Interactions with suppliers	x	x		
	Flexibility of contracts	x	x	x	o
	One or several contracts	x	x		
3	Buy or develop	x	x	o	
	Development approach		x	x	
	Project control approach	x	x	x	x
4	Types of service arrangement	x	x		
	Service control approach	x	x	x	x

Table 1 Risk management options relative to appropriate management levels

Options regarding the customer situation

Option: Decide to change some situational factors

The analysis of the situation may reveal situational factors whose values indicate a high uncertainty or complexity. Some of these factors may be difficult to change because they are inherent to the problem. Nevertheless, for other factors there might be some opportunity to change them for the better before starting a procurement. Chapter 5 lists possible measures to change specific situational factor values.

Option: Decide to change or refine requirements prior to tendering

Requirements may be refined or modified at different management levels depending on: the level of detail of the concerned requirement, the scope of the impact of the requirements modification, and the strategic level of the concerned requirement.

At the acquisition level, if it is considered that the requirements are not sufficient to perform the acquisition because it introduces unmanageable uncertainties into the process, a stringent requirements analysis may be performed before tendering. This may quite well be done as a project on its own.

Option: Decide on a strategy regarding standards

The decision to apply standards is usually taken at the organisational level. In public administrations the EC Standards Decision must be enforced, when the 'contracting authority' (the customer) acquires ownership of products falling within the scope of the Decision. The Standards Decision does not apply to products which remain in the ownership of the supplier.

The rationales for using standards are: ensuring openness of the solutions, avoiding lock-in to specific suppliers and solutions, maximising the inter-operability of systems, and using a common universal language

for expressing requirements and solutions.

Generally, the customer contract authority will have to determine which standards are applicable in the envisaged acquisition and how to apply them. Guidance on this topic should be provided at the organisational level.

Options regarding relationships with suppliers

Option: Determine types of suppliers: internal or external

Suppliers may be internal or external to the customer organisation. In some cases, the choice is constrained by a policy of the organisation.

Using external suppliers is appropriate when:

- Capability of the customer project team is low, i.e. the customer team has no experience with migration projects, only a small population of migration experts exists, or there is not enough expertise concerning the technologies to be used.
- There is a risk of increased cost for the migration project if it has to be executed by an internal project team. In this case, getting commitments from external suppliers (especially through fixed-price contracts) can be useful.
- Benefits can be gained from using an external supplier. Benefits of contracting a migration project can be: saving costs and time, reduction of (or at least no increase) staff, reduction in number of activities performed, access to specialist knowledge, better service provision, concentration on core business and help in introducing the migrated items.

Using internal suppliers is appropriate when:

- The strategic importance of the items that need to be migrated is too high to contract out their migration to an external supplier.
- The IT-department can be considered to have the necessary skills, knowledge, and capacity to perform the migration themselves,
- The benefits of using internal suppliers are bigger than the benefits of external suppliers in terms of costs, availability, size and culture of the organisation.

Option: Determine the types of tendering

Four award procedures are defined within the EC Services Directive (Also refer to the ISPL book on Public Procurement [FV99a]).

Open procedure, whereby all interested suppliers may submit a response.

Restricted procedure, whereby only suppliers invited by the customer contract authority may submit a response; such a set of candidate suppliers could be determined from the customer's market knowledge, from a market survey, or by pre-selecting them using a call for interest.

Negotiated procedure, whereby the customer contract authority consults suppliers of their choice and negotiate the terms of the contract with one or more of them.

Design contest, whereby the customer contract authority acquires a plan or design selected by a jury after being put out to competition with or without the award of prizes.

The Services Directive provides rules governing the choice of an award procedure. In procurements undertaken by public 'contracting authorities' and others to which the Directive applies (the customers), the negotiated procedure may be used in preference to the open or restricted procedures only where the circumstances permitting its use laid down in the Directive are fulfilled, e.g. when for reasons of exclusive rights only one supplier can execute the projects or provide the services.

Even for those organisations not subject to the Services Directive and its national transpositions, the normal cases should be the open and restricted procedures which allow the customer to gain the greatest advantages from a competitive market. The negotiated procedure should only be used when the uncertainty of the situation makes it difficult to determine the precise migration requirements (e.g. to estimate the costs), when the choice of possible suppliers is restricted by the very nature of the problem or when the urgency makes it difficult to use a more formal tendering procedure.

Option: Determine the interaction with suppliers

In complex or uncertain situations, a way of enhancing the current state before issuing the request for proposal is to get information from potential suppliers beforehand. This is not always allowed by the public regulations. These more complex exercises, however, can be viewed as a tendering process, where iterations are introduced: these are referred to as multi-phase tendering processes.

Multi-phase tendering processes provide the customer with additional information concerning the envisaged migration project. Consequently, uncertainty may be decreased regarding the initial state of the project. A drawback is the increase of time-scales compared to one-phase tendering processes, therefore it is not appropriate when schedules are tight.

Usually, the conditions in which multi-phase tendering can be used are regulated at the organisational level (e.g. public procurement regulations). During the tendering, the customer must ensure that all suppliers are treated equally and that no supplier gets an unfair competitive advantage by gaining access to more information than the others. It is also recommended that the customer funds the suppliers as soon as their work within the multiple-phase tendering process aims to contribute to a better understanding of the problem by the customer.

Option: Determine the flexibility of contracts

The flexibility of a contract is the capability of modifying or refining certain contractual elements such as the migration requirements, costs and schedules during the contract monitoring process. Some aspects of the planned migration project may not be totally clear at the signing of the contract and may have to be refined or revised during the course of the contract. Flexible contracts are normally not strict fixed-price contracts; prices may be adjusted according to changes in the contract. In general, the contract establishes margins for the possible modifications to protect customers and suppliers from the risk of unpredictable costs for the project.

Option: Identify contracts and sequencing constraints (one or several contracts)

It must be decided whether to achieve the acquisition in one or several contracts executed in parallel or in sequence. Two factors influence this decision:

- Internal rules of the organisation that may constrain a series of contracts.

  For instance a budget limitations for contracts and/or financial years or the need to use fixed-price contracts.

- The uncertainty of the situation.

  The use of a series of contracts instead of one single contract may:

– Provide the necessary flexibility for the clarification and evolution of the migration project, and a development of the requirements in line with the business needs during the course of the acquisition.
– Provide a means for the customer to control costs even when they are not totally predictable at the start of the acquisition. This is useful in all uncertain situations which generate risks of unpredictable costs for the business or increased costs of the service.

General experience shows that some combinations of initial and final states tend to result in projects that are difficult to control. This is mainly because the initial state is not elaborated sufficiently to reduce the uncertainties to be resolved in progressing towards the final state. These uncertainties make it difficult to design the actual migration. The design of a migration aims to define and analyse the impact of a migration path, where a migration path consists of a description of the procedures, techniques and tools needed to progress from the initial state to the final state (see also section 6.2.1).

Different strategies may be used to deal with these uncertainties:

- An incremental installation or migration approach using an *evolving* migration design, would allow for the progressive evolution of design of the migration to best fit the situation at hand as uncertainties are gradually clarified during the migration.

  A *single* contract may cover several migration steps if contractual arrangements are flexible enough to refine requirements and costs during the life of the contract. Otherwise a series of contracts may be used, where each contract covers one migration step.

- If a one-shot or incremental installation or migration approach is used with a *frozen* migration design (i.e. during the execution of project no changes to the migration design are allowed), the acquisition may be split into a sequence of *individual* contracts.

  Each contract will help in reducing uncertainties since the final state of a contract is used as the initial state of the next contract in the sequence. In other words, each contract gives a better knowledge of requirements, costs and future plans for the subsequent migration steps and contracts.

In the case of a series of project contracts, the initial state of a subsequent project can generally be derived directly from the final state of the previous one. This scenario is represented in Figure 18.

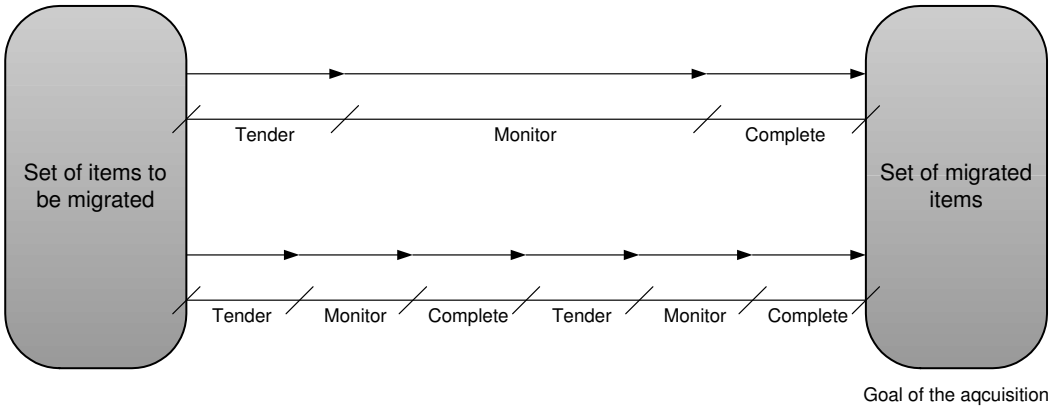

Figure 18 Reaching an acquisition goal by a single or multiple project contracts.

Options regarding projects

Option: Decide to buy or develop

Sometimes, a complete product (e.g. software) satisfying the original requirements may be bought (e.g. 'off the shelf' software package), replacing an existing system component (or operational item). This

effectively means that the replaced component does not have to be migrated anymore.

There can be a general policy at the organisation level concerning this option (e.g. decide specific developments only if no adequate product is available). Buying products is appropriate when:

- products are available with sufficient references and reliable suppliers (a typical example is the accounting domain),
- specificity of the information system is not high and the coverage of the required functionality by the products is high,
- ability of the actors is low, i.e. customer knowledge of the application is insufficient,
- risk of integrating the product within an existing information system is low,
- budget is tight,
- schedules are tight.

Developing products is appropriate when:

- available products with references and reliable suppliers are missing,
- specificity of the information system is high,
- risk of integration of the product within existing information system is high,
- risk of lock-in to a supplier.

Option: Determine requirements to project delivery strategy

The project delivery strategy consists of the installation, migration, description and project control approaches. These approaches and the guidance to choose among the available options are explained in sections 6.2 and 6.3. In particular, the guidance indicates how to reduce risks induced by complexity and uncertainty by choosing the appropriate approaches.

In the acquisition initiation, the customer contract authority will usually pose requirements on the installation approach (one-shot, incremental with frozen migration design, incremental with evolving migration design) to be used. The customer contract authority might also pose requirements on the migration approach used, and possibly even on the description approaches used if a uniformity of the approach at the acquisition level is desired. Very often, those choices are left to suppliers in their responses, i.e. at the contract management level.

Decisions regarding the project control approach can be taken on different levels, depending on the level of standardisation of the project control procedures in the organisation, specificity of the acquisition, contract or project (e.g. a project which is not very strategic could be less controlled than a strategic one).

Plan the main decision points

The customer contract authority must plan and organise the main decision points of the acquisition based on:

- migration requirements (the acquisition goal),
- migration scenarios (global plans for deliveries),
- situational factors and risks (situation appreciation),
- acquisition strategy (selected risk management options).

The acquisition plan should contain the planned procurements and other customer activities, e.g. change situational factors, change or refine requirements and acquire external assistance. The plan may evolve during the acquisition process, i.e. the level of detail will vary and be most detailed for the short term activities and procurements.

The decisions relating to a procurement documented in an acquisition plan are sketched in below:

- requirements to migrated items and migration project,
- time schedules, costs, benefits, stakes and stakeholders,
- type of supplier,
- type of tendering,
- interactions with suppliers,
- flexibility of contract,
- strategy regarding standards,
- requirements to each project:
  - initial and final states,
  - buy or develop,
  - situation appreciation,
  - project delivery strategy, in particular installation of migrated items and the project control approach(es) used,
  - investment decision points and main intermediate deliveries.

Setting-up the customer organisation within the acquisition

The customer is responsible for setting up the organisation which will carry out the acquisition. This consists in identifying the various roles needed (such as project authorities and the different experts) and allocating persons to these roles. The actors of the organisation and the information system who are concerned with the acquisition must also be identified, and their involvement must be planned. It must be checked that these persons are indeed available when they are needed during the course of the acquisition.

An option to be considered, is to use external assistance in the acquisition. External assistance provides expertise and manpower to the customer contract for the management of the acquisition. Such external assistance for the acquisition management is appropriate when:

- high heterogeneity of actors requires an external point of view, free of customer culture, history and internal disagreements,
- novelty of technologies to be used for the migration can not be managed by the customer team, or
- the migration project has a large overall complexity.

3.2 Procurement process

A procurement is the process of obtaining migration projects regulated by a contract. In the context of this plug-in, a procurement can include one or more projects. The requirements to a procurement are outlined during acquisition initiation and documented in an acquisition plan. These requirements may evolve during the procurement process. Hence, the plan must be kept up-to-date by appropriate version management control. The acquisition goal should also be revised according to refinements and modifications during the procurement process.

The procurement process is a sequence of the three processes tendering, contract monitoring and contract completion (see Figure 19).

Tendering. Aims to select a supplier and a proposal for the considered migration project, and to agree with a chosen supplier on a contract which defines deliverables and the responsibilities of both parties.

Contract monitoring. Aims to monitor the project as defined in the contract, to ensure that the deliverables and the projects conform to the requirements of the contract.

Contract completion. Aims to terminate the contract.

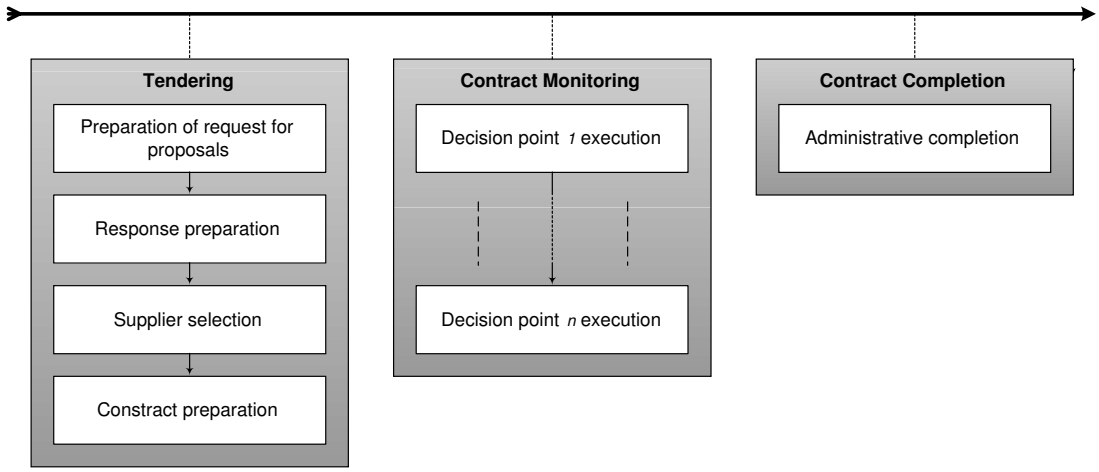

Figure 19 The procurement process.

3.2.1 Tendering

The tendering process aims to select a supplier and a proposal for some migration project and to agree with the chosen supplier on a contract defining the deliverables and responsibilities of both parties.

The tendering process consists of the following activities: preparation of request for proposal, response preparation, supplier selection, contract preparation and signing. These activities are performed either by the customer or the supplier or both; during these a description of the intended contract monitoring and contract completion processes is produced. The intended contract monitoring process is documented within a contractual delivery plan.

All these activities involve the production of documents which are exchanged as part of customer-supplier relationship, see also Figure 20. The tendering activities do not need to be executed in the sequence of Figure 20, they may overlap in time and there may be iterations.

During the carrying out of the tendering process, a description of the intended contract monitoring and contract completion process is produced. As shown in Figure 20, the intended contract monitoring process is documented within a contractual delivery plan. All these activities involve the production of documents which are exchanged as part of the customer-supplier relationship. The tendering process ends with the signing of the contract. The signing of the contract signifies the start of the contract monitoring process.

The actual project production or project execution may begin either with the signing of the contract, or as a result of the customer already notifying the supplier in a letter of intent; subject to the business practice at country level. In certain situations, such as within the public domain, the customer and the supplier will have to comply with national and European regulations. ISPL assists customer in performing these activities with reference to these regulations where appropriate (Also refer to the ISPL book on Public Procurement [FV99a]).

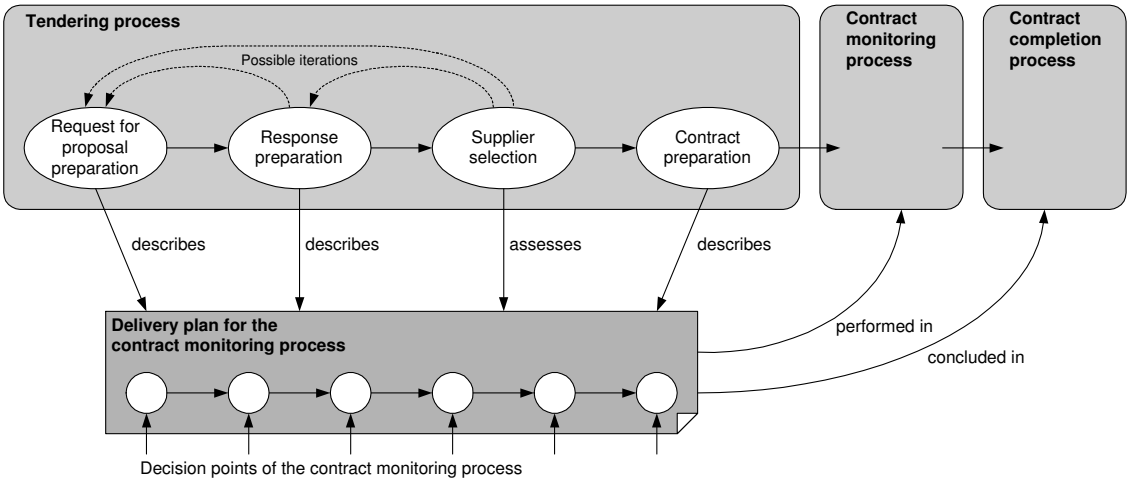

Figure 20 The tendering process.

Preparation of request for proposal

This activity involves the elicitation of the first version of the procurement requirements and their incorporation within the request for proposal deliverable: this deliverable initiates the customer-supplier relationship. In practice, the preparation of the first request for proposal may be integrated with acquisition initiation as there are many similar activities.

The instructions that need to be given to bidding suppliers must be considered when preparing the request for proposal. Some of them are closing date of responses and number of copies of the response. The following guidelines should provide some guidance on the activities to be performed when preparing such a request.

Define the target domain and the objectives

The target domain may be the one defined at the acquisition level or a sub-set of it; if it is a sub-set, it should be defined. For example, one request for proposal for a re-targeting of a system, and another one to componentise the applications involved.

The migration requirements, established during acquisition initiation, must be defined within the scope of this contract.

Determine the required delivery plan

Delivery plans included in a request for proposal can be of varying levels of detail. The delivery plan governs the contract execution and is the base for both the monitoring of the contract and its completion.

For each of the required project, the project planning included in the delivery plan could range from a simple risk analysis to such a level of detail that the strategy is defined and each identified decision and deliverable is elaborated.

There are three main kinds of target domain decisions: investment decisions, design decisions, and acceptance decisions. These decisions must also be made during the project as well as at the end of the project. The following steps are helpful in obtaining input for the project planning.

Analyse risks (mandatory). The result should be a description of the problem situation: final and initial states of the migration project, situational factor values, and critical risks.

Define strategy (optional). The result should be requirements for development approaches, a project con-

trol approach and actions to reduce risks.

Define decision points and deliveries (optional). The result should be requirements of sequence and contents of decision points; deliveries should be preconditions of, or the basis for, decisions.

The requirements to decision points within the project delivery plans should finally be aggregated into one set of requirements to decision points within contract monitoring. This should be complemented with a set of requirements to the contract completion decision point such as requirements to organisation, procedures and roles.

Determine constraints

Since no procurement takes place entirely in isolation of the ongoing business process of the organisation, the customer should identify organisational, planning and technical constraints, such as schedule constraints, technology constraints, the use of a predefined documentation style guide, etc.

The budget for the procurement should be estimated in line with the acquisition budget. The organisational financial authority should therefore be consulted to identify any financial constraints relating to the business plan of the organisation such as the upper limit of contracts.

Determine the legal clauses of the contract

The legal clauses of the contract have to be carefully determined. Some examples of clauses that need to be included are:

- Project execution acceptance criteria
- Payment conditions
- Warranties and duties care
- Limitation of liability
- Intellectual property rights
- Security and confidentiality
- Ownership of hardware, software licences, etc.
- Conditions to end the contract
- Applicable law
- Who acts as the independent referee when there are disputes
- Sub-contract control

Determine the supplier evaluation approach

The criteria that will be used to evaluate responses and select a supplier should be documented in the request for proposal; relevant criteria should be selected from the following aspects.

Proposed migration. Aspects of the methods, technologies, and delivery plan proposed, such as the adequacy of risk analysis, project execution strategy, decision points and deliveries.

Other contractual aspects. For instance price, proposed methods and skills of actors.

Quantitative measurements should be used where possible. Where this is not possible, a weighing scheme must be designed to properly take potential benefits into account as fits the business strategy and management. Such schema and their justification must be documented to ensure impartial selection. In addition, the customer should indicate which requirements are mandatory.

Response preparation

The goal of this step is to propose a competitive proposal addressing the customer's requirements as stated in the request for proposal. If the supplier decides to participate, the following activities have to be performed:

- define the target domain (supplier's point of view),
- determine the objectives, requirements, solutions,
- determine the proposed delivery plan,
- determine the charges and costs,
- describe the supplier's organisation characteristics, and
- present the advantages of the proposal.

