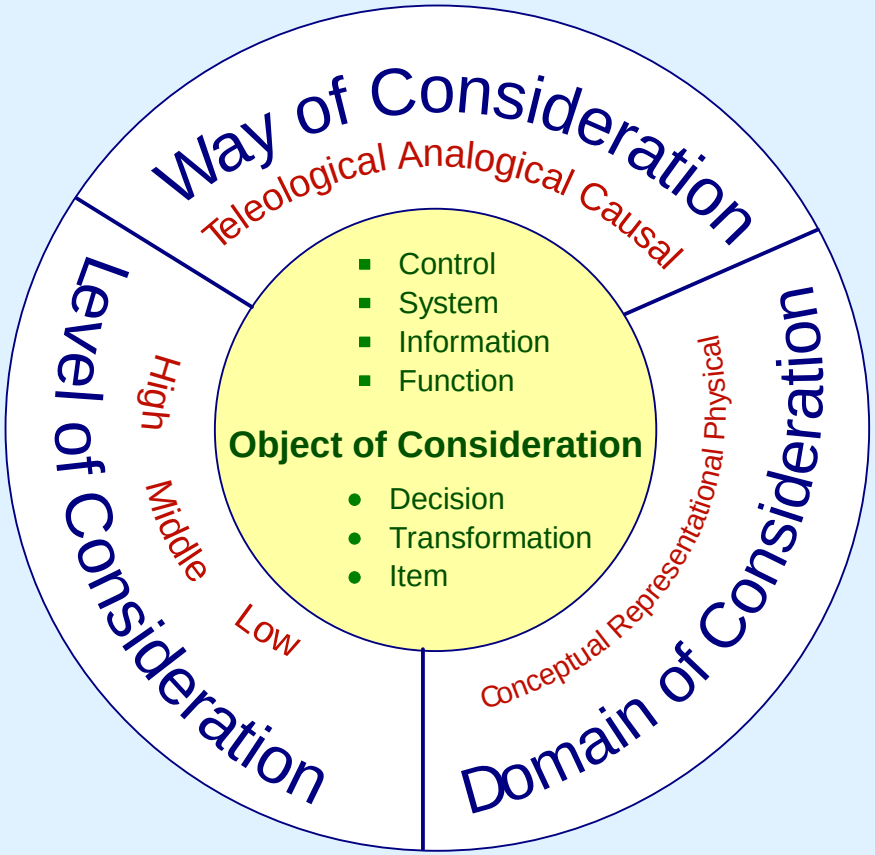

Foundations of Information Systems Development

Summary - Glossary - References

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The book was written in Dutch as a PhD dissertation during a sabbatical year, granted by IBM Netherlands. The English version of the glossary is added to this document.

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Preface

Structured Information Modeling (SIM) is a technique for developing a Hierarchical Data Model together with a Hierarchical Process Model.

These complementary models are corresponding parts of an Information Model. The dynamics of this model are mapped out in Workflow Models which connect data and processes in serial or parallel ways.

An Information Model represents a structured view of the real business, and can therefore be used as a basis for business re-engineering, and at the same time, as a blueprint for technical design.

Structured Information Modeling should be carried out in direct interaction with business professionals to ensure the validity in the "real world" of the model as it is mapped out during modeling sessions.

SIM is described in separate documents.

The underpinning methodology of SIM, as described in the PhD dissertation, incorporates both traditional techniques as well as concepts from the object-oriented approach.

Contents

7.0 Summary

Foundations of information systems development

The problem addressed by this study is stated in three parts:

- The development of information systems calls for skills grounded in knowledge of multiple disciplines. A cross-discipline approach involving concepts from fields such as economics, organisation theory, cybernetics, systems theory, linguistics, mathematics, and information theory - is not easy to achieve because of the lack of a common set of concepts.
- The formulation of a fruitful interdisciplinary intellectual framework requires a common frame of reference, allowing for unambiguous and consistent concept definition. No such adequate frame of reference is available.
- A methodology for information systems development must be built on a sound foundation of theory, allowing for cooperation between the various disciplines. No such theoretical base exists.

Chapter 3 expounds a frame of reference more general than those of the individual disciplines relevant to information systems development.