Define the target domain

The target domain within the response should be the same as the one defined in the customer's request for proposal. However, in submitting its response, a supplier may interpret the target domain as different from this. For example, due to an appreciation of the target domain gained from previous contracts related to migrations for other customers.

Determine the objectives, requirements and solutions

The supplier should clarify the appreciation of the objectives and requirements, and provide descriptions of the proposed migration as required within the request for proposal.

Determine the proposed delivery plan

A major part of the proposed delivery plan will be the supplier reviewing the customer's required delivery plan and defining all the additional details to the delivery plan appropriate to the solution being offered. The supplier should focus on:

- the initial and final states,
- risks and mitigation strategy,
- deliveries and decisions.

The following procedure can be used to make a delivery plan.

Step 1: Make one plan or several plans for the migration.

Each project delivery plan should include a complete strategy to address all the risks, and with each decision point description and deliverable description fully elaborated.

Step 2: Analyse and document the dependencies.

Analyse and document the timing dependencies between decision points belonging to different delivery plans, due to requirements to the sequence of decisions to be made, or deliverables to be delivered. This analysis of the dependencies is the basis for the aggregation of sequences of decision points originating from the different delivery plans.

Step 3: Aggregate the sequences of decision points.

The sequences of decision points of the different project delivery plans should be aggregated according to the dependencies between them. The number of decision points should be minimised to make a feasible plan for the involvement of the customer within the contract monitoring, i.e. aggregate as much as possible.

Step 4: Describe the contract completion decision point.

The contract completion point should be described using the guidance in chapter 7. This includes the description of detailed purposes of migration, roles involved, pre-conditions, basis for decisions, organisation and schedules.

Determine charges and prices

Consultation with the financial and marketing experts of the organisation should be undertaken to identify any organisational pricing, schedules and financial constraints relating to the charges and costs. Where possible, automated estimating tools, historical data and analogy techniques should be used to build a good costing schema.

There are four basic types of cost estimation methods to estimate costs of projects:

By analogy to previous experiences The estimates are based on the costs of similar projects. This type of method requires a capitalisation of experiences and a classification of those experiences according to parameters which influence the costs.

Mathematical models The estimates are based on a mathematical model which computes the costs from certain parameters like the number of programs, the number of lines-of-code, the kind of functionality involved, the complexity of the functionality, etc.

By task decomposition The estimates are based on a detailed work breakdown of the migration project into distinct tasks and are obtained by summing up the costs of each task.

By expert opinion The estimates are obtained by consulting experts and reaching a consensus.

Using more than one cost estimate method will give more confidence in the estimates. The assumptions and parameters used (e.g. technologies used, number of functions, function complexity, time scales, labour rate, inflation rate, currency exchange rates) need to be documented to check, negotiate and possibly revise the estimates during the course of the acquisition.

Describe the supplier's organisation characteristics

A statement on the organisation's suitability should be provided showing how it meets the characteristics defined in the request for proposal, such as:

- results of recent process capability and maturity evaluations,
- profiles of staff involved,
- experience with similar migration projects.

Supplier selection

Supplier selection consists of deciding which supplier is selected on the basis of response evaluations. There are two important decisions that have to made in relation to this:

1. Which proposals effectively meet the requirements (especially all the mandatory requirements)? This includes assessing the financial standing and technical capability of the bidder.

2. Which of those who satisfy the above requirement offers the most economically advantageous solution?

The responses should be both formally correct and complete. It should be noted that none of the bidding suppliers are allowed to participate in or influence the selection in any way. It is important that each bidding supplier be informed about the result of supplier selection by a notice. This notice should also justify the rating and relate it to both the best and mean response in the group.

Assess the supplier's organisation and response

Assessment may be done using such means as criteria derived from the capability and maturity in similar migration projects and on the criteria determined within the preparation of the request for proposal. For each criterion, the tender evaluation team should agree on a score taking the weight into account. The result should be an evaluation matrix such as the one in table 2

Evaluation Criteria	Weight	Bid 1	Bid 2
Adequacy of the price	15	13	11
Adequacy of the schedules	8	7	6
Understanding of the customer's problem	12	8	11
Adequacy of the situation analysis (including the risks)	10	2	9
Adequacy of the proposed risk management strategy	10	3	9
Adequacy of the sequence of decision points	8	5	7
Adequacy of the deliverables	8	5	7
Adequacy of the proposed methods	5	3	4
Adequacy of the service control approach	14	9	11
Adequacy of the skills of the service team	10	7	8
Adequacy of the services	10	5	6
Total	110	67	89

Table 2 Example of supplier evaluation criteria

Compare the responses

A matrix like the one shown in table 2 is useful to obtain a first impression on which is the best response. This should, however, be complemented with the assessment of the supplier organisation. The responses should then be compared directly with each other.

It is useful to deal with particular aspects of evaluation criteria separately and to produce written recommendations; overall comparison can then be carried out. This method makes the individual aspects and final overall weighing up explicit, which makes it easier to handle the conflicts of interest that often emerge.

Select the best response and inform the bidding suppliers

The best response should then be selected; the conclusion must be based on unified evaluation within the evaluation team. A supplier evaluation report should then be written which will form the basis for the notices sent to suppliers informing them of their selection/rejection. The customer must promptly inform candidates of the decision taken. If it was decided not to award a contract for which a request was issued, the reasons must be included in the notice to candidates.

Contract preparation and signing

The goal here is to agree on a contract consistent with current requirements which is likely to secure the best under the allocated budget. This involves negotiating with the selected supplier on what the final form of the contract shall be; concluded with the formal signing of the contract or withdrawal by either party from the contractual process.

In some special circumstances, additions can be made by using a negotiated procedure for the required project(s). The two main activities to be performed at this stage are obtaining an agreement from the supplier and the formal signing of the contract.

Obtain an agreement from the supplier

Since the goal is to award a contract consistent with current requirements which would secure the best value for money from the allocated budget, the customer should:

- identify the strengths and weaknesses of the selected response,
- review the final version of the contract,
- decide if the organisation's interests are still satisfied by the selected supplier and the proposed contract.

If the contract seems unsatisfactory (even when it is the best of the responses) the tendering process should be repeated.

Sign the contract

When a satisfactory final agreement is reached, the contract, of course, should be formally signed by both parties.

3.2.2 Contract monitoring

The contract monitoring process monitors the project executions as defined in the contract to ensure that deliveries conform to the requirements specified. Therefore, a defined number of contract status reports should be prepared during the project. Here, the role of the customer changes from driving processes to controlling those driven by the supplier. The goal here is to assess the progress of the procurement, make appropriate decisions and to keep a record of these.

Co-operation with the supplier should now take place at two separate levels: contractual and project.

At the contractual level, formal interaction with the supplier occurs at each of the delivery plan decision points. The aim here is to monitor and control the supplier's performance.

At the project level, feedback should be offered to the supplier into the migration process.

This co-operation is a decision driven process. At certain points in time, decisions have to be made regarding deliverables, costs, schedules, and other contractual matters. In the contract monitoring process, as shown in Figure 21, the delivery plan guides the validation of deliverables and execution of decision points. The whole process can be viewed as following a sequence of decision points.

Before decisions are made, a decision point proposal should be made to document the available options and the objectives of the decision point. After each decision point, a decision point report should be made to capture decision-making experience and to record the process (see chapter 7).

A decision point is associated with the exchange of deliverables; these deliverables are specified in the description of the decision point as a precondition of, or the basis for, decisions. (Deliverables specified as

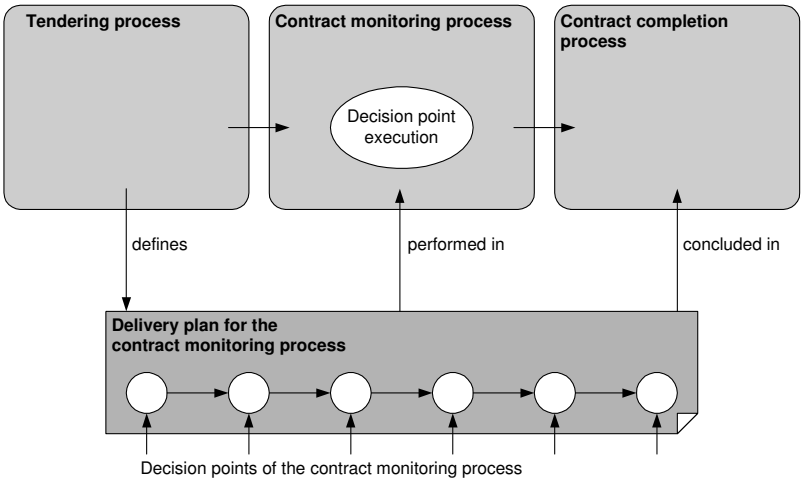

Figure 21 The role of the delivery plan in contract monitoring.

preconditions, of course, must be delivered before the execution of the decision point). Deliverables should serve as clearly defined milestones within the contract.

The customer's role is to control these deliverables submitted by the supplier and controlling the rework of deliverables when necessary. The control process of deliverables involve: receiving the deliverables, performing the deliverable assessment procedure, and approving, conditionally approving, or rejecting them.

Receipt of deliveries and deliverable assessment

The deliveries should be consistent with the objective that the final deliverables will fit into the organisation and address the objectives identified within the project requirements in the contract. Two decisions must therefore be made after they are received. First, whether the project is still on course - decisions based on the deliverables - and also whether the project is still on target to reach the required final state.

There are three main kinds of target domain decisions: investment decisions, design decisions, and acceptance decisions. It is important to identify them as it helps define which deliverables are necessary for making decisions. Deliverables can be classified according to decisions type as follows:

Investment decisions are concerned with the assessment of benefits, costs, and risks. The deliverables should cover the functional and quality properties that influence these elements.

Design decisions decide whether the migrated items would be acceptable as described. The deliverables needed for these decisions are:

- Descriptive items whose characteristics including all functional and quality properties.
- Quality assurance reports showing the quality control results of the descriptive items.

Acceptance decisions decide whether the migrated items as delivered are acceptable.

- The migrated items are either tested or installed.
- An up-to-date definitive description of the migrated items, if it has not been produced and checked earlier.
- Quality assurance reports showing the results of tests of the migrated items or validations of the installed items.
- Configuration management reports.

In order to make these decisions on whether deliverables are in a state to be approved, the description of the relevant decision point as well as the associated deliverable profiles must be reviewed. The results must then be recorded in an evaluation report. The check-list shown in table 3 will be of assistance to the approval process.

Checklist for assessment of deliverables
□ Has the purpose of the deliverables been fully achieved to meet the requirements of this decision point?
□ Do the deliverables consider all of the properties (functional properties, project properties and non-functional properties) required to satisfy the requirements of the decision points?
□ Is the development state consistent with that specified in the decision point description?
□ Is the quality state consistent with that specified in the decision point description?
□ Is the deliverable scope consistent with that specified in the decision point description?
□ Have all the rules for internal consistency been observed?
□ Do the migrated items fulfil the requirements of the migration project (as specified in the current decision point description)?

Table 3 Checklist for assessment of deliverables

Making decisions

The decision making itself is a co-operative process where both customer and supplier, are actively involved. Several decision-making processes are possible; two being predominant.

- The customer is the actual decision maker; the supplier's duty is that of adviser and controller to ensure that decisions are inline with the contractual arrangements.
- The customer and supplier both share the responsibilities.

The procedures set out in the description of the decision point should be used in the decision making process. One or more of the many decision-making techniques available may be used such as group decision-making, simulations, forecasts and risk, cost/benefit analyses. It is important that all decisions taken be recorded in a decision point report and distributed accordingly.

Results of deliverable assessment

One of several decisions can be made based on the evaluation report.

Accept the deliverables. Accept if all the expectations are satisfied.

Accept on condition. Accept the deliverables without requesting rework. However, a renegotiation of contract details may be in order.

An 'acceptance on condition' should be done when most of the expectations are satisfied, and the risks associated with accepting the deliverables in their current state are judged to be small compared to the potential delay when requiring rework.

Require rework. Demand rework of the deliverables in order to remove deficiencies discovered during evaluation. Assessment must be carried out again on the reworked deliverables.

Reject. The deliverables must be rejected if they are judged to be completely unsatisfactory.

In some cases rework of deliverables may be unavoidable. In such cases approval of reworked deliverables and the project status should be introduced into the delivery and project plans. This requires discussion with the supplier to assess the impact of delays and resources problems on the production process. It is important that the reworked deliverables are assessed using the same review criteria as used for the first inadequate version.

Recording experience for future use

By offering the means to clarify the delivery process, an ideal framework is provided to capture decision making experiences; it facilitates recording what is necessary to support a particular decision, and conversely what is not necessary. These observations help tailor the decision making process to meet the demands of future migration projects. The check-list provided in table 4 may be helpful in recording decision-point experiences.

Check-list for recording experiences with decision points
□ What parts of the deliverables were observed as facilitating the customer's decision making process?
□ Were any concepts in the deliverables not observed as facilitating the customer's decision making process?
□ Were all of the requirements of the decision point description equally well supported by the deliverables?
□ For those aspects of the decision point description which were not well supported by the deliverables, what must be done in future to provide a better quality product?

Table 4 Check-list for recording experiences with decision points

Controlling a contract change

During the monitoring process, if technical or planning risks are detected which are not handled within the existing contract, contract change control often follows the assessment of deliverables. Re-negotiation of contracts is not always possible.

3.2.3 Contract completion

This task should be carried out to ensure that all outstanding technical and commercial issues regarding the procurement have been satisfactorily concluded. The aim must be the formal closure of the deliverables and remaining concerns of the contract; this is an administrative process. See Figure 22 to observe the role of the delivery plan in contract completion. It should be checked that all deliverables such as migrated items, documentation, etc., have been successfully completed, and the obligations of the parties fulfilled. All outstanding issues, such as payment, transfer of ownership and warranty, should be resolved before closing the contract. A contract completion report should be prepared.

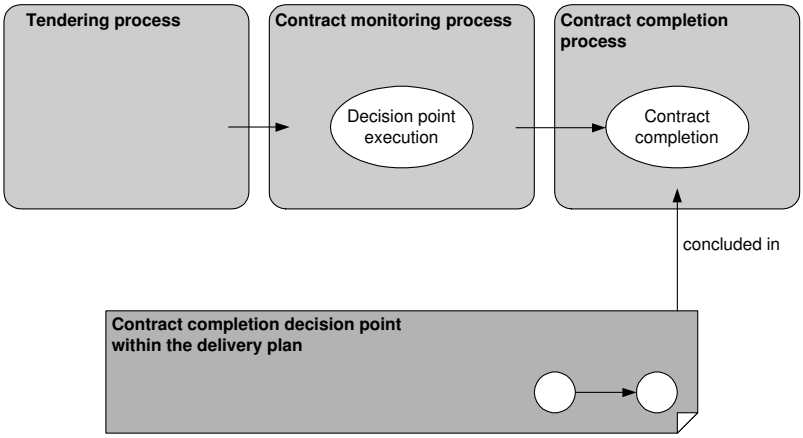

Figure 22 The role of the delivery plan in contract monitoring.

Report on contract status

A final contract status report must be made to support the contract completion decisions. This is sometimes done by supplier alone, but at other times by customer and supplier; this should be clarified in the delivery plan. The check-list provided in table 5 can be used for developing this.

Check-list for contract completion
Commercial and legal aspects: □ Have all the sub-contracts been honoured? □ Have all the invoices been issued to the appropriate organisations? □ Have all the cost statements been submitted? □ Have all required transferred of ownership being completed? *Technical aspects:* □ Have all plans been completed? □ Have the migrated items passed the acceptance tests to ensure the smooth running of the (operational) items? □ Have all the quality review documentation been completed and provided? □ Have all the user documentation been finalised and delivered?

Table 5 Check-list for contract completion

Contract completion decisions and report

The completion decisions based on the contract status report should be taken regarding both commercial and technical issues for unscheduled completion as well as scheduled completion. In either situation, co-operation with the supplier is necessary in order to phase out all management, financial and technical aspects of the procurement in a controlled manner.

A contract completion report should be written by the customer in co-operation with the supplier. This report should be a record of all the decisions made during contract completion and the extent to which the contract has successfully achieved its business objectives including the planned benefits; it should also include things to be kept in mind for future procurements and projects. This report is to be written at the

end of the contract period, regardless of the fact that some parts of the contract (projects) may have been fully completed previously.

Most of all, learn from experiences: support the decision process in future procurements and avoid the risk of receiving migrated items/systems that are either unsuitable or of low quality.

3.3 Acquisition completion

Acquisition completion seeks the formal closure of all procurements. It represents the end of all projects included in the procurement process. Input products are the contract completion reports of each project. Activities to be performed during this step are:

- Check that all contracts have been completed.
- Assess the achievement of the acquisition goal.
- Make the acquisition completion decisions.
- Evaluation of the results for future information service procurements.

First, it should be checked that contract completion processes and reports have been achieved for all contracts. If not, the contract completion processes should be triggered for those contracts that need it.

The attainment of the acquisition goal does not necessarily derive from the reaching of every individual contract goals. Indeed, all contract results must be consistent and integrated with each other, in such a way as they contribute as a whole to the acquisition goal. In other words, the acquisition goal is more than the sum of all its contract goals. There can also be missing parts in the acquisition, that have been overlooked in the acquisition plan.

The experiences with the procurement process as a whole are synthesised in a ‘lessons learned report’ to aid the decision process in future procurements. Several data are interesting to capitalise:

- real costs and duration compared against budget and plans,
- problems and their solutions,
- risks and assessment of the mitigation actions and strategies,
- required expertise within the acquisition,
- effectiveness of the delivery plans,
- quality of the suppliers,
- effectiveness of the various processes and needs for improvement,
- etc.

In summary, the lessons learned from this acquisition that must be absorbed in future acquisitions should be recorded in the ‘lessons learned report’.

4 Migration Project Description

Prior to planning a migration project, the project should first be described. In Figure 23, we have depicted the overall process of describing and planning a migration project. This chapter is concerned with the description of a project, while *situation analysis & risk analysis* is concerned in chapter 5, *project delivery strategy design* in chapter 6 and *decision point planning* in chapter 7.

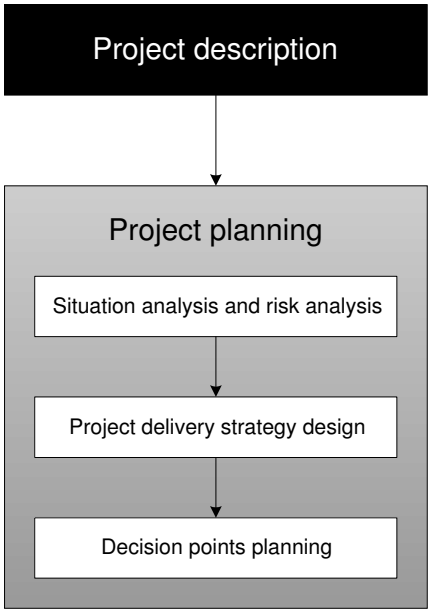

Figure 23 Project description and planning

Projects are described by their initial and final states. In practice, the descriptions of the initial and final states are typically produced in parallel. However, here we provide them in their natural order:

1. Document the initial state.
   Understand and describe the contents and quality of the descriptive items and operational items that are going to be available to the projecty actors performing the project.
2. Document the final state.
   Analyse which descriptive and operational items are going to be required and used by the customer after the completion of this project. Outline the operational items and describe the descriptive items in the form of profiles as explained in the ISPL book on Specifying Deliverables [FV99d].

4.1 Document the initial state

Some of the initial state products may exist, while others are expected to be produced prior to the start of the project, e.g. as a result of another project or as a result of a tendering process. Those expectations

should be documented based on current plans and any other relevant information.
The descriptive items at the initial state may describe the operational items in use at the initial state or future operational items, e.g. the operational items that should be constructed and installed within the project. The descriptions of future operational items can be used to gain an understanding of the required changes to the pre-existing operational system and an understanding of the required migrated system in its final state.
To document the initial state, it is generally necessary to decompose the initial state or future (migrated) system into sub-systems and, in those situations where it is possible and appropriate, describe the initial state for each of the sub-systems. Sub-systems can be defined by further decomposition of the target domain into smaller target domains.
For each sub-system, the following procedure can be used:

1. Assess which of the descriptions of operational items in use, or constructed at the initial state, are relevant to this project.
    - Describe the operational items by an overview based on the information that is available in the current situation.
    - Describe the descriptive items by their profiles, see also the ISPL book on Specifying Deliverables [FV99d].
2. Assess which of the descriptions of future operational items are relevant to use in this project.
    - Describe the descriptive items by their profiles, see also the ISPL book on Specifying Deliverables [FV99d].

4.2 Document the final state

To document the final state, it is generally necessary to decompose the final state system into sub-systems and, in those situations where it is possible and appropriate, to define the final state for each of the sub-systems. There may be different types of descriptive items related to the sub-systems.

For each sub-system, the following procedure can be used:

1. Describe the operational items in use or constructed at the final state by a summary of the descriptive items that exist in the current situation. The summary should focus on:
    - The operational items in the initial state system that are going to be changed, and the new operational items that are going to be constructed and installed as part of the migration.
    - The manuals and support documentation that are necessary to ensure a smooth running and efficient migrated system.
    - The data found in the existing system which needs to be converted into new operational items in the migrated system (migration of data).
    - The operational items that are going to be constructed as part of the migration, but will not be installed.
    - Changes to pre-existing interfaces, or new interfaces, between the migrated operational items that will be installed as part of this project, and the operational items which are presently in use and will not be changed by the migration.
    - New organisation and actors to be put in place, e.g. a service initiation or a service retirement.
2. Describe the profiles of the descriptions that should be available at the final state.
    - The descriptive items that are necessary to maintain the migrated system in an efficient way. The maintenance policy of these descriptive items should be defined, e.g. stating who is responsible for the maintenance.

- The descriptive items that are going to be used, after the termination of this project, for future development of the migrated system in an efficient manner. Available plans regarding further development should be applied wherever possible.

3. If this project results in proposals for future projects, then it is necessary to also describe:

   - The requirements of the appropriate plans for future projects, including requirements of profiles of descriptive items that will be availabe present at the final state of this project.

4.3 Checklists for describing projects

Tables 6 and 7 give an overview of the products that may be available at the beginning and at the end of a project. These tables can be used as checklists when documenting the initial and final states.

	System version			
	Products at the beginning of the project: Initial state products		Products at the beginning of the project: Final state products	
Product	Initial state system	Future system	Final state system	Future system
Operational items	I-1a: Operational items in use at initial state. I-1b: Existing processes or services. I-1c: Operational items subject to service execution.	I-2: Operational items constructed, but not yet in use.	F-1a: Operational items in use at final state. F-1b: Installed services. F-1c: Operational items subject to service execution.	F-2: Operational items constructed, but not yet in use.
Descriptive items	I-3a: Descriptions of I-1a I-3b: Descriptions of I-1b and I-1c.	I-4a: Descriptions of I-2. I-4b: Descriptions of F-1a and F-2. I-4c: Descriptions of F-1b and F-1c.	F-3a: Descriptions of F-1a. F-3b: Descriptions of F-1b and F-1c.	F-4a: Descriptions of F-2. F-4b: Descriptions of future operational items. F-4c: Descriptions of future processes or services.

Table 6 Initial and final state products related to the target domain

	Project	
	Products at the beginning of the project: Initial state products	Products at the beginning of the project: Final state products
Product	Current project that starts at the initial state	Future projects that start at the final state or later
Delivery plans	A delivery plan, including: • Descriptions of initial state: – Summary of I-3a and I-4a: descriptions of operational items in use or constructed at initial state. – Profiles of the descriptive items available at the initial state. • Descriptions of final state: – Summary of I-4b: descriptions of operational items in use or constructed at final state. – Profiles of the final state descriptive items. – Requirements of project plans present at final state.	Possibly delivery plans for future projects
Project plans	Possibly a project plan, including: • Migration plan • Quality control plan • Configuration control plan	Possibly project plans for future projects

Table 7 Initial and final state products related to the project domain

5 Situation & Risk Analysis

The focus of this chapter is situation analysis and risk analysis. Together, these two analysis form the first important steps of project planning (see also Figure 24). As mentioned before, the design of a project delivery strategy is covered in chapter 6, while decision points planning and the definition of deliveries are treated in chapter 7.

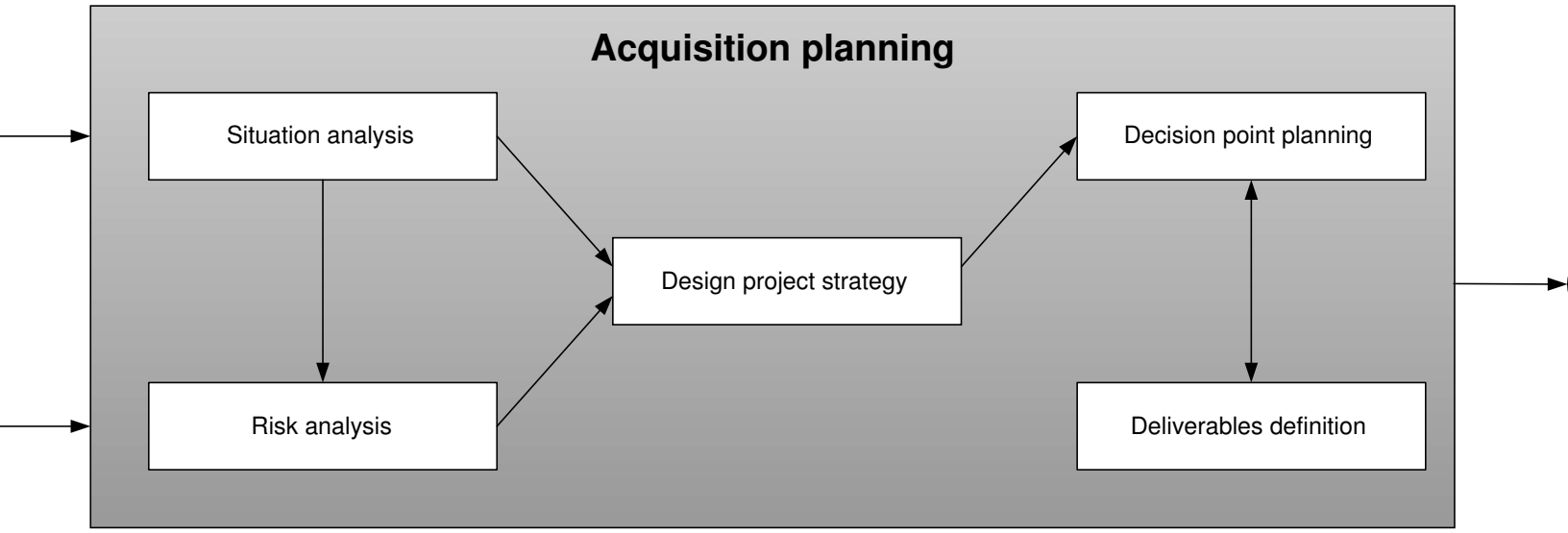

Figure 24 Project description and planning

At the start of any acquisition process, an analysis of the potential risks should be conducted. For this purpose, the initial and final states have to be refined and documented, situational factors assessed, and risks evaluated. The purpose of situation analysis techniques is to understand relevant aspects of the situation regarding either an ongoing or a future migration project in order to be able to act appropriately.

Risk analysis is an activity that should be conducted jointly by all parties involved in a migration project. Even more, in the case of a migration project, it is usually wise to continuously evaluate and manage the potential risks.

A risk is the possibility of exposure to the adverse consequences of future events, and is characterised by a probability (of the future event) and an impact (the adverse consequence). Both should be quantified. The risk exposure is defined as the product of probability and impact:

$$\text{Risk exposure} = \text{risk probability} * \text{risk impact}$$

Risk exposure is a measure that expresses the criticality of the risk. Risk management is a systematic approach to reduce the probability of the risks and/or to limit the damages caused by the risks using appropriate actions. It consists of risk analysis, risk management planning and risk monitoring. This chapter deals with risk analysis, while the next chapters deal with the planning and monitoring issues.

5.1 Situation analysis

The situation as it exists prior to an acquisition is analysed using a list of situational factors. Each factor is a potential cause for risks that can be identified in the initial state of the business system as it is relevant to the migration project. These situational factors are derived from best practices; projects in general, and migrations in particular. On the basis of these situational factors, risks may be assessed. A situational factor can consequently be seen as a property of the situation that should be used to determine the most appropriate risk management and migration strategies.

The situation can be assessed by assigning a value to each relevant situational factor. Situational factors contribute to the complexity and uncertainty of the project. The overall complexity and uncertainty of the project are evaluated on the basis of the situational factor values.

5.1.1 Assess situational factors

The situation analysis uses a check-list for obtaining knowledge about a situation. This knowledge can be elicited by analysing documents and by interviewing key actors. Such interviews should be planned carefully and the following points noted:

- Who is to conduct the situation analysis?

  In general, it is recommended to have the situation analysis carried out by more than one person.

- Who will be interviewed?

  A representative sub-set of the business actors and the project actors should be interviewed. The number of people interviewed is a trade-off between the cost and the completeness and accuracy of the situation analysis.

- How to phrase the questions?

  The situation analysis should always be adapted to the situation and questions phrased in such a way that the person being interviewed understands the factors and why the questions have been asked.

The interviews should provide information justifying the values of situational factors and thereby exposing the risks. Discussing the situational factors, the potential risks and possible impact with the relevant project and business actors is at least as important as a written valuation of the situational factor. Such a discussion enables a better understanding of the situation by the team of project actors as well as the business actors. Raising awareness, in particular of the risks associated to situational factors, may even be more important than the actual valuation.

In appendix A, a list of situational factors is provided, together with their definitions and possible values. From these descriptions, it is possible to derive the questions that should be asked to obtain the knowledge necessary for determining the situational factor values. Some of the situational factors have sub-factors, which can be individually assessed and documented. The value of the factor is derived from the value of its sub-factors. When the target domain is large, it could be divided into sub-domains. The situation factor values might vary for the different sub-domains and should be investigated for each of them. An overview of the situational factors is provided in tables 8, 9, 10, and 11.

Note the presence of situational factors concerned with the human system. One may expect the migration of a computerised system not to affect the human system. This is, however, not true. For example, a GUI-fication leads to a change in the user interface, which may lead to acceptance problems by the human actors who make use of the system. Changes in the computerised systems' architecture may result in better/worse performance of the system, which ultimately influence the user's acceptance of the system. Even though the impact of a migration on the human system is much less than the introduction of completely new computerised functionality, its impact should still be taken into account.

The list of situational factors provided in appendix A is neither definitive nor exhaustive. The list provided is based upon the list of situational factors provided by the ISPL book on Risk Management [FV99c], and

Domain	Factor	Brief description	Values
Computerised system	Complexity of requirements	Requirements are the essential conditions which a system resulting from a project has to satisfy. Requirements include business goals and stakes (and their stakeholders) to which the system or service must contribute. The complexity of requirements can be measured by the number of requirements, the number of relationships between them and their scope.	[low, medium, high]
Process	Complexity of business processes (computerised system)	The complexity of the processes of the computerised system.	[low, medium, high]
	Complexity of business processes (human system)	The complexity of the business processes of the business system.	[low, medium, high]
	Complexity of quality properties of the business processes	Quality properties relate to the quality of the business processes and resourcing constraints. This applies to both the human and computerised systems. For most migration projects only the quality properties of the computerised business processes will be relevant.	[low, medium, high]
Information	Complexity of business information	Complexity of the information resources of the target domain.	[low, medium, high]
	Complexity of quality properties of business information	Quality properties related to the quality of the information resource.	[low, medium, high]
Actors	Heterogeneity of computerised actors	The computerised actors are the components of the computerised system. Different hardware and software platforms may coexist thereby generating heterogeneity.	[low, medium, high]
	Heterogeneity of human actors	The human actors of the business system may be heterogeneous for organisational reasons, political reasons or individual reasons.	[low, medium, high]
	Complexity of business actors (computerised system)	The complexity of the computerised actors in the business system, relative to the migration.	[low, medium, high]
	Complexity of business actors (human system)	The complexity of the human actors in the business.	[low, medium, high]
	Size of distribution of business actors (computerised system)	Number of geographical sites for the computerised system.	[low, medium, high]
	Size of distribution of business actors (human system)	Number of geographical sites for the human system.	[small, medium, large]
Technology	Complexity of business technology (computerised system)	Complexity of the technology used for the hardware and system software platform of the computerised system.	[low, medium, high]
	Complexity of business technology (human system)	Complexity of the methods, tools, techniques used by the human actors for the performance of the business processes.	[low, medium, high]

Table 8 Complexity factors related to the target domain

further augmented with the experiences of migration experts (see also appendix C). The list contains examples that can be used and enhanced based upon personal and organisational experience. It is recommended that practitioners record their own experience regarding:

- Which additional situational factors (not currently defined) are important to take into account, and how they can influence the risks management and migration strategies.
- How to determine the relevant situational factors - e.g. in the form of metrics, e.g. project size, adapted to their typical situations; and the methods to obtain the necessary knowledge in an organisation.
- Which situational factors are the most important - e.g. in the form of weightings to be applied to the different factors.

For each of the situational factors as listed in appendix A the *domain* the factor pertains to and the knowledge characteristics are listed as well. The domain dimension determines which organisation to investigate. Two domains are considered:

Target domain is that part of the (customer) organisation, in terms of processes, information and actors, that is affected by the project.

Project domain is the project organisation that executes the migration project.

The situational factors that are related to the target domain factors are grouped further into four classes:

Process properties that characterise the business processes in the target domain.

Information properties that characterise the business information in the target domain.

Domain	Factor	Brief description	Values
Business system	Understanding of existing business system	The understanding of the business system by the business actors. Poor understanding includes lack of awareness of the current state of the business system and its computerised system.	[high, medium, low]
	Stability of business system	The instability of business system is a measure of the importance of changes to be expected during (but not necessarily caused by) the migration project.	[high, medium, low]
	Stability of environment	Stability of the environmental factors that have an impact on the target domain.	[high, medium, low]
Computerised system	Availability, clarity and stability of requirements	Requirements are the essential conditions a system resulting from a project has to satisfy. Requirements include business goals and stakes (and their stakeholders) to which the system or service must contribute.	[high, medium, low]
	Quality and availability of existing operational items	At the outset of the project, there may be several operational elements available that are related to the existing computerised system. The quality of these existing operational items should be assessed relative to their need within the migration project.	[high, medium, low]
	Quality of service offered by existing operational items	At the outset of the project, the existing computerised system may consist of several operational items.	[high, medium, low]
	Quality and availability of existing specifications	Specifications are definitive descriptions of a system for the purpose of developing it or validating it. The quality of existing specifications should be assessed relative to the need within the migration project.	[high, medium, low]
Process	Adequacy of business processes	A measure of the adequacy of the business processes, approaches, strategies, culture, and maturity for the implementation of the project.	[high, medium, low]
	Formality of business processes	Formality of business processes is their conformity to rules and elaborated procedures.	[high, medium, low]
Information	Formality of business information	Formality of business information is their conformity to rules and structure.	[high, medium, low]
Actors	Attitude of business actors	The attitude of the human actors regarding the migration project.	[positive, neutral, negative]
	Ability of business actors	Skills, experience, knowledge, and capacity of the human actors. Most migrations will need the participation of the business actors for some part of the process, if only to provide input for testing the migrated system.	[high, medium, low]
	Attitude of business management	The attitude of the management may be negative for lack of awareness, organisational reasons, political reasons or individual reasons.	[positive, neutral, negative]
	Importance of changes triggered by the project (computerised system)	Impact of the project on the computerised system structure and its component characteristics.	[low, medium, high]
	Importance of changes triggered by the project (human system)	Impact of the project on the organisation structure and the actor characteristics.	[low, medium, high]
Technology	Novelty of business technology (computerised system)	A measure of how innovative with respect to the state-of-the-art is the technology used for the hardware and system software platform of the computerised system.	[low, medium, high]
	Novelty of business technology (human system)	A measure of how innovative with respect to the state-of-the-art are the methods, tools and techniques used by the human actors for the performance of the business processes.	[low, medium, high]
	Availability of appropriate business technology (human system)	A measure of the availability of the methods, tools (including computerised tools), and techniques needed by the human actors. Some migrations, for example GUI-fication, or 7x24 hours on-line, will lead to changes in the need for (human) business technology as well.	[high, medium, low]
	Availability of appropriate business technology (computerised system)	A measure of the availability of the technology needed for the computerised system to be migrated.	[high, medium, low]

Table 9 Uncertainty factors related to the target domain

Domain	Factor	Brief description	Values
Process	Complexity of project processes	The complexity of the processes of the migration project.	[low, medium, high]
	Complexity of quality properties of project processes	Quality properties relate to the quality of the project processes and resourcing constraints.	[low, medium, high]
Information	Complexity of project information	The complexity of the project information refers to the information used by the project actors for the project execution.	[low, medium, high]
	Complexity of quality properties of project information	Quality properties relate to the quality of the information used by the project actors for the project execution.	[low, medium, high]
Actors	Heterogeneity of project actors	The project actors may be heterogeneous which may create difficulties in communication and co-operation within project execution.	[low, medium, high]
	Complexity of project actors	The complexity of the actors involved in the project execution.	[low, medium, high]
	Size of distribution of project actors	Number of geographical sites where the project actors are located.	[small, medium, large]
Technology	Complexity of project technology	Complexity of the methods, tools (including computerised tools), techniques used by the project actors. The complexity should be assessed relative to the expected skills of the project actors.	[low, medium, high]

Table 10 Complexity factors related to the project domain

Domain	Factor	Brief description	Values
Process	Adequacy of schedules	A measure of how tight the schedules are due to bad estimates or urgency of the project.	[–, normal, tight]
	Adequacy of budget	A measure of how tight the budget is due to bad estimates or constraints.	[–, normal, tight]
	Adequacy of project processes	A measure of the adequacy of the processes, approaches, strategies, culture, maturity of the service organisation for the attainment of the goal of the project.	[high, medium, low]
	Formality of customer-supplier process	Conformance of the customer-supplier process to defined rules and procedures.	[high, medium, low]
	Specificity/Novelty of project	A measure of how specific/innovative the project is with respect to the state-of-the-art.	[low, medium, high]
	Dependency on other services	Dependency on ongoing services or projects that interface to the migration project. For migration projects, it is usually not desirable if during the course of the migration project other projects make changes to the system to be migrated.	[none, low, high]
Information	Formality of project information	Formality of project information is their conformity to rules and structure.	[high, medium, low]
Actors	Attitude of project actors	The attitude of the project actors themselves regarding the project.	[positive, neutral, negative]
	Ability of project actors	Skills, experience, knowledge, and capacity of the project actors. Note that this may include some of the ongoing-service actors as they may be involved for the installation of migrated items.	[high, medium, low]
	Dependency on sub-contractors or suppliers	The dependency on other parties than the customer and the main supplier. These other parties may provide products or services to the project.	[none, low, high]
Technology	Novelty of project technology	A measure of how innovative with respect to the state-of-the-art of the methods, tools (including computerised tools), and techniques used by the project actors for the execution of the project.	[low, medium, high]
	Availability of appropriate project technology	A measure of the availability of the methods, tools (including computerised tools), and techniques needed by the project actors for the execution of the project.	[high, medium, low]

Table 11 Uncertainty factors related to the project domain

Actor properties that characterise the business actors in the target domain; this includes properties of their organisational structure. If the target domain contains computerised systems, it includes properties of the computerised components and the computerised system architecture. In some cases, it is clearer to split these situational factors in factors related to the *human system* and factors related to the *computerised system*.

Technology properties that characterise the technology (methods, techniques and tools) used in the target domain. Where it concerns computerised systems, this set of properties includes properties that characterise the technology used in the computerised system.

A factor may pertain to all aspects of the business systems, e.g. the availability, clarity and stability of requirements concerns processes, information, actors and technology. Such factors are labelled with *business system*. The same principle applies to factors pertaining to all aspects of the computerised system.

The project domain factors are grouped into four classes:

Process properties that characterise the processes that contribute to the delivery of the project.

Information properties that characterise the information used to deliver the project.

Actor properties that characterise the actors who execute parts of the project; this includes properties of their organisational structure. The actors may include developers, project managers, experts, users involved in the service execution, sub-contractors, etc.

Technology properties that relate to the technology (methods, techniques and tools) used to deliver the project.

The other dimension, the knowledge characteristic, groups the knowledge about the situation into complexity and uncertainty.

Complexity can be regarded as the difficulty encountered in managing the available knowledge.

Uncertainty can be regarded as the lack of available knowledge.

5.1.2 Evaluate overall uncertainty and complexity

Once the situational factor values are determined, the overall complexity and uncertainty of the migration project should be assessed. These two factors have a big influence on the definition of the appropriate project delivery strategy, as will be explained in chapter 6.

The following procedure can be used:

1. List all factors with a high complexity or a high uncertainty. If possible, in the order of the amount of influence on the overall complexity and uncertainty.
2. Evaluate all the factors with a moderate value and describe any influence on the overall complexity and uncertainty.
3. List all factors with a low complexity or uncertainty. Evaluate how much these factors counteract the overall complexity and uncertainty. This list can also be used to assess whether a project delivery strategy is feasible and appropriate.
4. Use the expertise within the organisation to complement the list of situational factors and evaluate their influence on complexity and uncertainty.
5. Using the results of the previous four steps determine the overall complexity and uncertainty of the project.

The influence of a factor on the overall complexity or uncertainty, can be analysed by assessing the risks that the factor may cause, see the next sections. The heuristics regarding the assessment of risks are sometimes based on the overall complexity and uncertainty - i.e. there are interdependencies between the various risk analysis techniques and they should be used in parallel and/or iteratively.

5.2 Analyse risks

Risk analysis consists of risk identification, risk probability assessment, risk impact assessment and critical risk identification. As mentioned before, it is found necessary for migration projects to regularly re-evaluate the situation and resulting risks. The processes involved in a risk analysis may therefore have to be applied regularly during a migration project, and as a result, risk mitigation may have to be adjusted as the project goes on.

5.2.1 Identify risks

In appendix B, a list of common risks is enumerated. They are described in terms of the adverse consequences that may result, i.e. their impact. Two classes of risks are considered:

Risks for the business are those risks which have a direct impact on the business performance in terms of quality, costs, non-attainment of stakes, etc.

Risks for the project are the risks which have a direct impact on the project performance in terms of quality, costs, delays, etc. Their impact on the business is only indirect through the increase of probability of some risks for the business.

The word ‘system’ in the formulation of these risks refers to the result of a migration project. As discussed before, the result of a migration project does not always have to be a migrated *computerised system*. For instance, in the case of a *design recovery*, the result will be a set of newly created or modified descriptive items. The result of a migration project can therefore be any set of migrated operational/descriptive items.

There is a causality relationship between situational factors and risks: situational factors are sources of risks. These relationships between (valuated) situational factors and risks are presented in tables 12, 13,

14, 15. They are general relationships that could not suit certain specific situations. Therefore, in each specific case, these relationships should be scrutinised carefully in order to determine which of them are relevant and which relationships are missing.