Using that frame of reference, an interdisciplinary system of concepts is defined in chapter 4.

Chapter 5 contains the formulation of a schema of applicable techniques for analysis and design of information systems, using chapter 3's frame of reference and the concepts of chapter 4.

An information system is regarded here as a tool used to collect, process, store, and deliver data to decision-makers.

Decisions concern such matters as the assignment of tasks to various means of production, the allocation of resources to functions, and ultimately the realisation of an organisation's goals.

Details of the ways information systems are implemented - hardware, software, and people - are beyond the scope of my study; the subject matter is conceptual.

The concepts and techniques discussed, however, allow not only for producing a conceptual description of an information system, but also for systematically describing the real organization in which an information system will be one of the means of production.

Solving the problems caused by differences in meaning of technical terms which impede interdisciplinary communication can be made easier by distinguishing different ways of considering objects or phenomena, different object domains of consideration, and different levels of consideration.

Three different ways of consideration or reasoning are distinguished:

- Causal - explains things in terms of causes and effects.
- Analogical - involves comparison as a method:
  - formally, by comparing the object or phenomenon with formal models;
  - substantively, by reasoning according to comparable objects or phenomena in physical reality.
- Teleological - postulated to be the most important one for the discipline of development. In a teleological view, objects and phenomena are considered from a perspective of means and ends.

Three worlds in the object domain of consideration are distinguished:

- The physical world, observable by sensory perception.
- A world of notions in the human mind.
- A world of representations, models, definitions, expressions, descriptions, simulations, and so on.

For the discipline of development, the linguistic schema syntax / semantics / pragmatics is unsatisfactory.

Distinguishing teleological, analogical (formal and substantive), and causal aspects of the means of description offers the developer a surer grip on the domain of representations.

The third dimension of the framework considers levels. This dimension is defined in two directions:

- Top-down - in terms of transitive verbs such as 'to detail' or 'to decompose'.
- Bottom-up - using verbs such as 'to generalize' or 'to compose'

The concept of hierarchy is shown to be a useful model, especially if one abstracts from connotations of authority or power.

The class name and the usual way of depicting hierarchical databases is wrong and misleading, as is the use of the terms 'aspect' and 'level' interchangeably.

An object is something considered in a teleological, analogical, or causal perspective; in a defined domain, abstract or physical; on a determined level of consideration, elementary or composite. The domain of representations is formed by the text and figures of this paper.

Distinguished as elementary object types are decisions, transformations, and entities, which have or can acquire properties. These are defined thus:

- A decision is an action of the will concerning the state of entities.
- A transformation is a converting operation: creating, changing, or destroying a property of an entity.
- An entity or entity type is an object with a factual, possible existence of its own, with the property of countability.

It is demonstrated that composite objects can be described using those elementary types: for example 'function', 'structure', 'system', 'program', 'procedure', 'control', 'plan', 'policy', and 'organization'.
A 'relationship' is a role of a transformation or of an entity.

Information is data with a specific property, namely the capacity to reduce a decision-maker's uncertainty, a subjective issue.

The difference between knowledge and data is determined according to the object domain of consideration. 'Data' is part of the domain of representations, expressing knowledge.

'Knowledge' is considered as an image in the domain of notions in the human mind.

A key concept in this paper is 'function'. It is shown that for the discipline of development, the concept of function is a teleological object, consisting of a transformation and an entity, expressable as a transitive verb and a noun.

Depending on the chosen level of consideration, a function is viewed as an elementary function, or as a structure of functions in which transformations and entities relate the parts.

The mathematical signification of functions corresponds with a formal / analogical way of consideration, which is beneficial for the efficiency or elegance of expressions, models, and simulations, or whatever representation.

The problem of function decomposition - often mentioned in the literature, and also the frequently-quoted contradistinction between a 'data-driven' and a 'process-driven' design methodology - is solved with the system of concepts and the dimensions of the frame of reference of my study. The role of linguistic concepts is instrumental in this context.

A function can be decomposed by examining the details of its entity part, determining the content of the noun in question in a functional relationship with a given transformation.

Another method is by going into the details of its transformation part, determining the content of the transitive verb in question and the functional relationship it has with a given entity.