	Complexity of business actors is high (human system)	Complexity of business actors is high (computerised system)	Complexity of business processes is high (human system)	Complexity of business processes is high (computerised system)	Complexity of business information is high	Complexity of business technology is high (human system)	Complexity of business technology is high (computerised system)	Complexity of quality properties of the business processes is high	Complexity of quality properties of business information is high	Complexity of requirements is high	Heterogeneity of computerised actors is high	Heterogeneity of human actors is high	Size of distribution of business actors is large (human system)	Size of distribution of business actors is large (computerised system)
Delays in deliveries					x	x								
Delays in the system delivery					x	x								
Demotivation of project actors														
Increased costs of the project	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Integration problems of system components		x		x			x			x	x			
Lack of business actor participation/commitment														
Loss of control of project	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Non-attainment of business stakes								x	x					
Poor quality of deliverables														
Poor quality of delivered system	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Poor quality of ongoing-service delivery during migration														
Shortfalls in sub-contracted/suppliers tasks														
Shortfalls in input deliverables														
System not accepted by business actors								x	x					
Uncertain interfaces within target domain											x	x		
Unclear migration requirements											x	x		
Unpredictable costs for the business	x	x												
Unstable, or conflicting, systems requirements											x	x		

Table 12 Risks associated to complexity of target domain

5.2.2 Assess probability and impact of risks

The risks that may have been identified need to be qualified and quantified somehow in order to be able to effectively prioritise any actions and strategies that may be needed to mitigate these risks. To this end, each risk will be assessed for its probability and potential impact. This section provides a technique to make such assessments.

An example of risk probabilities and impacts is given in table 16. In assessing the probability of risks, the following procedure can be used:

1. List the situational factors.
2. Mark the associated risks with Xs according to the relationships in tables 12, 13, 14 and 15.
3. Assess the probability of each risk.

The probability of a risk depends on:

- The number of situational factors having a negative value that contribute to the risk .
- The relevance and importance of these situational factors in the specific situation
- The magnitude of the negative value of each of those situational factors.

In some situations, risks may be decreased by situational factors having a positive value. There is no formal algorithm to compute a risk probability. Expert judgement is required. The probability should be expressed

	Ability of business actors is low	Adequacy of business processes is low	Attitude of business actor is negative	Attitude of business management is negative	Availability, clarity and stability of requirements is low	Availability of appropriate business technology is low (human system)	Availability of appropriate business technology is low (computerised system)	Formality of business information is low	Formality of business processes is low	Importance of changes triggered by the project is low (human system)	Importance of changes triggered by the project is low (computerised system)	Novelty of business technology is high (human system)	Novelty of business technology is high (computerised system)	Quality and availability of existing operational item is low	Quality and availability of existing specifications is low	Quality of service offered by existing operational items is low	Specificity of business processes is high	Stability of business system is low	Stability of environment is low	Understanding of existing business system is low
Delays in deliveries	x	x	x	x	x	x	x					x	x	x	x		x	x	x	x
Delays in the system delivery	x	x	x	x	x	x	x					x	x	x	x		x	x	x	x
Demotivation of project actors	x	x	x	x	x	x	x					x	x	x	x		x			x
Increased costs of the project	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	
Integration problems of system components					x			x	x					x		x		x		
Lack of business actor participation/commitment				x	x						x	x								
Loss of control of project						x	x	x					x	x	x				x	x	x
Non-attainment of business stakes			x	x	x	x					x								x	x	x
Poor quality of deliverables	x			x	x	x									x	x					x
Poor quality of delivered system	x	x	x	x	x	x	x				x	x	x	x	x			x	x	x
Poor quality of ongoing-service delivery during migration																	x		x	x	x
Shortfalls in sub-contracted/suppliers tasks						x	x	x					x	x		x					
Shortfalls in input deliverables															x						x
System not accepted by business actors	x	x	x	x	x	x					x	x			x						x
Uncertain interfaces within target domain						x			x	x					x	x			x	x	x
Unclear migration requirements	x	x	x	x	x	x			x	x					x		x				x
Unpredictable costs for the business	x	x	x	x	x						x	x			x	x	x		x	x	x
Unstable, or conflicting, systems requirements		x	x	x	x														x	x	

Table 13 Risks associated to target domain uncertainty

	Complexity of project actors is high	Complexity of project information is high	Complexity of project processes is high	Complexity of project technology is high	Complexity of quality properties of project information is high	Complexity of quality properties of project processes is high	Heterogeneity of project actors is high	Size of distribution of project actors is large
Delays in deliveries	x	x	x	x	x	x	x	x
Delays in the system delivery	x	x	x	x	x	x	x	x
Demotivation of project actors				x			x	
Increased costs of the project	x	x	x	x	x	x	x	x
Integration problems of system components								
Lack of business actor participation/commitment								
Loss of control of project	x	x	x	x	x	x	x	x
Non-attainment of business stakes								
Poor quality of deliverables				x			x	
Poor quality of delivered system				x			x	
Poor quality of ongoing-service delivery during migration			x				x	
Shortfalls in sub-contracted/suppliers tasks				x				
Shortfalls in input deliverables								
System not accepted by business actors								
Uncertain interfaces within target domain								
Unclear migration requirements								
Unpredictable costs for the business								
Unstable, or conflicting, systems requirements								

Table 14 Risks associated to complexity of project domain

	Ability of project actors is low	Adequacy of budget is low	Adequacy of schedules is low	Adequacy of project processes is low	Attitude of project actors is negative	Availability of appropriate project technology is low	Dependency on other services is high	Dependency on sub-contractors or suppliers is high	Formality of customer-supplier process is low	Formality of project information is low	Novelty of project technology is high	Specificity/Novelty of service is high
Delays in deliveries	x	x	x	x	x	x	x	x	x		x	x
Delays in the system delivery	x	x	x	x	x	x	x	x	x		x	x
Demotivation of project actors	x	x	x	x	x	x	x	x	x		x	x
Increased costs of the project	x	x	x	x	x	x	x	x	x		x	x
Integration problems of system components												
Lack of business actor participation/commitment												
Loss of control of project	x		x	x	x	x	x	x	x	x	x	x
Non-attainment of business stakes												
Poor quality of deliverables	x	x	x	x	x	x	x	x	x	x	x	x
Poor quality of delivered system	x	x	x	x	x	x	x	x	x		x	x
Poor quality of ongoing-service delivery during migration												
Shortfalls in sub-contracted/suppliers tasks		x	x					x				
Shortfalls in input deliverables												
System not accepted by business actors					x		x		x			
Uncertain interfaces within target domain							x					x
Unclear migration requirements							x		x			x
Unpredictable costs for the business							x					
Unstable, or conflicting, systems requirements							x		x			x

Table 15 Risks associated to project domain uncertainty

	Probability	**Impact**	Adequacy of budget is tight	Adequacy of schedules is tight	Availability, clarity and stability of requirements is low	Complexity of business processes is high	Importance of changes triggered by the project is high	Novelty of business technology is high	Specificity of business processes is high	Stability of environment is low
Delays in deliveries	+++	+	x	x	x			x	x	x
Delays in the system delivery	+++	+	x	x	x			x	x	x
Demotivation of project actors	+	+	x	x	x		x	x		
Increased costs of the project	+++	+	x	x	x	x		x	x	x
Integration problems of system components	++	+			x	x				
Lack of business actor participation/commitment	0	0					x			
Loss of control of project	+++	+		x	x	x		x		x
Non-attainment of business stakes	+	++			x		x			x
Poor quality of deliverables	+	+	x	x	x					
Poor quality of delivered system	+++	+	x	x	x	x		x	x	
Poor quality of ongoing-service delivery during migration	+	+								x
Shortfalls in sub-contracted/suppliers tasks	NR		x	x	x			x		
Shortfalls in input deliverables	NR									
System not accepted by business actors	+	++			x		x			
Uncertain interfaces within target domain	+	+			x					x
Unclear migration requirements	++	+			x				x	
Unpredictable costs for the business	+	+			x		x			x
Unstable, or conflicting, systems requirements	++	+			x					x

Table 16 Risk probabilities and impacts, an example. In this table the following conventions have been used: NR means not relevant, + means low, ++ means medium, and +++ means high.

as a real number included between 0 and 1. However, a more qualitative approach can also be used, e.g. a three grades scale such as the one presented in the example of table 16.

For each risk identified, the impact should be assessed as well. The impacts of risks are very much dependent on, and specific to, the context of the service. The risks within the check-list are described by types of impacts, e.g. unpredictable costs, delays in the service or in delivery of deliverables and poor quality of service or deliverables. This impact is different whether the risk is for the service or the business. The impact of a risk for the service is measured in terms of an increase of probability of other risks for the service and for the business. Refer to Figure 25 for a graphical representation of the causality relationships between risks. An arrow between (sets of) risks indicates that if (one of) the first risk is likely to occur, than (one of) the second risks is likely to occur as well.

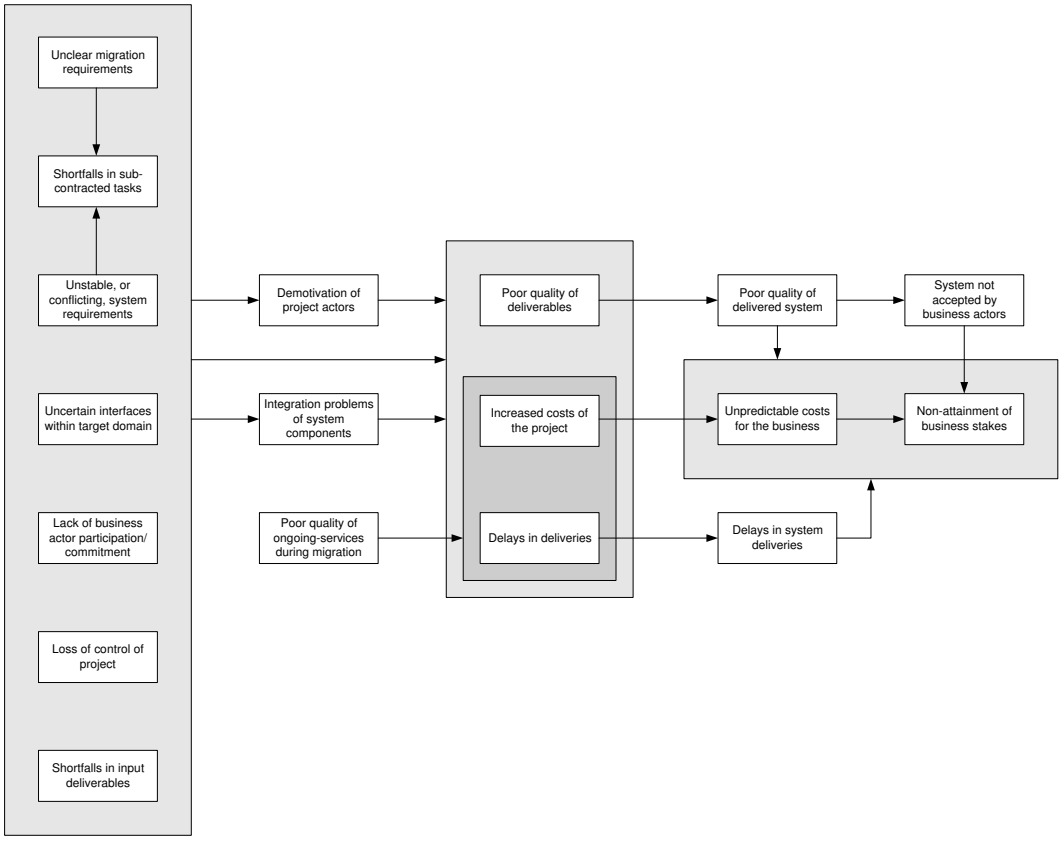

Figure 25 Causality relationship between risks.

The impact of a risk for the business is measured in terms of losses incurred by the business. These losses should be quantified, as far as possible in financial terms. For instance, the non-attainment of a reduction of total-cost-of-ownership of a computerised system, if a migration project fails. However, other quantitative measurements are acceptable, such as:

- Loss of customers of the business.
- Handicap to meet the strategic targets of the business (related to the strategic importance of a service or project).
- Alteration of the image of the business in the market.
- Direct threat to the survival of the business.

Year 2000 and Euro migrations were examples of migration projects, where delays in system deliveries, or a poor quality (disfunctional) of the delivered system had a high impact. The economic survival of the entire business system was dependent on a timely delivery of the migrated system that meets the quality criteria set.

5.2.3 Identify critical risks

Special attention should be given to the risks with a high probability and a high impact, i.e. with a high exposure. These risks are called the critical risks. The critical risks should influence the definition of the project delivery strategy and the decision points, and they should be documented in the delivery plan.

The critical risks should be documented by characterising their:

- Probability.
- Main type of impact, e.g. the name in the list of risks.
- Description of impact.

The impact should be expressed by examples of consequences. If possible, some quantitative measurement of the consequences should be provided.

6 Design of a Migration Project Delivery Strategy

After appreciating the situation under which a migration project should take place, a project delivery strategy can be formulated to best address the situation at hand. This chapter is concerned with the design of such a strategy. The word ‘design’ is used rather than ‘select’ or ‘determine’ to stress the fact that it involves more than ‘simply’ selecting the right options from a pre-defined set of options dictated by some experts. The actions and strategic options discussed in this chapter should therefore be used as a source as inspiration, but should most certainly not be seen as an authoritative and exhaustive list.

A strategy is the approach that is intended to be used to achieve the objectives of an acquisition, while effectively managing risks in the development situation. This strategy is elaborated within a risk mitigation framework, see Figure 26. Risk mitigation is a systematic approach to reduce the probability of the risks and/or limit the damage caused by the risk using appropriate counter or preventive actions.

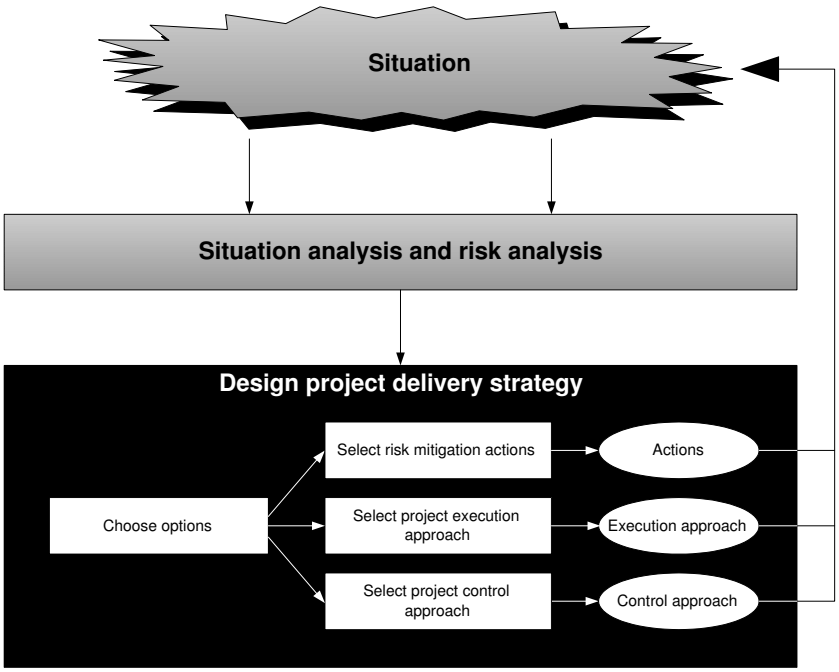

Figure 26 Risk analysis and design of a project strategy

The techniques discussed in this chapter allow the selection of an appropriate migration strategy that consists of:

- selection of appropriate actions to mitigate risks,
- design of a project execution approach,
- design of a project control approach.

The following procedure can be used to select an appropriate project delivery strategy based on a risk analysis as discussed in the previous chapter:

1. Select actions to counter complexity and uncertainty by applying:
   - heuristics within ISPL,
   - personal and organisational experience.

   See section 6.1.
2. Assess the effects of the actions on the situational factors and the critical risks, and document the situation assessment that should be the basis for the selection of strategy options in the next steps.

   See section 6.1.
3. Design a project execution approach by applying the heuristics of ISPL, and personal as well as organisational experience.

   See section 6.2.
4. Design a project control approach by applying the heuristics of ISPL, and personal as well as organisational experience.

   See section 6.3.
5. Analyse the impacts of the selected strategy.

   See section 6.4.

The situation assessment that forms the basis for the selection of actions and strategy options may change as a result of the execution of the actions identified in step 1. Therefore, it may be necessary to re-do step 1-5 until the resulting project delivery strategy is 'fit for purpose'. The chosen project delivery strategy is the basis for the subsequent planning of decision points, see chapter 7.

The strategy provides the justification for the sequence and contents of the decision points. Therefore, the strategy should be documented as part of the delivery plan. Please note that the heuristics within the techniques are neither definitive nor exhaustive. They are examples only, that can be used and enhanced based upon personal and organisational experience.

6.1 Select actions and assess impact

This technique consists of a set of heuristics on how to mitigate risks caused by the complexity and uncertainty in a situation. These heuristics lead to actions that aim to reduce uncertainty or complexity, or aim to reduce the probability or impact of risks. In addition to actions that may be executed before, or during, the project, the heuristics may also produce requirements on decision points of the delivery plan. Those requirements should be considered in the decision points planning as discussed in the next chapter.

The heuristics are provided in four tables:

- actions to mitigate risks in tables 17 and 18,
- actions to change individual uncertainty factors in table 19,
- actions to change individual complexity factors in table 20.

When the selected actions are executed before, or during, a project, the risk analysis as discussed in chapter 5 may have to be revised. Some values of uncertainty and complexity factors may have been reduced, or the impact and probability of risks lessened, leading to a different situation. Therefore a re-assessment of the risk analysis will be required.

Risk	Actions to mitigate risks
Delays in deliveries	⇒ Plan work-arounds. For time and business critical migrations such as the year 2000 and Euro conversions, this may result in the development of an emergency/contingency plan. ⇒ Plan for investment decision points where ambitions may be revised. ⇒ Allocate more people to the project team. ⇒ Do more work in parallel. ⇒ Automate the migration process as much as possible by using scanning, conversion, etc., tools. ⇒ Increase skills in the project team. ⇒ Revise delivery plan.
Delays in the system delivery	⇒ Plan work-arounds. For time and business critical migrations such as the year 2000 and Euro conversions, this may result in the development of an emergency/contingency plan. ⇒ Plan for investment decision points where ambitions may be revised. ⇒ Allocate more people to the project team. ⇒ Do more work in parallel. ⇒ Automate the migration process as much as possible by using scanning, conversion, etc., tools. ⇒ Increase skills in the project team. ⇒ Revise delivery plan.
Demotivation of project actors	⇒ Train project actors. ⇒ Motivate project actors. ⇒ Avoid management by blame. ⇒ Produce realistic and feasible plans.
Integration problems of system components	⇒ Block all changes during the migration of system components to which a dependency exist, and which are not included in the project. ⇒ Plan the project in co-ordination with those who are responsible for these components. ⇒ Define strict interfaces to other system components as early as possible. ⇒ Use a formal configuration control.
Lack of business actor participation/commitment	⇒ Ensure that the project reports directly to the board of directors of the business. For example, for year 2000 and Euro migration projects this seemed to be a common strategy. ⇒ Get senior management support and responsibility for participation. ⇒ Investigate and analyse the motivation of the target domain actors. ⇒ Motivate/involve the actors, e.g. by making the benefits/impacts understandable and visible. For example, motivate the actors by showing (if possible in financial terms) what may happen if the migration would not take place. For instance, in the case of the introduction of the Euro, one may have motivated the business actors by showing them the effects of the introduction of the Euro on daily operations and the resulting effects on the computerised system.
Loss of control of project	⇒ Ensure that the project reports directly under the board of directors of the business. For example, for year 2000 and Euro migration projects this seemed to be a common strategy. ⇒ Use a formal program/project management approach.
Non-attainment of business stakes	⇒ Implement a form of project management driven by stakes. ⇒ Measure the attainment of stakes as early as possible. ⇒ Manage critical risks. ⇒ Ensure that the project reports directly under the board of directors of the business. For example, for year 2000 and Euro migration projects this seemed to be a common strategy.
Poor quality of deliverables	⇒ Use a clear and measurable definition of the required quality. ⇒ Train the project team, e.g. train those actors that are involved in the project. ⇒ Increase skill level of the project team. For example, by adding external expertise. ⇒ Check the usage of tooling. Are the right tools used in the right way with the right input? ⇒ Revise delivery plan.
Poor quality of delivered system	⇒ Make use of strict test plans, and possibly treat failures found during the final tests with the same priority as faults encountered in an operational system. ⇒ Verify, as soon as possible, whether the quality of the migrated system/items will be at least as good as the quality of the existing system/items, i.e. requirements to the sequence, purposes and deliverables of decision points. ⇒ Produce requirements statements, prototypes and specifications of the migrated items. ⇒ Gather experiences obtained from similar situations. ⇒ Use reverse engineering, i.e. add decision points to the delivery plan associated with raising the understanding of the existing system through descriptions of the existing system. ⇒ Check the usage of tooling. Are the right tools used in the right way with the right input? ⇒ Use IS-experts with high level of technical skills. ⇒ Perform regular checks of the conformance to requirements.
Poor quality of ongoing-service delivery during migration	⇒ Verify, as soon as possible, whether the quality of the ongoing-services during the migration project will be as good as the quality of the existing ongoing-services, i.e. requirements to the sequence, purposes and deliverables of decision points. ⇒ Gather experiences obtained from similar situations. ⇒ Use IS-experts with high level of technical skills. ⇒ Perform regular checks of the conformance to requirements.

Table 17 Actions to mitigate risks

Risk	Actions to mitigate risks
Shortfalls in sub-contracted/suppliers tasks	⇒ Include the external supplier in the specification phases and describe not only the deliverables but also what they are used for. ⇒ Control the external delivery. ⇒ Use formal customer-supplier relationships and delivery plans with sub-contractors/suppliers. ⇒ Create a control mechanism in the target domain, e.g. a project control team. ⇒ Team up with other customers of the same supplier to force quality improvements of the product, or necessary changes to the product. For example, enforcing year 2000 or Euro compliance.
Shortfalls in input deliverables	⇒ Start an investigative project first to asses the quality of input deliverables. The adagio garbage-in - garbage-out applies here. Make sure that the input deliverables are of the quality needed. In addition to an investigative project, one may choose to do a 'clean-up' project before the actual migration project commences.
System not accepted by business actors	⇒ Produce prototypes for simulation of work practice properties. For instance, to illustrate how certain quality properties of the system/items may change, such as performance. ⇒ Create or maintain a positive attitude of the business actors.
Uncertain interfaces within target domain	⇒ Carefully specify the interfaces. ⇒ Use published standards focusing on interoperability. ⇒ Set your own standards and promote them. ⇒ Involve management from related processes in the project control.
Unclear migration requirements	⇒ Create or utilise a good understanding, if any, of the items to be migrated. ⇒ Make early decisions on descriptions of the migrated items, e.g. make a stringent requirements analysis and add decision points to the delivery plan regarding requirements and implement a requirements control system. ⇒ Include business actors as project actors. ⇒ Use formal requirements analysis methods. ⇒ Use scanning tools to establish the quality and complexity of the existing operational and descriptive items as early as possible. The quality and complexity of these pre-existing items is a potential (hidden) uncertainty of the requirements for migration projects.
Unpredictable costs for the business	⇒ Decrease the uncertainty regarding costs by having decision points in the delivery plan concerning these costs early in the project execution. ⇒ Use of professional assistance to identify and evaluate those costs. ⇒ Use a frequent budget control. ⇒ Plan for investment decision points where ambitions may be revised.
Increased costs of the project	⇒ Decrease the uncertainty regarding costs by having decision points in the delivery plan concerning these costs early in the project execution. ⇒ Use of professional assistance to identify and evaluate those costs. ⇒ Use a frequent budget control. ⇒ Plan for investment decision points where ambitions may be revised.
Unstable, or conflicting, systems requirements	⇒ Pay considerable attention to the design and construction of an adaptable system/items, i.e. the quality plan should contain quality criteria on adaptability. ⇒ Implement a stringent change control system together with the customer. ⇒ Plan for investment decision points where requirements are revised. ⇒ Use scanning tools to establish the quality and complexity of the existing operational and descriptive items as early as possible.

Table 18 Actions to mitigate risks

Uncertainty factor	Actions to change individual uncertainty factors
Availability, clarity and stability of requirements is low	⇒ Perform a stringent requirements analysis, i.e. add decision points to the delivery plan regarding requirements statements of the items to be migrated and implement a requirements control system.
Ability of business actors is low	⇒ Use business actor training, e.g. perform a training program for the people who are stakeholders.
Ability of project actors is low	⇒ Use project team training, e.g. conduct a training program for the people who are actors in the project. ⇒ Increase skills in the project team. For instance by better dividing existing skills over project teams, or by hiring external expertise. Seek a balance between domain knowledge, knowledge of the current system/environment and knowledge of the new system/environment. ⇒ Perform a pilot project to gain more knowledge about the migration tasks at hand. ⇒ Introduce forms of 'knowledge management' to enable the sharing of relevant knowledge about the ongoing migration effort between the project teams. Ensure there is a team spirit and sharing of knowledge & experience among the team members. Maybe introduce a centre of expertise and flying squads when dealing with very large migration projects covering multiple operational (and development!) sites.
Adequacy of schedules is low	⇒ Install something as fast as possible. ⇒ Add appropriate skills in project team.
Attitude of business actors is negative	
• Commitment and involvement from actors is low	⇒ Involve the actors, e.g. increase the information flow to actors, the actor participation and the actor influence within the project. ⇒ Use change management strategies for any organisational changes required. This may also include the business' customers. Consider, for example, the introduction of the Euro, where customers were 'familiarised' with the Euro even before its official introduction. ⇒ Introduce some form of a communication plan to communicate the impact and needs for the migration to the business actors. Attention should be paid to the continuous creation of awareness.
• Perception of the need for migration is negative	⇒ Motivate the actors, e.g. by making the benefits understandable and visible. For example, discuss (if possible in financial terms) what may happen if the migration would not take place, or discuss the effects of the introduction of the Euro on daily operations and the resulting effects on the computerised system. ⇒ Add appropriate skills to project team.
• Willingness to accept the changes brought about by the migration is low	⇒ Most migrations lead to some compromise of application coding and structure. Ensure that development staff from the customer's side are involved in technical decision regarding the migration as early as possible to gain their commitment to the planned changes. This could be combined with doing a pilot project.
Attitude of business management is negative	
• Willingness of management to commit themselves to the entire project is low	⇒ Ensure that the project reports directly to the board of directors of the business (or as high as possible in the hierarchy of command). Alternatively a steering committee may be assigned. This committee should contain expertise on the relevant domains, and have the power to make and enforce decisions. For year 2000 and Euro migration projects, this seemed to have become a common strategy.
• Perception of the need for migration is negative	⇒ Motivate management, e.g. by making the benefits understandable and visible. For example, discuss (if possible in financial terms) what may happen if the migration would not take place, or discuss the effects of the introduction of the Euro on daily operations and the resulting effects on the computerised system.
• Expectations of management with regards to the migration project are unrealistic	⇒ Better inform management, and manage their expectations. For example, when using advanced tools during the migration, in particular in the context of a factory based approach, customer's management may get too optimistic impressions of the speed at which the migration may proceed.
Availability of appropriate business technology (computerised system) is low	
• Delivery of technology is low	⇒ Do a (small, but significant) pilot project first to check the performance/quality of technology needed for the migrated items.
Overall uncertainty of project is high	⇒ Start an investigative project specifically targeted at reducing the uncertainty.
Quality and availability of existing operational items is low	⇒ Do a thorough (but not indefinite!) search for the missing operational items. ⇒ Improve the overall quality by removing dead elements, like dead code, irrelevant documentation, etc.
Quality and availability of existing specifications is low	⇒ Redo the specifications, i.e. add decision points to the delivery plan regarding the approval of the specifications of the migrated items. ⇒ Review the existing specifications with the business actors.
Understanding of existing business system is low	⇒ Use reverse engineering, i.e. add decision points to the delivery plan associated with raising the understanding of the existing system through descriptions of the existing items.

Table 19 Actions to change individual uncertainty factors

Complexity factor	Actions to change individual complexity factors
Complexity of business actors (computerised system) is large	⇒ Split the target domain. ⇒ Use a factory-based approach for the execution of the migration. ⇒ Consider using off-the-shelf software, or standard functionality provided by the new platform (if relevant), to replace complex elements of the current system. ⇒ Consider using a new platform. For example, for some year 2000 projects it turned out to be easier to convert the software to a new platform and make it year 2000 compliant on the new platform, rather than sticking to the old platform.
• Complexity of the code	⇒ Use local experts who are well versed in the localisation of the code.
Complexity of business actors (human system) is large	⇒ Split the target domain.
Complexity of business processes (computerised system) is high	⇒ Clarify the interfaces early in the description process. ⇒ Use a factory based approach, if the specificity of the processes is low. ⇒ Test the external interfaces carefully. ⇒ Produce plans for the necessary changes to each external system of interest. ⇒ Plan the construction, testing and installation of the interfaces in co-ordination with those responsible for the external systems of interest. ⇒ Consider the possibility of using off-the-shelf software, or standard functionality provided by the new platform (if relevant), to replace complex functionality offered by the current system.
Complexity of business processes (human system) is high	⇒ Use the business process view in descriptions to support early decisions regarding the business processes. ⇒ Use IS experts with high level of skills in this application domain.
Complexity of project processes is high	
• Number of migration causes is high	⇒ Try to avoid combining migration causes as much as possible. For instances, if you want to change the DBMS and the data model, change the DBMS first, and then change the model. If that is not possible, try to add a third step rather than try and achieve it all in one project.
Complexity of information is high	⇒ Use the business information view in the descriptions to support early decisions regarding the business information. ⇒ Use IS experts with a high level of skills in this application domain.
Complexity of quality properties is high	⇒ Approve descriptions of quality properties within early decision points during the project. ⇒ Make early decisions on the trade-off between the functional properties and quality properties. ⇒ Produce prototypes as part of the descriptions.
Overall complexity of project is high	⇒ Split the project into several projects. ⇒ Use a factory-based approach for the execution of the migration.
Complexity of project processes is high	
• Number of interfaces to other services is high	⇒ Plan the project in co-ordination with those people responsible for the other services. ⇒ Clarify the interfaces (external system interfaces, migration interfaces, etc.) early in the project execution. ⇒ Report on these interfaces regularly.
Complexity of project technology is high	⇒ Use safe, well-known and mature technology. ⇒ Use IS experts with a high level of technical skills.

Table 20 Actions to change individual complexity factors

6.2 Project execution approach

An approach should be defined for the actual execution of a migration project. This section starts out by providing a set of options for project execution. The provided options can be adapted to the context within an organisation and enhanced based on experience, resulting in strategy options that are specific to the organisation. At this time, no guidance on such enhancements is provided.

6.2.1 Introduction to strategy options

An execution approach for migration projects is a specialised version of the generic service execution approach used by ISPL. A migration project is considered to consist of an analysis, a migration and an installation phase. The analysis phase is concerned with analysing and defining the planned migration in terms of its initial state, final state, as well as the procedures and techniques used to reach the final state from the initial state. This phase, therefore, has three sub-phases:

Analyse initial state, which aims to provide an analysis of the initial state. This concerns both the relevant descriptive and operational items of initial state, as well as the surrounding business system.

Analyse final state, which aims to provide an analysis of the desired final state. Focus will be on requirements for the operational and descriptive items for the final state, and business technology to be used.

Design the migration, which aims to define and analyse the impact of a migration path. The migration path defines which procedures, techniques and tools (project technology) are needed to be able to progress from the initial state to the final state. One of the decisions that also needs to be taken at here is whether a factory based approach shall/can be used in the migration.

An impact analysis of the migration path chosen is also needed to reduce uncertainty regarding the impact and practicality.

For each of these phases, different strategy options apply. Table 21 provides an overview of these options. Please note that the listed options are only possible options. They should always be scrutinised for their relevance to the local situation, and if needed, they should be further extended with additional options that may be more applicable in a local situation.

6.2.2 Options for the analysis approach

An analysis approach provides the cognitive and social approach required during the analysis phase. The *cognitive approach* used during the analysis phase represents the way in which information is processed to make design decisions in the migration project. Two options are distinguished:

Analytical approach: When information is processed analytically, the available information is simplified through abstraction in order to reach a deeper and more invariant understanding. An analytical approach is used to handle the complexity of the information. In an analytical approach the information system is mainly described by use of some degree of formality.

Experimental approach: When using an experimental approach the project actors learn from doing experiments. The purpose is to reduce uncertainties by generating more information. Experiments can, for example, be based on prototypes, mock-ups, benchmark test of migrated components or other kinds of techniques which make the results of migration scenarios visible.

The two cognitive approaches may need to be combined. An analytical approach to reduce complexity may introduce new sources of uncertainty requiring experimental actions. Conversely, an experimental approach to reduce uncertainty may introduce new sources of complexity requiring analytical actions. It is therefore only the primary cognitive approach that is referred to in the project delivery strategy.

Project execution approach	Strategy options
Analysis approach - Analyse initial state	
• Cognitive approach	⇒ Analytical ⇒ Experimental
• Social approach	⇒ Expert-driven ⇒ Participatory
Analysis approach - Analyse final state	
• Cognitive approach	⇒ Analytical ⇒ Experimental
• Social approach	⇒ Expert-driven ⇒ Participatory
Analysis approach - Design the migration	
• Cognitive approach	⇒ Analytical ⇒ Experimental
• Social approach	⇒ Expert-driven ⇒ Participatory
Migration approach	⇒ One-shot migration ⇒ Incremental migration – Frozen strategy ⇒ Incremental migration – Evolving design
Installation approach	
• System coverage	⇒ One-shot installation ⇒ Incremental installation– Frozen design ⇒ Incremental migration – Evolving design
• Geographical coverage	⇒ Global installation ⇒ Local installation

Table 21 Strategy options

The *social approach* is the way in which project actors work together with the business actors during the analysis phase. Two options are distinguished:

Expert-driven: In an expert-driven approach, project actors (the experts) will produce descriptions on the basis of their own expertise, and interviews and observations of business actors. The descriptions can then be delivered to the business actors for remarks or approvals.

Participatory: In a participatory approach, the project actors produce the descriptions in close co-operation with some or all the business actors, e.g. in workshops with presentations, discussions and design decisions. A participatory approach may allow the acquisition of knowledge, the refinement of requirements and the facilitation of organisational change.

The choice of an analysis approach will place requirements both on the deliverables that are exchanged between the customer and the supplier, and the methods and techniques used in the project. For each of the three sub-phase of the analysis phase, customer and supplier should choose among the four possible combinations of cognitive approach options and social approach options:

1. Analytical and expert-driven approach.
2. Analytical and participatory approach.
3. Experimental and expert-driven approach.
4. Experimental and participatory approach.

In tables 22, 23 and 24 examples of each of the possible combinations of cognitive and social approaches are given for the three analysis phases.

	Analytical	Experimental
Expert-driven	Experts perform a thorough analysis of all the relevant operational and descriptive items of the initial state. During this process, the experts may, for instance, apply a scanning tool to assess the state of the source code.	The experts probe the relevant operational and descriptive items of the initial state to gather information about their actual state. These probes may consist of 'random' inspections of items (possibly using scan tools) that are presumed to provide a significant overview of the initial state. The key aim being the reduction of uncertainty regarding the initial state.
Participatory	The project actors, in conjunction with the business actors, analyse all relevant operational and descriptive items of the initial state. The input from the business actors will mainly be directed towards an analysis of the business setting of the items to be migrated. For example, to assess how well the descriptive items in the initial state reflect the business reality, and what is implemented in terms of the operational items.	The project actors, in conjunction with the business actors, gather information about the initial state by probing the relevant operational and descriptive items. These probes may consist of joint (random) inspections and walkthroughs of items (possibly using scan and simulation tools) that are presumed to provide a significant overview of the initial state. The key aim being the reduction of uncertainty regarding the initial state.

Table 22 Analyse initial state

	Analytical	Experimental
Expert-driven	Experts perform an analysis of the desired final state of the information/computerised system. The requirements for the final state are described using some form of formalism.	By doing some pilot migration projects (leading to prototypes or mock-ups) starting from the initial state, knowledge is gathered about the desired final state. This way uncertainty (in particular technical) regarding the requirements on the final state may be reduced.
Participatory	The project actors, in conjunction with the business actors, analyse the requirements for the desired final state. The use of Joint Application Design (JAD) would be an example of a technique that can be used for these purposes in a participatory setting.	Some pilots of the planned migration are conducted in close collaboration with the business actors. This approach allows uncertainty (in particular concerning business issues) regarding the requirements on the final state to be reduced. It is, for instance, very important to identify the precise business aim of the project as it has a profound impact on the desired final state. For example, is the business aim to reduce cost-of-ownership of the system, or is the aim to increase the systems' flexibility in order to reduce time-to-market for new products? By developing some pilots, and discussing their business impact, these issues may be clarified.

Table 23 Analyse final state

	Analytical	Experimental
Expert-driven	Experts design the migration by selecting procedures, tools, and techniques (project technology) for the actual execution of the migration. They use their expertise from past migrations to make the selections, in combination with analytical techniques to assess the financial and organisation impact of the selections.	By doing some pilot migration projects (leading to prototypes or mock-ups) starting from the initial state, the experts gathered more knowledge about the feasibility, impact and practicality of the possible migration scenarios and selected project and business technology. This approach allows uncertainties regarding the feasibility of the chosen paths to be lessened. It is a suitable way to experimentally test the selected project and business technologies.
Participatory	The project actors, in conjunction with the business actors, design the migration using a top-down analytical approach. The involvement of the business actors allows ample attention to be paid to the organisational impact of the migration. For example, the continuation of the ongoing-services during the migration.	The project actors, in conjunction with the business actors, design the migration while using pilot projects to gather knowledge about the feasibility, impact and practicality of the possible migration scenarios and selected project and business technology. The involvement of the business actors allows ample attention to be paid to the organisational impact of the migration. For example, the continuation of the ongoing-services during the migration. Making the migration design decisions in conjunction with the business actors from the client's IT department also allows typical compromises to the structure of the operational items, that may be unavoidable for the migration, to be discussed (and shown in terms of the pilots) with those actors.

Table 24 Design migration

6.2.3 Options for the migration approach

A migration approach defines how the items are actually going to be migrated and tested. The choice of a migration approach consists of making decisions regarding the steps along which the items are migrated and tested, i.e. decisions regarding the sequence and the type or versions of items that should be migrated, tested and delivered by the project to the customer.

The customer and supplier should choose from the following three migration approaches:

One-shot migration: The whole set of items is migrated (and tested) in one step.

Incremental migration – Frozen design: The complete set of items is migrated (and tested) in successive increments (subsets). The requirements and the migration design are fully defined before the first migration steps and will not be changed afterwards.

Incremental migration – Evolving design: The complete set of items is migrated (and tested) in successive increments (subsets). The requirements are fully defined before the first migration steps and will not be changed afterwards. However, between the migration of two increments, the migration design can be changed after learning from the migration and testing of the previous increment.

As a short-hand notation, the latter two approaches will be abbreviated to: *frozen migration design* and *evolving migration design*.

The ISPL book on Risk Management [FV99c] also identifies an *evolutionary installation approach*, in which case a system is constructed and installed in a series of successive versions. Such an evolutionary approach is typically used in a situation where the (functional) requirements on the resulting system are not clear yet. In the context of a migration, these requirements will be fixed as they follow directly from the pre-existing system and its environment. Also note that the definition of large-scale migrations as used in this plug-in excludes making fundamental changes to the functionality as provided by the computerised system to its environment.

To partition the whole set of descriptive/operational items that needs to be migrated, different ways of partitioning are possible. Two main streams can be identified: business-driven and technology-driven.

When using a business-driven way of partitioning, one will typically make a sub-division of the items to be migrated based on business processes, or business information. Euro-projects are typical examples of projects that used a business-driven approach to partition the set of items, for instance based on distinct products/services offered to customers.

A technology-driven way of working will use technology inspired criteria for partitioning of the items. For example, platforms, programming languages, databases, etc. Year 2000 migrations are typical examples of projects that tended to use a technology-driven approach to partition the items into increments. Whichever approach for system partitioning is used, the partitioning should be possible in the first place, but more importantly, the resulting partition should be practical.

When using an incremental approach with an evolving migration design, there are a number of things that can lead to changes of the migration design between the successive steps. Changes that are caused by the migration itself, or simply because the environment has evolved during the execution of the migration step. Some examples are:

1. Some situational factors may have changed.
2. The impact/probability of a risk may have changed.
3. New off-the-shelf software/hardware may have become available that allows for the complete replacement of a system part that still needs to be migrated.
4. More experience about the chosen strategy is learned.

6.2.4 Options for the installation approach

To determine an installation approach, decisions must be made regarding the increments and versions of the items that should be installed in the target domain, and the sequence of these installations. The customer and supplier should choose from the following three options:

One-shot installation: The whole set of migrated items is installed (and used) in one version (also known as a 'big-bang' installation).

Incremental installation – Frozen design: The set of migrated items is installed (and used) in successive increments (subsets). The requirements and the migration design are fully defined before the first migration steps and will not be changed afterwards.

Incremental installation – Evolving design: The set of migrated items is installed (and used) in successive increments (subsets). The requirements are fully defined before the first migration steps and will not be changed afterwards. However, between the migration of two increments, the migration design can be changed after learning from installing and using the previously installed increment.

Orthogonal to these three approaches for system coverage is the geographical coverage within each of the successive installation steps. The customer and supplier should choose from the following two options for geographical coverage:

Global installation: The migrated items are installed in all the locations within the target domain in one step.

Local installation: Sets of migrated items are installed in several steps covering more and more locations of the target domain.

The first step of an installation of a version would typically have a limited geographical coverage, e.g. only one branch, one department or one office. This step can be used as a pilot installation with the purpose of tuning the migrated versions and improving the installation process before the whole target domain is influenced by the changes. The following steps can then increase the geographical coverage, with the last step having a total coverage of the target domain.

The two geographical coverage options can be combined with any of the three coverage approaches: one-shot, frozen migration design, and evolving migration design.

6.2.5 Select options

The selection of a project execution approach takes as input an overall assessment of situational factors and critical risks, and has as output approaches for analysis, migration and installation which are appropriate for this project, together with their justifications. During the selection, the following issues should be taken into account:

1. The analysis of the initial state is crucial to the success of a migration project.

   A migration project relies heavily on the initial state of the descriptive and operational items. The adagio of garbage-in garbage-out most certainly does apply to migration projects! It may actually be the case that analysing the initial state requires a project of its own.

2. Due care and attention must be paid to defining the installation approach.

   The main objective of most migration projects is to make changes to the operational system through the installation of migrated operational items. The installation is a key moment in the execution of the project. Especially since most situations in practice require the ongoing-services offered to suffer minimal disruptions during the installation. Therefore, the definition of a suitable installation approach is a critical success factor in a migration project.

3. Define measures to define a suitable migration and installation approach.

   The selection of a migration or an installation approach should be influenced by the situational factors. However, the knowledge about the situation can be insufficient to make such a selection. In this case, the project should include activities to obtain the knowledge necessary to make decisions regarding a suitable approach. The deliverables at the early decision points related to the description of the items should support the definition of suitable approaches.