Apart from the concepts in the domain of notions, physical objects, called 'factors', are briefly discussed. A factor embodies a concept.

People, software packages, computers, buildings, stocks, hard cash, all are means of production in a physical domain, with which abstract systems have been or will be realized.

Relationships between physical objects and abstract objects are primarily established in a teleological way as allocations or assignments. The concept of 'to organize' can be clarified using these notions.

A 'policy' is a set of conditions, restricting and directing the scope of functions. With a 'plan', functions are projected in the dimension of time. Time is looked upon as being a physical dimension, like length, width, and height, which are essential in a physical reality, but from which one can grossly abstract in a conceptual domain of notions.

Using the system of concepts of chapter 4, chapter 5 depicts a consistent set of design techniques. This schema indicates how a system developer can map out blueprints of an organization and also of a conceptual information system for that organization.

The difference between top-down and bottom-up directions, applying a considered design technique, is clarified. Top-down development is more effective than bottom-up: going into details is easier than generalization and dividing takes less effort than unifying, given that the developer has the capacity to view the system to be designed at an adequate level.

The so-called 'technique of consideration' comprises a consistent set of mental actions within an established frame of reference, for determining the identities and properties of objects or phenomena.
The term 'technique' should therefore not be identified with actions and objects in the physical domain.

It is shown that the consistency of the variants of the technique of consideration can be determined with the dimensions of the framework: ways of consideration, domains of consideration, levels of consideration.

With the help of linguistic concepts, it is also shown that concepts of organization theory such as 'to differentiate' and 'to specialize' can be usefully applied to the arranging of components in a conceptual information system.

Subordinating and coordinating variants can be ordered according to teleological, analogical, and causal features. As a consequence of and consistent with a designed structure of functions, the pertinent control structure and data structure can be arrived at.

Several variants are discussed with the help of various examples. A competent representative of the organization which will use the system should be involved in the selection of an applicable decomposition technique. This person will be guided by his or her own teleological notions concerning the desired future reality.

With respect to the ordering of the structure of a function, several guidelines were mentioned. More research is needed to verify these guidelines and the fruitfulness of the decomposition techniques presented.

B. Glossary

Abstract
Free of any form of appearance.
An abstract object is not observable by sensory perception,
but can only be seen in the mind's eye.

Advisory data
Information of an exploratory nature, which assists in the execution of a process.

Allocate
To allot resources to a process, or media to data.

Analogical
A specific way to consider, describe or explain objects, using comparison as a method.
Two main types of analogical reasoning are distinguished:
- Formally, by comparing the object or phenomenon with formal models.
- Substantively, by reasoning according to comparable objects or phenomena in physical reality.

Analogical reasoning deals with the question: ‘like what’.
See also: Causal, Teleological.

Analyze
To examine existing *objects*, *relationships* or *properties*, within a *domain of consideration*.

Aspect
The sight of an object from a specific point of view.
A represented aspect tells something about this point of view, or about the object being considered.
An aspect is a recognized or attributed property.
See also: Property, Value.

Assign
To designate a task for a resource.

Attribute
A characteristic of an *entity*.
This definition may have two different meanings, which should not be used interchangeably:
- An *entity*, subordinate to a considered entity. For example: the pipe of Sherlock Holmes.
- A *property* that can be separately *transformed*. For example: the format of a field.

See also: Property, Value.

Balance of information
- The ratio between supplied and obtained,
- or between requested and offered information

of persons or organizations that exchange data.

Bottom-up An upward technique for analysis, design and realization.
This technique takes details into consideration first,
and subsequently views these details as parts of a *structure*.
See also: Level of consideration, Generalize, Integrate, Parallel.

Business Process A process in an enterprise.
See also: Process, Function

Causal A specific way to consider, describe or explain objects,
by following a chain of causes and effects that leads back to earlier causes or origins.
Causal reasoning deals with the question: ‘from what’.
See also: Analogical, Teleological.

Characteristic An *attribute* or a *property*.

Code A system of *symbols*, in the form of: characters, figures, colors, shapes, sounds.

Complex Multiple occurrences in multiple dimensions.

Concept An image or notion of something in one's mind.
Concepts are part of the abstract *domain of consideration*, which may be represented by symbols.