4. Be aware of relationships between the approaches.

   The selection of an installation approach can put constraints and requirements on the other approaches. Similarly, the migration and installation approach can put constraints on the analysis approach. For example, when the installation and migration approaches have been selected potential risks associated with these approaches can be identified. During the analysis extra attention can be paid to reducing the uncertainty related to these latter risks.

   Therefore, it is recommended to select the development approach in the following sequence: installation, migration and then analysis approach, and to check the consistency between the chosen options.

The general mode of operation is to start by making an initial selection of the project execution approach using an overall assessment of situational factors and critical risks, the detailed heuristics provided, and the available experience within the organisation. This can then be followed by a consistency checks of the chosen strategy options, and further adjustments of the choices if needed.

The selected strategy options may require certain conditions within the situation, to be realistic. For example, to be successful, the experimental and incremental approaches require specific project management skills, while the participatory approach requires communication skills in the project team. These conditions should also be analysed and taken into account when selecting the strategy options.

The following procedure may be used in deriving an initial selection:

1. Select strategy option for coverage of installations.

   The (naive) default choice for migrations is a one-shot approach. With a one-shot approach, the project management is simpler, i.e. it mitigates the general risk of loss of control over the project

domain. Therefore, if possible, a one-shot approach should be used. One of the two incremental approaches should be chosen dependent on particular situational factors, see heuristics in table 25.

Practice dictates that most migration projects (and after all, this book is concerned with *large-scale* migrations) are too large to use a one-shot approach. Most migration projects should therefore expect to be using an incremental approach.

2. Select strategy option for geographical coverage of installations.

   The default choice of approach is the global installation, i.e. all migrated items are installed in all locations in one step. A local installation approach, i.e. stepwise installation with more and more locations covered, can be used to handle a complex problem situation, see heuristics in table 25.

3. Select strategy option for migration.

   Similarly to the installation option, the default choice is the one-shot approach. With a one-shot approach, the project management is simpler, i.e. it mitigates the general risk of loss of control of the project. An incremental approach should be chosen dependent on particular situational factors, see heuristics in table 25.

   Similarly to the options for coverage, practice usually dictates the use of one of the two incremental approach due to complexity and uncertainty.

4. Select strategy options for description.

   In general, it will not be the case that one of the analysis approach options can be applied alone. There are likely to be cases where the chosen approach needs to be combined with one of the others. The selected primary cognitive and social approaches should be defined as part of the project delivery strategy. See also the heuristics in table 25.

   Depending on the primary cause for the migration (see Figure 13), the following defaults apply to the social approach (of all three sub-phases):

   - If the migration is due to a problem with descriptive items, use a participatory approach.
   - If the migration is due to a problem with operational items, use an expert-driven approach.

   For the social approach, the following defaults apply (for all three sub-phases):

   - If the uncertainty is high, use an experimental approach.
   - If the complexity is high, use an analytical approach.

   More heuristics can be found in table 25.

Note that the order in which the strategy options should be selected is the reverse of the order in which they should be executed. To select the strategy options for the analysis, the options selected for the migration and installation should be known first. The reason being that the latter options may bring along some risks that can be mitigated by specific actions during the analysis phase. Similarly, the selection of an installation approach has effects on the kind of migration approach to choose.

To check whether the chosen combination of strategy options are feasible, the heuristics in table 26 may be applied. Based on the heuristics listed in this table, the choices made may have to be revised.

6.3 Project control approach

Where a project execution approach organises the target domain, a project control approach aims to organise the service domain. This section starts out by providing a set of options for project control. Again, the provided options can be adapted to the context within an organisation and enhanced based on experience, resulting in strategy options that are specific to the organisation.

	Analytical analysis - Analyse initial state	Experimental analysis - Analyse initial state	Expert-driven analysis - Analyse initial state	Participatory analysis - Analyse initial state	Analytical analysis - Analyse final state	Experimental analysis - Analyse final state	Expert-driven analysis - Analyse final state	Participatory analysis - Analyse final state	Analytical analysis - Design the migration	Experimental analysis - Design the migration	Expert-driven analysis - Design the migration	Participatory analysis - Design the migration	Incremental migration – Frozen design	Incremental migration – Evolving design	Incremental installation – Frozen design	Incremental installation – Evolving design	Local installation
Complexity factors related to the target domain																	
Complexity of business actors is high																	x
Complexity of business information is high				x				x				x					
Complexity of business processes is high (computerised system)				x				x				x					
Complexity of business technology is high																	x
Complexity of quality properties of business information is high																	x
Complexity of quality properties of business processes is high																	x
Complexity of requirements is high	x			x	x			x	x			x					
Heterogeneity of business actors is high			x				x				x						x
Size of distribution of business actors is large																	x
Uncertainty factors related to the target domain																	
Ability of business actors is high				+				+				+					
Ability of business actors is low			x				x				x						
Attitude of business actors is negative				x				x				x					
Availability, clarity and stability of requirements is high				x				x				x					
Changes triggered by the project are important				x				x				x				x	
Formality of business information is low				x				x				x					
Formality of business processes is low				x				x				x					
Specificity of business processes is high				x				x				x					
Stability of business system is low				x				x				x					
Uncertainty factors related to the project domain																	
Ability of project team is low													x				
Budget is tight			x				x				x						
Dependency on other services is high																	x
Novelty of project is high														x		x	
Novelty of project technology is high														x			
Schedules are tight			x				x				x		x	x	x	x	
Schedules are not tight				+				+				+					
Overall complexity and uncertainty																	
Overall complexity is high	x				x				x				x	x	x	x	
Overall uncertainty is high		x				x				x				x		x	

Table 25 Heuristics for the selection of a project execution approach. (+: This factor is necessary; x: This factor is addressed)

Installation approach	Migration approach			Remarks
	One-shot	Incremental Frozen design	Incremental Evolving design	
One-shot	x	x	x	Migration can always be followed by a final acceptance test of the whole set of migrated items and then a one-shot installation.
Incremental Frozen design	x			One-shot migration can be followed by a final acceptance test of the whole set of migrated items and then successive installation of the increments, or a one-shot migration of each part can be followed by acceptance testing and installation of the increments.
		x		Incremental migration of each increment can be followed by acceptance testing and installation of the increment.
			x	Incremental migration of each increment can be followed by acceptance testing and installation of the increment.
Incremental Evolving design	-	-	x	The use of an evolving migration design approach during installation implies the use of the same approach during migration, since the migration design may have to be changed based on experiences with using and installing the migrated items.
An expert-driven approach can be simpler to plan and control than a participatory approach. A participatory approach can be easier to control when an approach with an evolving migration design is used.				

Table 26 Dependencies between strategy options. (X: The combination is possible; -: The combination is not possible)

6.3.1 Strategy options

In defining the strategy options for project control, three aspects are considered: frequency, formality and customer responsibility.

Frequency: the frequency of customer-supplier decision points within the control process.

Formality: the degree of formality within organisation, procedures and disciplines used by the control process.

A high degree of formality in project control can, for example, be implemented by:

- Periodical approvals of status and plan.
- Use logbooks to maintain a history of changes made.
- Well-defined requirements on the content of management reports.
- Well-defined target domain deliverables with deadlines and defined approval procedures.
- Use of defined metrics to measure quality and progress.
- Use of a defined inspection technique to control the quality of code.
- Well-defined configuration control procedures.
- Well-defined procedures for the escalation of problems.
- Make use of tools to keep track of progress and identify bottle-necks as they occur.

Customer responsibility: definition of customer responsibility for processes related to project control.

Generally, it is assumed that the supplier is responsible for all processes unless the customer responsibility is explicitly defined in the contract. For example, the responsibility of the customer may be defined as follows. The customer is responsible for:

- Timely delivery (and configuration control) of the right operational and descriptive items corresponding to the initial state.
- Configuration control of requirements.

- Defining adequate test plans/cases that cover critical situations from the business process perspective.
- Inter-project co-ordination.
- Quality control of descriptions with respect to requirements and business needs.
- Preparing the organisation for the installation of the migrated items.
- Obtaining any agreements within the organisation regarding the requirements to the information system.

Project control may be split among the three processes: development, quality assurance and configuration management. In accordance with this, three project control processes are distinguished:

Migration control: The project management process necessary to control the project tasks performed within the actual migration process.

Quality control: The techniques and activities that are used to fulfil the quality requirements. Quality control involves techniques and activities aimed at both monitoring a process and eliminating the causes of unsatisfactory performance at all stages of the quality loop in order to achieve economic effectiveness.

Configuration control: This is an element of configuration management, which consists of the evaluation and co-ordination, approval or disapproval, and implementation of changes to configuration items after the formal establishment of their configuration item identification.

For each of the project control processes defined above, the customer and supplier should choose among the options regarding the three aspects considered. An overview is presented in the table 27.

Project control processes	Project control aspects	Strategy options
Migration control Quality control Configuration control	Frequency	Intervals or dates with as extremes *frequent* and *seldom*.
	Formality	Degrees of formality with as extremes *formal* and *informal*.
	Customer responsibility	Customer responsibilities for different processes.

Table 27 Values for project control options

6.3.2 Select options

The selection of a project control approach takes as input an assessment of the situation in the form of situational factors and overall complexity and uncertainty, and results in a control approach which is appropriate for this project, together with its justification.

The selection of strategy options starts with an initial selection using the heuristics provided, and the experience within the organisation. This initial selection is then adjusted by checking the consistency between the chosen strategy options. The consistency with the project execution options should be validated as well.

Generally, a high degree of formality in quality control is always preferable, but the procedures that are applied can be more or less complex dependent on the size of the project. More heuristics, based on the situational factors, can be found in table 28.

For a migration project, the following defaults apply:

- Formal quality control.

  Possibly by using (external!) audits or inspections.

- Frequent migration control.

  Most migration projects are critical enough to require a close monitoring of the migration. In addition, frequent control allows timely adjustments to be made. For example, a regular re-assessment of the situational factors and risks may be necessary.

- Formal configuration control.

  Due to the complexity of most migrations, and dependencies between the different items to migrate, formal configuration control should be seen as the default.

- Customers' responsibilities.

  By default, these may include:

  - timely delivery (and configuration control) of the right operational and descriptive items corresponding to the initial state,
  - configuration control of requirements,
  - defining adequate test plans/cases that cover critical situations from the business process perspective,
  - inter-project co-ordination,
  - quality control of descriptions with respect to requirements and business needs.

To check whether the chosen combination of strategy options are feasible, the heuristics in table 26 may be applied. Based on the heuristics listed in this table, the choices made may have to be revised.

6.4 Analyse the impact of the chosen strategy

After the selection of the actions and strategy options, it should be checked that all critical risks have been addressed. It is recommended that a matrix relating the identified critical risks and the selected options and actions is produced - see an outline in table 29. The strategy options chosen may increase some risks. These risks should be analysed (probability and impact) and included in the matrix, if they are critical. Tabel 30 contains examples of risks that may be increased by the choice of strategy options. The techniques in chapter 5 can be used to analyse the risks.

	Frequent migration control	Frequent quality control	Frequent configuration control	Formal migration control	Formal quality control	Formal configuration control	Customer responsibilities	
Complexity factors related to the target domain								
Heterogeneity of business actors is high								Handling of conflicts and organisational changes
Complexity of business actors is high		x						
Size of distribution of business actors is high								Control of changes of requirements
Uncertainty factors related to the target domain								
Ability of business actors is low					x			
Attitude of business actors is negative					x			Involving the appropriate business actors
Availability, clarity and stability of requirements is high			x		x	x		Description of requirements
Changes triggered by the project are important	x	x			x			Handling of conflicts and organisational changes
Formality of business information is low					x			Provision of knowledge and decision making
Formality of business processes is low					x			Provision of knowledge and decision making
Novelty of business technology is high					x			
Quality of existing specifications is low	x				x			
Specificity of business processes is high					x			Provision of knowledge and decision making
Stability of business system is low			x		x	x		Control of changes of requirements
Stability of environment is low			x		x	x		Provision of knowledge and decision making
Understanding of existing business system is low					x			Provision of knowledge and decision making
Complexity factors related to the project domain								
Complexity of project actors is high	x	x	x	x	x	x		
Complexity of project technology is high		x			x			
Uncertainty factors related to the service domain								
Ability of service actors is low					x			
Availability of appropriate service technology is low		x			x			
Budget is tight	x				x			
Dependency of other projects is high		x	x		x			Co-ordination of projects
Dependency of sub-contractors or suppliers is high	x	x		x	x			
Formal customer-supplier context is low					x			
Novelty of project is high	x				x			
Novelty of project technology is high		x			x			Provision of knowledge and decision making
Schedules are tight	x				x			
Overall complexity and uncertainty								
Overall complexity is high				x	x	x		
Overall uncertainty is high				x	x			

Table 28 Heuristics on the suitability of project control options. (x: This factor is addressed by the option)

	Analyse initial state	Analyse final state	Design the migration	Migration	Installation (system coverage)	Installation (geographic coverage)	Migration control	Quality control	Configuration control	Customer responsibilities	Actions
Critical risks											
Risk 1	-		-	-	+		-	-			
Risk 2		-	-	+	-	-					
Risk 3	+										
Risk 4	-	+		+	-						
...											
Justification:											

Table 29 Outline of a matrix relating selected options to critical risks. This matrix summaries the project strategy. (-: The option will mitigate the risk; +: The option will increase the risk)

	Analytical analysis	Experimental analysis	Expert-driven analysis	Participatory analysis	One shot installation	Incremental installation – Frozen design	Incremental installation – Evolving design	Total installation	Local installation	Frequent project control	Formal project control	Customer does analysis	Customer does migration	Customer does installation
Risks														
Delays in deliveries		+		+	+			+		+	+	+	+	
Delays in system delivery		+		+	+			+		+	+	+		
Demotivation of service actors														
Increased costs of the service		+		+		+	+		+	+	+	+	+	+
Lack of business actor participation	+		+		+	+		+						
Loss of control of service		+		+			+		+			+	+	+
Non-attainment of business stakes					+									
Poor quality of deliverables					+	+		+						
Poor quality of service/system	+		+		+	+		+				+	+	
Service/system not accepted by business actors	+		+		+	+		+						
Shortfalls in sub-contracted tasks												+	+	+
Uncertain interfaces within target domain	+				+									
Unclear service/systems requirements	+													
Unpredictable costs for the business				+			+		+					
Unstable, or conflicting, systems requirements		+		+			+					+		

Table 30 Risks that may be increased by strategy options. (+: The strategy option will increase the risk)

7 Plan Decision Points and Define Deliveries

A decision point is a milestone where the customer, possibly together with the supplier, make decisions concerning the execution of the migration project. It is characterised by the decisions that are made, the roles involved, and the deliverables that are exchanged. The sequence and contents of decision points should reflect the project delivery strategy used. The deliverables serve as pre-conditions or as a basis for the decisions to be made.

Most important input to decision point planning, as shown in Figure 27, is the design of the project delivery strategy. The results of decision point planning are:

- sequence of decision points, see outline in table 31,
- decision point descriptions, see structure in table 32.

This chapter is concerned with the processes of planning these decision points and specifying the deliverables that serve as input to these decisions.

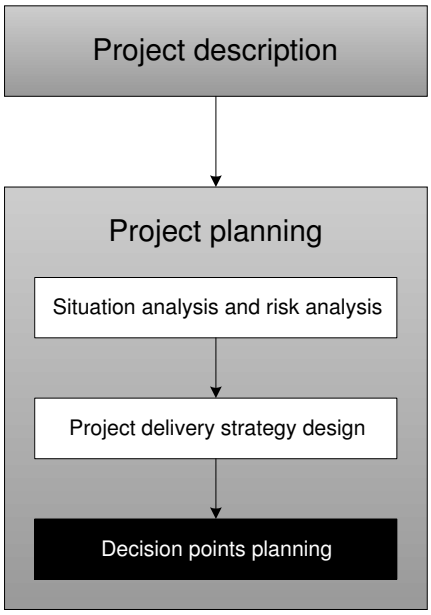

Figure 27 Project description and planning

7.1 Decision point planning

The purpose of the techniques in this section is to define the appropriate decision points at the contract management level within a project. Once a project delivery strategy and the initial & final states have

Decision point	Month from start of the project																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<Decision point 1>		x																
<Decision point 2>				x														
etc.																		

Table 31 Outline of a sequence of decision points

1. Purpose or goal.
   1.1. Target domain purpose.
   1.2. Project domain purpose.
   1.3. Contract domain purpose.
2. Roles involved.
3. Deliverables.
   3.1. Pre-conditions: target domain deliverables and project domain deliverables.
   3.2. Basis for decision: decision point proposal, contract status report, etc.
4. Organisation and time schedules.
5. Cost.

Annex: Profiles of the required deliverables.

Table 32 Structure of a decision point description

been defined, it is possible to define a sequence of decision points that is tailored to the situation at hand, reflecting the selected project delivery strategy. This chapter provides techniques to define such a tailor made sequence of decision points. The techniques should be used in the following sequence:

1. Derive basic sequence of decision points.

   This can be based on strategy options, see chapter 6, or strategy options from the specific methods used in the project.

2. Adapt basic sequence to accommodate actions.

   Examples of actions are provided in section 6.1.

3. Describe decision points.

   In a decision point description, all deliverables that should be delivered in the period since the previous decision point, should be outlined. Two types of deliverables are distinguished. Deliverables that serve as a:

   Basis for decisions. This refers to deliverables that serve as the basis for the decisions at the contractual level.

   Pre-conditions. These are all other deliverables that should be delivered.

Afterwards, the detailed description of the deliverables should be added using the techniques presented in section 7.2. The decision points plan may evolve during the acquisition process, i.e. the level of detail will vary and be most detailed for short term activities and deliveries. In addition, earlier decisions made may lead to refinements in ensuing decisions. For instance, due to reduced uncertainty concerning the initial state, some parts of the plan may have to be revised to reflect the newly uncovered findings.

In a decision point, several decisions of different types may have to be taken. The three major decision types are:

1. Decisions on issues in the target domain, i.e. on the operation/descriptive items that are to be migrated. For these decisions, three sub-types can be identified:

(a) Investment decisions, i.e. whether to invest or not, based on an assessment of costs, benefits and risks.

(b) Design decisions, i.e. whether the design for the migration is acceptable as it is described.

(c) Acceptance decisions, i.e. determine if the migrated items are accepted or not. It is usually performed by checking the deliverables against the goal, the final state and deliveries definition.

Acceptance decisions are not exclusively related to migrated operational items, but can be concerned with newly created or modified descriptive items as well. For example, in the case of a *design recovery*.

2. Decisions on issues in the project domain, i.e. on the organisation and the plans to perform the work.

3. Decisions on issues in the contract domain, i.e. on the contractual issues.

The purpose of a decision point should be related to those three types of decisions, see the structure in table 32. The contents of deliverables which are used in making a decision depend on the decision type. Therefore, it is useful to characterise a decision purpose in terms of its type because it gives some guidance on which deliverables are necessary to make the decision, see the general heuristics in table 33.

Decision type	Purpose	Deliverables
Investment decision	Decide whether or not to invest in migrated (or new) operational/descriptive items. The initial investment decision is reviewed or refined on the basis of the additional information gained during the project execution.	Descriptive items which support the assessment of: benefits, costs and risks. Besides those investment properties, the descriptions should cover the functional and quality properties that have an influence on these elements.
Design decision	Decide whether migrated (or new) operational/descriptive items are acceptable as it is described.	Descriptive items whose characteristics depend on the project execution approach. Potentially, all functional and quality properties may be required. It depends on the area of concern. Quality assurance reports showing the results of the quality control applied to the descriptive items.
Acceptance decisions	There are two types of acceptance decisions: • Decision to accept modified (or new) descriptive/operational items. • Decision to accept installed operational items.	Operational items that are either tested or installed. Descriptive items if they have not yet been produced and checked earlier. Quality assurance reports showing the results of the tests of the operational items migrated/constructed, or validations of installed operational items. Configuration management reports.

Table 33 General heuristics regarding target domain decisions

7.1.1 Derive basic sequence

The sequence of decision points should reflect the project execution and control approaches as part of the project delivery strategy. The technique presented in this section provides heuristics of how to define decision points depending on the chosen strategy options. For decision point planning, the following procedure can be used:

1. Derive a basic sequence based on strategy options.

   The decision points are defined using the strategy options for project execution and control.

2. Take the actions defined in the project delivery strategy into account.

The heuristics related to description approaches are presented in table 34. These heuristics refer to the functional properties and the level of detail of a descriptive item. Refer to the ISPL book on Specifying Deliverables [FV99d] for an explanation of these concepts.

Note that according to the heuristics given in table 34, decision points may require information from the computerised system as well as the information system views. Even though chapter 2 has limited the scope of migrations to computerised systems, decision points will have to look beyond the computerised system scope. The migrations as considered in this plug-in do not aim to change the business setting of a computerised system. However, aspects from the business setting are quite likely to govern the actual migration.

Consider, for instance, an organisation which wishes to migrate their computerised systems to a new architecture (i.e. making profound changes in the architecture view of a computerised system) with the aim of improving the flexibility of the computerised system with respect to expected *future* business developments. During this migration the business setting will serve as an important input to determine the best target architecture for the computerised system.

Another reason for taking the business setting into consideration is to determine the potential impact of the migration on the business. Even though a migration does not aim to provide new business functionality, it is likely to have some form of impact on the functionality provided. For instance in terms of quality of service during, and after, the migration.

	Heuristics regarding decision points	
Cognitive approach	Business setting vs. technical system	Abstract level vs. concrete level
Analytical	From business setting to technical system	From abstract to concrete
Experimental	Business setting and technical system in parallel	From concrete to abstract

General heuristics regarding the deliverables that support the decisions:

- Decisions on the business setting are supported by the information system views.
- Decisions on the technical system are supported by the computerised system views.
- Decisions on an abstract level are supported by the actor independent information system views (business information and business process views) and the processing unit independent computer system views (computerised system data and computerised system function views).
- Decisions on a concrete level are supported by the work practice and the computerised system architecture views.

Table 34 Heuristics on how to define decision points depending on the analysis approach

For each of the two main cognitive approaches (analytical and experimental), examples of possible sequences of decision points are provided in table 35. The sequences are split over the three sub-phases involved in the analysis phase. Note that for each of the sub-phases, a choice between an analytical and an experimental approach can be made. In the table, the decision points have been characterised by a (sequence) number and the main subject of the decision that needs to be made. The term *sampling* is used in this table as a generic term for *probing*, *simulation*, and *prototyping*. Depending on the specific situation and tasks at hand, a suitable form of *sampling* the initial or final state may be selected. The term *context* is used to refer to the actors, business processes, systems, etc., that are in the context of the items to be migrated, and which are somehow dependent on these latter items. For example, when doing a GUI-fication, this will have a direct influence on the way the business actors will interact with the system to be migrated. These actors would therefore be a part of the relevant context.

The decision concerning the *detailed initial state description* is a very important one in the customer-supplier relationship. The underlying deliverables are one of the key starting points of the design of the actual migration. The (hidden) overall aim of describing the initial state will always be the reduction of uncertainty concerning this initial state. The level of uncertainty concerning the initial state has, as discussed in chapter 6, a significant influence on the migration strategy.

In the context of large-scale migrations, the distinction between the two social approaches (participatory and expert-driven) is not expected to lead to dramatic differences concerning decision points. One may expect that a participatory approach would involve more decision points concerning the simulations and

Analytical	Experimental
Initial state	
1. Overall business setting and abstract description of initial state. 2. Detailed business setting and concrete description of initial state.	1. Overall sampling of business setting and concrete initial state. 2. Overall business setting and concrete description of initial state. 3. Detailed sampling of business setting and concrete initial state. 4. Detailed concrete description of initial state. 5. Detailed abstract description of initial state.
Final state	
1. Overall business setting and abstract description of final state. 2. Overall design for concrete final state. 3. Detailed design for concrete final state.	1. Overall sampling of business setting and concrete design of final state. 2. Overall business setting and concrete design of final state. 3. Detailed sampling of concrete final state. 4. Detailed concrete design of final state. 5. Detailed abstract design of final state.
Design migration	
1. Overall migration design. 2. Detailed migration design.	1. Overall sampling of migration. 2. Overall design of migration. 3. Detailed sampling of migration. 4. Detailed design of migration.

Table 35 Examples of sequences of decision points, for each of the two main cognitive approaches.

designs, as it may be more difficult to get consensus regarding the contents of the descriptive items. These decision points might be separated out for different aspects and views of the final state. For example: architecture view, function view, and data view.

For the three options (one-shot, frozen migration design, evolving migration design) that apply to the migration and installation approaches, examples of possible sequences of decision points are provided in table 36.

One-shot	Frozen migration design	Evolving migration design
Migration		
As a pre-condition to these decision points, all decision points concerning the analysis phase should be passed first. 1. Acceptance of migrated and tested items.	As a pre-condition to these decision points, all decision points concerning the analysis phase should be passed first. 1. Acceptance of migrated and tested increments. This step should be iterated for all identified increments. 2. Acceptance of complete set of migrated and tested items.	1. Acceptance of migrated and tested increment. This step should be iterated for all identified increments. When using an evolving migration design, the results of the execution of consecutive migration steps may be changed based on the experiences with earlier migration steps. Therefore, before considering this decision point, only those decision points of the analysis phase need to be passed that are concerned with the increment that is involved in the current iteration. 2. Acceptance of complete set of migrated and tested items.
Installation		
As a pre-condition to these decision points, all decision points concerning the migration phase should be passed first. 1. Acceptance of installed items.	As a pre-condition to these decision points, all decision points concerning the migration phase should be passed first. 1. Acceptance of installed increments. This step should be iterated for all identified increments. 2. Acceptance of complete set of installed items.	1. Acceptance of installed increment. This step should be iterated for all identified increments. When using an evolving migration design, the results of the execution of consecutive migration steps may be changed based on the experiences with installation of earlier migration steps. Therefore, before considering this decision point, only those decision points of the migration phase need to be passed that are concerned with the part that is involved in the current iteration. 2. Acceptance of complete set of installed items.

Table 36 Examples of sequences of decision points, for migration and installation approaches.

To compile a complete basic sequence of decision points based on the input so-far, the following procedure can be used. The procedure assumes that the set of items to be migrated is divided into increments, and that there may be different strategy options related to the different increments. In case there is no decomposition into increments, step one is performed only once.

1. For each increment with a different strategy, do the following:
   (a) Combine the examples of sequences related to the development approaches into one sequence.
   (b) Enhance the decision points with project domain purposes according to the chosen project control approach.
   Add more decision points if needed.
   Table 37 provides heuristics for the project control approaches' influence on decision points planning.

2. Combine the sequences for the increments into one sequence for the whole project.

Project control approach	Influence on decision points planning
Frequent project control	• Project control at each decision point: define purpose, roles and deliverables. • Perhaps add decision points with project control purposes only: deliverables depends on the frequency of topics of interests, e.g. costs, plans, quality assurance and configuration management.
Formal project control	• Include project control at periodical decision points with well-defined requirements to plans and reports. • Define metrics for project progress and quality, and require metrics within plans and reports at decision points. • Define formal quality control procedures, e.g. specific inspection techniques, and require quality states of descriptive items according to these procedures. • Define formal configuration control procedures, and require configuration plans and reports at certain decision points.
Customer responsibility	• Description of requirements: Plan decisions on requirements as early as possible with deliverables from the customer to the supplier. • Timely delivery of the right operational and descriptive items corresponding to the initial state: Plan (timely) decisions on the availability, completeness and correctness of operational and descriptive items concerning the initial state. • Configuration control of requirements, operational items, and descriptive items. Plan configuration control plans and reports from the customer at certain decision points. • Definition of adequate test plans/cases that cover critical situations from the business process perspective: Plan decisions that verify the availability and adequateness of test plans/cases. • Handling conflicts within the target domain: Plan decisions on requirements related to conflicts. • Inter-project co-ordination: Plan decisions on the co-ordination of interfaces to other services with plans and reports from the customer. • Provision of knowledge and decision making: Plan with the necessary investment and design decisions.

Table 37 Examples of the influence of project control approaches on decision point planning

7.1.2 Adapt to actions

This technique provides heuristics and procedures on how to adapt a basic sequence of decision points to take the actions into account. The actions have been selected by using the technique in section 6.1. The following procedure can be used:

> Go through the actions proposed in the project delivery strategy. For each action, the basic sequence of decision points should be adjusted accordingly:
>
> 1. Define and add new decision points.
> 2. Group the decision points, e.g. for scheduling reasons.
> 3. Change the sequence of decision points.
> 4. Change the contents of decision points, i.e. the decision purpose, the roles involved, the deliverables to be exchanged or the organisation and schedules.

Table 38 provides examples of the actions' influence on decision points planning.

Action	Influence on decision points planning
Involve the business actors	• A plan for business actor involvement should be decided early in the project. • Informing the business actors is a pre-condition for some decision points.
Plan workarounds	• Add decision points concerned with the planning of workarounds. Are they needed? When should the workarounds be designed?
Use reverse engineering	• Add decision points associated with raising the understanding of the items related to the existing information system by descriptions of the existing system.
Perform a stringent requirements analysis	• Add decision points regarding requirements to the migrated items, and plan with configuration control of requirements.
Redo specifications	• Add decision points regarding the approval of specifications
Use project team training	• A plan for a training programme for the project team should be decided early in the project. • Reports on the project team training should be planned as pre-conditions of some decision points.
Split the project	• Plan early investment or design decisions on the definition of a sequence of projects.
Use IS experts with high level of skills	• Plan project domain decisions on the allocation of project actors. A project plan with profiles of the project actors is required.
Clarify external interfaces to other systems	• Plan design decisions regarding external interfaces. Descriptive items covering the appropriate properties, and plans for construction, test and installation of the interfaces are required.
Handle complexity of quality properties	• Plan early design decisions on the trade-off between functional and quality properties. Approve the required descriptions of quality properties and functional properties to support those decisions.
Use standards	• Plan with early design decisions on the use of standards, e.g. the standards for open computer systems. Descriptive items covering the computerised system architecture view with a focus on use of standards are required.

Table 38 Examples of actions' influence on decision points, in the context of a project.

7.1.3 Describe decision points

The elements of a decision point description within a delivery plan is prescribed in table 39. For each decision point this structure should be used. Table 39 provides guidance on each of the description elements. In addition, it is recommended that:

- The sequence and schedules of the decision points should be documented in one place in the delivery plan to ease the maintenance, e.g. in the form of tables or diagrams. That is, there should be no absolute schedules in the decision point descriptions.
- In the early versions of a delivery plan, the schedules can be stated relative to the start of the project.

Description element	Guidance on decision point description
1. Purpose	Describe the overall purpose of the decision point.
Target domain purpose	Describe the purpose of the decisions related to the target domain, e.g. choice of solutions and approval of descriptions of existing or migrated items.
Project domain purpose	Describe the purpose of the decisions related to the project domain, e.g. decisions regarding deliverables, schedules, budget and allocation of resources.
Contract domain purpose	Describe the purpose of the decisions related to the contract domain, e.g. decisions regarding the delivery plan and other contractual issues.
2. Roles involved	Describe the roles involved in the decision making process. Identify the actors allocated to the roles, for each organisation (customer and supplier) and for each role.
3. Deliverables	Provide an overall description of the deliverables and how they can support the decision making.
Pre-conditions	Describe the deliverables that are to be delivered in the period between the previous decision point and the envisaged decision point, except the basis for decisions - see element 3.2. The deliverables can be: target domain deliverables (descriptive items, operational items) and management deliverables (plans and reports). They make up a milestone of deliverables to be validated within decision point execution. Both deliverables from the supplier to the customer and deliverables from the customer to the supplier should be described with references to the deliverable profiles in the ISPL book on Specifying Deliverables [FV99d].
Basis for decisions	Describe the deliverables that are planned to be delivered as the basis for decisions. The deliverables can be: decision point proposal, descriptive items, plans, reports, delivery plan. Plans and reports should cover properties regarding resources and budget related to the completion information. Both deliverables from the supplier to the customer and deliverables from the customer to the supplier should be described with references to the deliverable profiles in the ISPL book on Specifying Deliverables [FV99d]. The decision point proposal is mandatory and it should describe alternative outcomes of the decisions, e.g. deliverables are fully accepted, conditionally accepted or rejected; and the alternative actions related to those actions, e.g. perform required rework and re-submit the deliverable. If appropriate, the alternative outcomes and actions may be outlined in the purposes of the decision point description, see element 1.
4. Organisation and time schedules	Describe the organisation of the decision making process and the time schedules for the deliverables. This includes the responsibilities for making a decision point proposal and a decision point report. Normally, the decision making process contains deliverable validations, preparation of the decisions, and one or several decision point meetings. The organisation and schedules should take the availability of the involved persons into account; and allow enough time for the preparation of decision point meetings.
5. Cost	Estimate the project cost at the decision point, i.e. the cost incurred by the project from the previous decision point (or start of the project) to the current one plus the cost of the decision making process itself.
Annex	Provide profiles of some required deliverables: descriptive items, plans and reports, see guidance in chapter 5. Provide references to the descriptive items that will describe the required operational items.

Table 39 Guidance on description of decision points.

7.2 Describe deliverables

The basic rule to determine which deliverables are required for a decision is that the deliverables must contain the right information to make the decision but no more than that; too much information is costly in its production and obscures the picture, thus hampering the decision makers.

The required deliverables should be described by use of the method independent concepts as defined in the ISPL book on Specifying Deliverables [FV99d]. This section provides guidance on describing profiles of descriptive items (as part of a decision point). Table 40 contains guidance on making a descriptive items profile. Tables 41, 42 and 43 contain general heuristics on the planning of the three target domain decision types: investment, design and acceptance of migrated items, including guidance on the requirements to descriptive items.

Description element	Guidance on making a descriptive item profile
Views and functional properties	Describe the views and functional properties that are necessary to support the decisions, see examples in tables 41, 42 and 43 regarding investment, design and acceptance decisions.
Quality properties	Describe the quality properties that are necessary to support the decisions, see examples in tables 41, 42 and 43 regarding investment, design and acceptance decisions.
Investment properties	Describe the investment properties that are necessary to support the decisions, see examples in table 41 regarding investment decisions.
Scope	Define the different types of scoping that will be used in the project, e.g. in terms of business area, organisational unit, a set of processes, or sub-systems in the target domain. Allocate the appropriate type of scope to this descriptive item deliverable.
Alternative solutions	Indicate to which degree this descriptive item contains descriptions of alternative solutions.
Level of agreement	Describe the different types of agreement levels that will be used in the project by indication of: • Which target domain actors are involved in the agreement on the descriptive item • Which agreement management procedures are used. Allocate the appropriate type of agreement level to this deliverable.
Degree of formality	Define the different types of formality that will be used in the project, e.g. in terms of modelling techniques. Allocate the appropriate type of formality to this deliverable.
Quantification	Indicate whether or not the properties should be quantified.
Simulation	Indicate whether or not this descriptive item is a prototype.
Version identification	Indicate which version of the descriptive/operational items this deliverable should describe, e.g. the current situation or a future situation.
Level of detail	Define the different types of levels of detail that will be used in the project, e.g. in terms of level of decomposition and specialisation used in the modelling techniques. Allocate the appropriate type of level of detail to this deliverable.
Quality state	Define the different types of quality states that will be used in the project, e.g. in terms of the types of quality procedures in the quality assurance system, e.g. inspection, peer review and critical readings. Allocate the appropriate type of quality state to this deliverable.

Table 40 Guidance on making a descriptive item profile.

Description element	General heuristics regarding decisions
1. Purpose	Decide whether or not to invest in new (or modified) descriptive/operational items.
2. Roles involved	Includes the senior management roles.
3. Deliverables	
3.1. Operational items	
3.2. Descriptive items	
3.3. Views and functional properties	The functional properties, which support the assessment of benefits, costs, risks and plans. These functional properties must address all the views that have an influence on these elements, namely the views that will show a change between the current and the future items. For example, if the computerised system architecture is going to change, then the computerised system architecture will likely impact on the benefits, costs, etc. and the computerised system architecture view must be addressed.
3.4. Quality properties	Requirements to efficiency, security, maintainability, etc.
3.5. Investment properties	**The benefits.** What is the benefit brought by the migrated (or new) items? This may be assessed in terms of new market opportunities, competitive advantage, improved quality of a service or product, better management, more efficient operation, reduced organisational costs, improved working conditions for the business actors, etc. **The costs.** What are the costs of the project, e.g. costs of the hardware and software, construction costs, installation costs, etc.? What are, for example, the operational costs of a migrated system as opposed to the costs of the current system? **The risk.** What are the risks involved in the project? For example, migrating the current systems onto a new hardware platform that is soon to become obsoleted as well.
3.6. Scope	Full scope, unless a representative set of items can be used to assess the benefits, costs, risks, etc.
3.7. Alternative solutions	Alternatives should be presented.
3.8. Level of agreement	The decision point report should have legal implications.
3.9. Degree of formality	Informal, in overviews, tables and maybe diagrams for specific views.
3.10. Quantification	Estimations of volumes, capacity, etc. which are necessary for the assessment of costs, benefits and risks.
3.11. Simulation	Consider demonstrating critical or uncertain parts of the items to be migrated by means of prototypes, e.g. mock-ups.
3.12. Version	A set of migrated items. However, sometimes deliverables addressing the current operational/descriptive items may be introduced. These deliverables may be used for the following purpose: • Assessing whether the understanding of the current items is correct. • Serving as a baseline to express the planned changes to pre-existing items. • Justifying proposals for changes by a diagnosis of the current items. • Comparing the migrated items to the current ones and ensuring that there is an improvement. Besides these purposes, there is no justification for introducing a deliverable concerning the current items as input to an investment decision, even if its production is planned by a development method.
3.13. Level of detail	A global view (low degree of decomposition, low degree of specialisation) is sufficient to assess the benefits, costs, risks, etc. However, in some cases it is needed to have a deeper insight into those items which are considered critical, complex or uncertain. For those parts, more detail is needed in the descriptions; the right level of detail is the one which makes it possible to make the investment decision.
3.14. Quality state	Must be tailored to the decision to be made: the ultimate consistency, accuracy or completeness is usually not required for investment decisions.
3.15. Plans and reports	
3.16. Delivery plan	The complete delivery plan is not necessarily required, but some key dates must be known such as the date when the major migrated items become available.
4. Organisation and time schedules	Some time between the delivery and the decision point meeting, is needed.

Table 41 Heuristics on the definition of investment decisions

Description element	General heuristics regarding decisions
1. Purpose	Decide whether a the migrated items are acceptable as it is described.
2. Roles involved	
3. Deliverables	
3.1. Operational items	Some items may be used to illustrate migration design decisions. For instance, concerning uncertainties or technical issues. The items involved could be original as well as migrated items.
3.2. Descriptive items	The characteristics depend on the design approach used.
3.3. Views and functional properties	Potentially all properties. It depends on the purpose.
3.4. Quality properties	Potentially all quality properties.
3.5. Investment properties	
3.6. Scope	Depend on the nature of the decision and its position in the sequence.
3.7. Alternative solutions	
3.8. Level of agreement	
3.9. Degree of formality	
3.10. Quantification	
3.11. Simulation	
3.12. Version	The migrated items as well as the original items.
3.13. Level of detail	Depend on the nature of the decision and its position in the sequence.
3.14. Quality state	The quality procedures to be applied are usually more elaborated than for investment decisions. Quality control procedures may control the correctness, accuracy, completeness, consistency, tractability to requirements, etc. according to the plans.
3.15 Plans and reports	Quality assurance reports showing the results of the quality control applied to the descriptive items.
3.16 Delivery plan	
4. Organisation and time schedules	Some time between the delivery and the decision point meeting, is needed.

Table 42 Heuristics on the definition of design decisions.

Description element	General heuristics regarding decisions
1. Purpose	There are two types of acceptance decisions: • Decision to accept a migrated and tested set of items. • Decision to accept an installed and operational set of items.
2. Roles involved	
3. Deliverables	
3.1. Operational items	Operational items that are either tested or installed.
3.2. Descriptive items	An up-to-date definitive description of the migrated items, if it has not been produced and checked earlier.
3.3. Views and functional properties	
3.4. Quality properties	
3.5. Investment properties	
3.6. Scope	
3.7. Alternative solutions	No alternatives
3.8. Level of agreement	
3.9. Degree of formality	
3.10. Quantification	
3.11. Simulation	
3.12. Version	Migrated set of items
3.13. Level of detail	Detailed (high degrees of decomposition and specialisation).
3.14. Quality state	Up-to-date and reviewed according to the quality procedures.
3.15. Plans and reports	• Quality assurance reports showing the results of the tests of the migrated items or validations of the installed items. • Configuration management reports (may be).
3.16. Delivery plan	
4. Organisation and time schedules	Some time between the delivery and the decision point meeting, is needed.

Table 43 Heuristics on the definition of acceptance decisions.

A Situational Factors

Ability of business actors
Explanation: Skills, experience, knowledge, and capacity of the human actors. Most migrations will need the participation of the business actors for some part of the process, if only to provide input for testing the migrated items.
Domain: Target, actors
Characterises: Uncertainty
Values: [high, medium, low]
Sub-factors: ⇒ Ability to specify migration requirements. ⇒ Actors are able to provide appropriate input for test plans. ⇒ Capacity for abstraction. ⇒ Experience with computerised system. ⇒ Experience with past information system adaptations and migrations.

Ability of project actors
Explanation: Skills, experience, knowledge, and capacity of the project actors. Note that this may include some of the ongoing-service actors as they may be involved for the installation of migrated items.
Domain: Project, actors
Characterises: Uncertainty
Values: [high, medium, low]
Sub-factors: ⇒ Experience of actor with migration projects in the past. ⇒ Actor's level of skills & knowledge (target & source platform).. In particular skills & knowledge concerning the target & source platforms and the way their underlying concepts can be related to each other. ⇒ Actor's ability to deal with advanced configuration and change management procedures. ⇒ Actor's knowledge about the pre-existing information system and relevant business domain. Availability of original developers of the system. ⇒ Ability of actors to elicit and evaluate requirements. ⇒ Communication skills of actors. ⇒ Commitment of actors.

Adequacy of budget
Explanation: A measure of how tight the budget is due to bad estimates or constraints.
Domain: Project, process
Characterises: Uncertainty
Values: [–, normal, tight]

Adequacy of business processes
Explanation: A measure of the adequacy of the business processes, approaches, strategies, culture, and maturity for the implementation of the project.
Domain: Target, process
Characterises: Uncertainty
Values: [high, medium, low]

Adequacy of project processes
Explanation: A measure of the adequacy of the processes, approaches, strategies, culture, maturity of the service organisation for the attainment of the goal of the project.
Domain: Project, process
Characterises: Uncertainty
Values: [high, medium, low]
Sub-factors: ⇒ Adequate quality assurance procedures. ⇒ Adequate testing facilities. ⇒ Reversibility of changes made during a migration project.

Adequacy of schedules
Explanation: A measure of how tight the schedules are due to bad estimates or urgency of the project.
Domain: Project, process
Characterises: Uncertainty
Values: [–, normal, tight]

Attitude of business actors
Explanation: The attitude of the human actors regarding the migration project.
Domain: Target, actors
Characterises: Uncertainty
Values: [positive, neutral, negative]
Sub-factors: ⇒ Clarity of business actors involvement. What is expected of them? ⇒ Perception of need for the migration. For migration projects it is important to identify if the migration is considered to be due to a business issue or a technology issue. For example, in the case of the introduction of the Euro. Do all business actors involved realise the implications which the introduction of the Euro will have on their day to day work activities? ⇒ Commitment and involvement from actors. ⇒ Willingness to accept the changes brought about by the migration.

Attitude of business management
Explanation: The attitude of the management may be negative for lack of awareness, organisational reasons, political reasons or individual reasons.
Domain: Target, actors
Characterises: Uncertainty
Values: [positive, neutral, negative]
Sub-factors: ⇒ Willingness to accept the changes brought about by the migration. Some of the managers may actually have 'emotional ties' to the pre-existing computerised system as they may have been closely involved in its creation in the past. These ties may lead to a resistance to radical changes to the system. ⇒ Alignment of migration with overall business & IT strategy. ⇒ Management awareness of the business value and business criticality of the system. ⇒ Priority assigned to the migration project by management. ⇒ Willingness of management to commit themselves to the entire project. In the case of migration projects, this could run up to 1 to 4 years. ⇒ Perception of need for the migration. For migration projects it is important to identify if the migration is considered to be due to a business issue or a technology issue. For example, in the case of the introduction of the Euro. Do all business actors involved realise the implications which the introduction of the Euro will have on their day to day work activities? ⇒ Expectations of management with regards to the migration project. For example, when using a factory-based approach to a migration, management may have the perception that everything will go 'automatically'. ⇒ Clarity of business actors involvement. What is expected of them?

Attitude of project actors
Explanation: The attitude of the project actors themselves regarding the project. Note that this may include some of the ongoing-service actors as they may be involved for the installation of migrated items.
Domain: Project, actors
Characterises: Uncertainty
Values: [positive, neutral, negative]
Sub-factors: ⇒ Perception of need for the migration. ⇒ Commitment and involvement from actors. ⇒ Willingness to accept the changes brought about by the migration. Some of the project actors may actually have 'emotional ties' to the pre-existing computerised system as they may have been closely involved in its creation in the past. These ties may lead to a resistance to radical changes to the system. Please note that the group of project actors may not only consist of actors from the supplier's side, but also actors from the customer's side. In particular the actors from the customer's side may have strong opinions about changes to the current system.

Availability, clarity and stability of requirements
Explanation: Requirements are the essential conditions that the migrated items system resulting from a project have to satisfy. Requirements include business goals and stakes (and their stakeholders) to which the items must contribute.
Domain: Target, computerised system
Characterises: Uncertainty
Values: [high, medium, low]

Availability of appropriate business technology (computerised system)
Explanation: A measure of the availability of the technology needed for the computerised system to be migrated.
Domain: Target, technology
Characterises: Uncertainty
Values: [high, medium, low]
Sub-factors: ⇒ Delivery of technology. Does the new hardware/software platform, as provided by an external supplier, perform as required? ⇒ Support for the technology. ⇒ Accessibility of the technology. For example, does the project have permission to copy functionality offered from a proprietary library on the pre-existing platform to the new target platform?

Availability of appropriate business technology (human system)
Explanation: A measure of the availability of the methods, tools (including computerised tools), and techniques needed by the human actors. Some migrations, for example GUI-fication, or 7x24 hours on-line, will lead to changes in the need for (human) business technology as well.
Domain: Target, technology
Characterises: Uncertainty
Values: [high, medium, low]

Availability of appropriate project technology
Explanation: A measure of the availability of the methods, tools (including computerised tools), and techniques needed by the project actors for the execution of the project.
Domain: Project, technology
Characterises: Uncertainty
Values: [high, medium, low]
Sub-factors: ⇒ Correspondence between deliverables (both operational & descriptive) and the available tools. ⇒ Availability of appropriate test tools. ⇒ Sufficiency of hard-/software infrastructure. ⇒ Accessibility of needed technology. ⇒ Support provided for technology (to be) used.

Complexity of business actors (computerised system)
Explanation: The complexity of the computerised actors in the business system, relative to the migration.
Domain: Target, actors, computerised system
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Complexity & number of operational items to migrate. ⇒ Complexity of the source code. Is the code filled with local specificity? Have coding guidelines been used? For example, common functionality in subroutines, system and i/o interfacing in specific subroutines, naming conventions, standards for use of dates, etc. ⇒ Number of components (e.g. number of copies of a component). ⇒ Number of relationships between the operational items. ⇒ Number of component types. ⇒ Complexity of the components (e.g. variety of roles and capabilities).

Complexity of business actors (human system)
Explanation: The complexity of the human actors in the business.
Domain: Target, actors, human system
Characterises: Complexity
Values: [high, medium, low]
Sub-factors: ⇒ Number of actor types. ⇒ Number of actors. ⇒ Number of relationships between actors (organisational structure). ⇒ Complexity of the actors (e.g. variety of roles and capabilities).

Complexity of business processes (computerised system)
Explanation: The complexity of the processes of the computerised system.
Domain: Target, process
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Number and complexity of user interfaces. ⇒ Number of processes. ⇒ Number and complexity of sub-processes. ⇒ Number of process interfaces (internal within the target domain and external). ⇒ Complexity of business rules and algorithms.

Complexity of business processes (human system)
Explanation: The complexity of the business processes of the business system.
Domain: Target, process
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Number of business processes. ⇒ Number of process interfaces (internal within the target domain and external). ⇒ Complexity of business rules and algorithms.

Complexity of business information
Explanation: Complexity of the information resources of the target domain.
Domain: Target, information
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Number of information resources. ⇒ Number of relationships between information resources. ⇒ Complexity of the information resources (e.g. number of attributes).

Complexity of business technology (computerised system)
Explanation: Complexity of the technology used for the hardware and system software platform of the computerised system.
Domain: Target, technology
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Number of different hard- and software environments involved. ⇒ Number of programming languages used.

Complexity of business technology (human system)
Explanation: Complexity of the methods, tools, techniques used by the human actors for the performance of the business processes.
Domain: Target, technology
Characterises: Complexity
Values: [low, medium, high]

Complexity of project actors
Explanation: The complexity of the actors involved in the project execution.
Domain: Project, actors
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Number of actor types. ⇒ Number of actors. ⇒ Number of relationships between the actors (organisational structure). ⇒ Variety of actor roles and capabilities.

Complexity of project information
Explanation: The complexity of the project information refers to the information used by the project actors for the project execution.
Domain: Project, information
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Number of information resources. ⇒ Number of relationships between information resources. ⇒ Complexity of the information resources (e.g. number of attributes).

Complexity of project processes
Explanation: The complexity of the processes of the migration project.
Domain: Project, process
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Number of project processes. ⇒ Computerised system needs to remain operational during migration. ⇒ Number of process interfaces (internal within the project domain and external to other projects and *ongoing-services*). ⇒ Complexity of rules.

Complexity of project technology
Explanation: Complexity of the methods, tools (including computerised tools), techniques used by the project actors. The complexity should be assessed relative to the expected skills of the project actors.
Domain: Project, technology
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Number of technology suppliers.

Complexity of quality properties of the business processes

Explanation:

Quality properties relate to the quality of the business processes and resourcing constraints. This applies to both the human and computerised systems. For most migration projects only the quality properties of the computerised business processes will be relevant.

Domain: Target, process

Characterises: Complexity

Values: [low, medium, high]

Sub-factors:

The following list of sub-factors is taken from the ISO-9126 standard. More information on these is given in the ISPL book on Specifying Deliverables [FV99d]. It is given as an example and does not pretend to provide a definitive view on quality properties. The estimate of these values for each of the listed sub-factors, depends on the type of system. Therefore, it is recommended to refer to the existing body of knowledge about quality properties for the type of system of interest. Be aware that these quality properties are defined for software only.

⇒ Efficiency:

The relationship between the level of performance of the business system (or a component) and the amount of resources used, under stated conditions. Efficiency may be related to time behaviour (response time, processing time, throughput rates) and to resource behaviour (amount of resources used and duration of such use).

⇒ Security:

Ability of the business system (or a component) to prevent unauthorised access, whether accidental or deliberate, to programs and data.

⇒ Reliability:

The capability of the business system (or a component) to maintain its level of performance under stated conditions for a stated period of time.

⇒ Maintainability:

Maintainability bears on the effort needed to make specified modifications to the system (or a component). Modification may include corrections, improvements or adaptation to changes in environment, and in descriptive items.

⇒ Portability:

The ability of the business system (or one of its components) to be transferred from one environment to another.

⇒ Usability:

Usability bears on the effort needed for the use of the business system (or one of its components) by the business actors.

Complexity of quality properties of business information
Explanation: Quality properties related to the quality of the information resource.
Domain: Target, information
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Consistency: Ability of the business system (or a component) to maintain the consistency of information resources. ⇒ Volatility: The volatility of the information resources handled by the business system. ⇒ Security: Ability of the business system (or a component) to prevent unauthorised access, whether accidental or deliberate, to business information. ⇒ Maintainability: Maintainability bears on the effort needed to make specified modifications to the business system (or a component). Modification may include corrections, improvements or adaptation to changes in the environment, and in descriptive items.

Complexity of quality properties of project information
Explanation: Quality properties relate to the quality of the information used by the project actors for the project execution.
Domain: Project, information
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Consistency: Ability to maintain the consistency of project information. ⇒ Volatility: The volatility of project information. ⇒ Security: Ability to prevent unauthorised access, whether accidental or deliberate, to project information. ⇒ Maintainability: Maintainability bears on the effort needed to make specified modifications to the project information.

Complexity of quality properties of project processes
Explanation: Quality properties relate to the quality of the project processes and resourcing constraints.
Domain: Project, process
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: Some possible sub-factors (specific quality properties) are: ⇒ Efficiency: The relationship between the level of performance of the project organisation and the amount of resources used, under stated conditions. Efficiency may be related to time behaviour (response time, processing time, throughput rates) and to resource behaviour (amount of resources used and duration of such use). ⇒ Security: Ability of the project organisation to prevent unauthorised access, whether accidental or deliberate, to project information. ⇒ Reliability: The capability of the project organisation to maintain its level of performance under stated conditions for a stated period of time.

Complexity of requirements
Explanation: Requirements are the essential conditions which a system resulting from a project has to satisfy. Requirements include business goals and stakes (and their stakeholders) to which the system or service must contribute. The complexity of requirements can be measured by the number of requirements, the number of relationships between them and their scope.
Domain: Target, computerised system
Characterises: Complexity
Values: [low, medium, high]
Sub-factors: ⇒ Number of causes for migration. Combining certain classes of causes may be unwise or may point at an inefficient strategy. For instance, componentisation and a migration to a new programming language might be feasible. Combining a Euro and year 2000 project were not likely to be feasible as simultaneous causes for a single project. ⇒ Computerised system needs to remain operational during migration.

Dependency on other services
Explanation: Dependency on ongoing services or projects that interface to the migration project. For migration projects, it is usually not desirable if during the course of the migration project other projects make changes to the system to be migrated.
Domain: Project, process
Characterises: Uncertainty
Values: [none, low, high]
Sub-factors: ⇒ Number of other (ongoing/planned) projects that interface with the migration project. ⇒ Computerised system is required to remain operational during migration. This constitutes a dependence on the ongoing-service that keeps this system operational. (See also "*Complexity of project processes*".)

Dependency on sub-contractors or suppliers
Explanation: The dependency on other parties than the customer and the main supplier. These other parties may provide products or services to the project.
Domain: Project, actors
Characterises: Uncertainty
Values: [none, low, high]

Formality of business information
Explanation: Formality of business information is their conformity to rules and structure.
Domain: Target, information
Characterises: Uncertainty
Values: [high, medium, low]
Additional guidance: ⇒ High formality refers to well structured information for which the range of values is well defined. ⇒ Medium formality refers to structured information for which the range of values is not well defined. ⇒ Low formality refers to weakly structured information for which the range of values is fuzzy.

Formality of business processes
Explanation: Formality of business processes is their conformity to rules and elaborated procedures.
Domain: Target, process
Characterises: Uncertainty
Values: [high, medium, low]
Additional guidance: ⇒ High formality refers to procedural processes. These processes are often found in administrative, operational and technical information systems. ⇒ Medium formality refers to non procedural processes containing well defined rules. ⇒ Low formality refers to non procedural processes with fuzzy rules. These processes are often found in executive information systems.

Formality of customer-supplier process
Explanation: Conformance of the customer-supplier process to defined rules and procedures.
Domain: Service, process
Characterises: Uncertainty
Values: [high, medium, low]

Formality of project information
Explanation: Formality of project information is their conformity to rules and structure.
Domain: Project, information
Characterises: Uncertainty
Values: [high, medium, low]

Heterogeneity of computerised actors
Explanation: The computerised actors are the components of the computerised system. Different hardware and software platforms may coexist thereby generating heterogeneity.
Domain: Target, actors
Characterises: Complexity
Values: [low, medium, high]

Heterogeneity of human actors
Explanation: The human actors of the business system may be heterogeneous for organisational reasons, political reasons or individual reasons. Examples of organisational reasons: ⇒ Different business areas or organisational units in an enterprise may have different views on a situation or different interests. ⇒ A management level and an operational level may have different views on a situation or different interests. Example of political reason: ⇒ There may be power conflicts within the actor group and the information system may be considered as an instrument of power. Example of individual reason: ⇒ Different individuals have different personalities, cultural background, and cognitive styles, e.g. analytical or intuitive.
Domain: Target, actors
Characterises: Complexity
Values: [low, medium, high]

Heterogeneity of project actors
Explanation: The project actors may be heterogeneous which may create difficulties in communication and co-operation within project execution.
Domain: Project, actors
Characterises: Complexity
Values: [low, medium, high]

Importance of changes triggered by the project (computerised system)
Explanation: Impact of the project on the computerised system structure and its component characteristics.
Domain: Target, actors
Characterises: Uncertainty
Values: [low, medium, high]

Importance of changes triggered by the project (human system)
Explanation: Impact of the project on the organisation structure and the actor characteristics.
Domain: Target, actors
Characterises: Uncertainty
Values: [low, medium, high]

Novelty of business technology (computerised system)
Explanation: A measure of how innovative with respect to the state-of-the-art is the technology used for the hardware and system software platform of the computerised system.
Domain: Target, technology
Characterises: Uncertainty
Values: [low, medium, high]

Novelty of business technology (human system)
Explanation: A measure of how innovative with respect to the state-of-the-art are the methods, tools and techniques used by the human actors for the performance of the business processes.
Domain: Target, technology
Characterises: Uncertainty
Values: [low, medium, high]

Novelty of project technology
Explanation: A measure of how innovative with respect to the state-of-the-art are the methods, tools (including computerised tools), and techniques used by the project actors for the execution of the project.
Domain: Project, technology
Characterises: Uncertainty
Values: [low, medium, high]

Quality and availability of existing operational items

Explanation:

At the outset of the project, there may be several operational elements available that are related to the existing computerised system. The quality of these existing operational items should be assessed relative to their need within the migration project.

Domain: Target, computerised system

Characterises: Uncertainty

Values: [high, medium, low]

Sub-factors:

⇒ Maintenance performed on the current system.

⇒ Overall quality of the source code.

Have coding guidelines been used? For example, common functionality in subroutines, system en i/o interfacing in specific subroutines, naming conventions, standards for use of dates, etc.

⇒ Structure of the computerised system.

⇒ Use of modern programming/development techniques.

⇒ Age of the software/hardware.

⇒ Maintainability of the software.

⇒ Fragility (brittleness) of the code.

⇒ Availability of an inventory of all operational and descriptive items involved.

⇒ Availability of information about the development infrastructure used.

This includes the original compiler options.

⇒ Availability of operational items such as the (right!) source code.

Additional guidance:

One way of judging the availability of the information needed on the pre-existing computerised system is to ask for some sample items before the start of the project. By looking at the time needed to obtain these samples, one may be able to better judge their overall availability.

An implied requirement of any migration project is that the pre-existing computerised system should be used as a starting point. Any uncertainty related to the quality and complexity of this system is therefore also an unclarity in the migration requirements.

Quality and availability of existing specifications
Explanation: Specifications are definitive descriptions of a system for the purpose of developing it or validating it. The quality of existing specifications should be assessed relative to the need within the migration project.
Domain: Target, computerised system
Characterises: Uncertainty
Values: [high, medium, low]
Sub-factors: ⇒ Consistency between descriptive items and operational items. ⇒ Correspondence between the business processes and business rules as defined in 'theory', and the ones as used in practice in the information/computerised system. ⇒ Availability of domain experts. ⇒ Maintenance performed on the current specifications. ⇒ Overall quality of the source code. Have specification guidelines been used? ⇒ Use of modern design techniques. ⇒ Age of the specifications. ⇒ Availability of an inventory of all specifications involved.

Quality of service offered by existing operational items
Explanation: The level of service offered by the existing operational items at the outset of the migration project.
Domain: Target, computerised system
Characterises: Uncertainty
Values: [high, medium, low]
Sub-factors: ⇒ Reliability of the computerised system. Does the system fail periodically?

Size of distribution of business actors (computerised system)
Explanation: Number of geographical sites for the computerised system.
Domain: Target, actors
Characterises: Complexity
Values: [small, medium, large]

Size of distribution of business actors (human system)
Explanation: Number of geographical sites for the human system.
Domain: Target, actors
Characterises: Complexity
Values: [small, medium, large]

Size of distribution of project actors
Explanation: Number of geographical sites where the project actors are located.
Domain: Project, actors
Characterises: Complexity
Values: [small, medium, large]

Specificity/Novelty of project
Explanation: A measure of how specific/innovative the project is with respect to the state-of-the-art.
Domain: Project, process
Characterises: Uncertainty
Values: [low, medium, high]

Stability of business system
Explanation: The instability of business system is a measure of the importance of changes to be expected during (but not necessarily caused by) the migration project.
Domain: Target, business system
Characterises: Uncertainty
Values: [high, medium, low]

Stability of environment
Explanation: Stability of the environmental factors that have an impact on the target domain.
Domain: Target, business system
Characterises: Uncertainty
Values: [high, medium, low]
Sub-factors: ⇒ Political environment. ⇒ Legal environment. ⇒ Market situation. ⇒ Business and financial environment. ⇒ Technological stability.

Understanding of existing business system
Explanation: The understanding of the business system by the business actors. Poor understanding includes lack of awareness of the current state of the business system and its computerised system.
Domain: Target, business system
Characterises: Uncertainty
Values: [high, medium, low]

B Risks

Delays in deliveries
Risk for: Project
Explanation: Some deliverables are delivered late. These deliverables may be: ⇒ Intermediate deliverables in projects or management deliverables for services in general. ⇒ The delivery of installed systems is covered under the risk "Delay in system delivery" which is a risk for the business.

Delays in the system delivery
Risk for: Business
Explanation: The system is delivered too late thereby creating problems to the business. For example, the stagnation of roll-out of migrated operational items.

Demotivation of project actors
Risk for: Project
Explanation: Some actors of the project loose their motivation and commitment for various reasons.

Increased costs of the project.
Risk for: Project
Explanation: The costs of the project increase.

Integration problems of system components.

Risk for: Project

Explanation:

Problems arise related to the integration of components of the system to be delivered by the migration project.

Lack of business actor participation/commitment

Risk for: Project

Explanation:

The business actors (users, stakeholders, etc.) participate insufficiently in the migration project.

Loss of control of project

Risk for: Project

Explanation:

The project runs out of control from the management.

Non-attainment of business stakes

Risk for: Business

Explanation:

The delivered service or system does not contribute to the business stakes at the expected level. Reasons may be:

- ⇒ bad quality,
- ⇒ unpredictable costs,
- ⇒ delays in the delivery,

but also more complex combinations of factors. The migration may even turn out to be unnecessary.

Poor quality of deliverables

Risk for: Project

Explanation:

Some deliverables are not delivered to the required quality. These deliverables may be:

- ⇒ intermediate deliverables in projects
- ⇒ management deliverables for projects

The delivery of installed systems is covered under the risk “Poor quality of delivered system”, which is a risk for the business.

Poor quality of delivered system

Risk for: Business

Explanation:

The delivered system/items does not have the required quality. This may mean that it is not working, or not adapted to the business needs or that there are shortfalls in some quality properties (functionality, efficiency, reliability, etc).

Poor quality of ongoing-service delivery during migration

Risk for: Business

Explanation:

While a computerised system is being migrated, the system may have to be kept operational. The activities of the migration project may impede badly on the quality of service offered by the system during the migration. Compare this to the situation of renovating a shopping-mall while keeping it open for business.

Shortfalls in sub-contracted/suppliers tasks

Risk for: Project

Explanation:

Tasks that are sub-contracted are not performed with the required quality, or items/services purchased from suppliers do not meet the set criteria. This may be in terms of the deliverables or the services delivered.

Shortfalls in input deliverables

Risk for: Project

Explanation:

The quality & completeness of the input deliverables of the initial state is less than expected.

System not accepted by business actors

Risk for: Business

Explanation:

The service or system (in case of a project) is not accepted by the business actors; the reason may be a poor quality but it may also encompass sociological or human issues.

Uncertain interfaces within target domain

Risk for: Business

Explanation:

The uncertainty about interfaces may pertain to interfaces with:

⇒ Other systems within or outside the target domain.

⇒ Processes within our outside the target domain.

⇒ Interfaces to services.

Unclear migration requirements

Risk for: Business, project

Explanation:

The requirements on the migration are not clear or not available. Please note that an implied requirement of any migration project is that the pre-existing computerised system should be used as a starting point. Any uncertainty related to the quality and complexity of this system is therefore also an unclarity in the migration requirements.

Unpredictable costs for the business

Risk for: Business

Explanation:

The delivered service or system generate unpredictable costs for the business organisation (target domain); these costs may relate to usage, operation, maintenance, etc. and be due to bad quality or other reasons.

Unstable, or conflicting, systems requirements

Risk for: Business

Explanation:

The requirements to the service or the system are not stable (they are evolving), or even conflicting.

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