Conclusion A deduction or inference ascertained by existing data.
A conclusion is fundamentally different from a decision,
the former being a matter of certainty and predefined choice,
the latter dealing with uncertainty and being an action of the will.

Concrete A property that can be measured or evaluated.

Condition A desired property of an object.

Consider
To deal with something in one's mind.
Compare: to contemplate, to reflect, to observe.
Note: For this term no adequate word is available in the English language.
To consider should cover the concept of the German word ‘anschauen’
(Dutch: ‘beschouwen’), a term with philosophical connotations.
See also: Frame of consideration, Object of consideration, Technique of consideration.

Constant
A fixed or invariable property of an object during a specific period.
This period may be shorter or longer than the cycle time or life cycle
of the system, of which the object is a part.

Constraint
A restriction of the range of *values* applicable to the execution of a process.
See also: Policy, Strategy.

Control
To make *decisions* about the execution of a process.
Decision making is often constrained by conditions, and supported by available information.

Control condition
A constraining rule for making decisions.

Control time
The time elapsed between examination and evaluation of information,
making a decision, and passing on the decision.

Co-ordinate
Positioned on the same *level*.
Apples and pears are co-ordinate on the same level under fruit.
Skin, flesh, and core are sub-ordinate of fruit.

Data
Descriptions of any kind in any form.
Data is part of the *domain of representations*.
Data, in fact, is encoded knowledge.

Decide
To resolve an uncertain state by the authoritative statement of ‘yes’ or ‘no’.
To decide is the core action of control.

Decision
Action of the will concerning the state of objects.
Resolution of uncertainty.

Decisions by object

This is a classification according to the object of the decision, yes or no, concerning:

- The allocation, re-allocation, or de-allocation of resources to a process
- The assignment, re-assignment or de-assignment of tasks for a resource
- The allocation or authorization of power to a resource.

Decisions by type

This is a classification according to conditions and their handling:

- Unconditional
- Once-only single conditional (‘if’)
- Once-only multiple conditional (‘case’)
- Repeatedly single conditional (‘while’)
- Repeatedly multiple conditional (‘case and while’).

Description

A representation of an abstract or physical object.
See also: Mapping, Model.

Design

To imagine and lay down desired *elements, relations* and *properties*.

Develop

To bring an object into being, so that it has an existence of its own and fulfills the ascribed meaning.

Differentiate

To break down a process into *subprocesses*
by particularizing the *transformation* part of the *process*.

For example: the process ‘sell bicycles’ is differentiated
by specifying details about selling, in functional relationship with bicycles.

Differentiation can be done *co-ordinately* (specifying the kind of selling),
or *sub-ordinately* (specifying the phases of selling).

Both variants can be specified in more detail according to *teleological, analogical* or *causal* values.
To differentiate is the opposite of to *integrate*.
See also: Top-down, Level of consideration, Specialize.

Diversify

To combine *specialized* processes into a *multi-top* structure.

Domain

- A demarcated area in which objects can be positioned, and evaluated.
- The same name is used for another, more specific concept:
  a range of possible *values* of a *property*.

Domain of consideration

A demarcated area in which objects can be positioned, and evaluated.
Three different domains of consideration are distinguished:

- The *abstract* domain of ideas: conceptual, immaterial; a world of notions in the human mind.
- The domain of *representations*, models, definitions, expressions, descriptions, simulations.
- The physical domain: material, substantial.

Domain of consideration is part of the *Frame of consideration.*
See also: Object of consideration, Technique of consideration.

Dynamic system

A system in action, of which the elements and their relations have *variable properties*.

Effective

Approaching a defined goal, or fulfilling an objective.

Efficient

Achieving maximal results with a given amount of resources,
or achieving a defined result with a minimum amount of resources.

Element

An object that is not to be broken down into constituent parts,
either because this is practically not useful, or because it is theoretically impossible.

Elementary

On the lowest level; not to be broken down further.

Entity

An object of consideration with an actual or possible existence of its own,
with the property of countability. Entities are denoted with nouns.
A cup of coffee is an entity; coffee is not (not countable).

Words as such are entities; that which is denoted with a word
can be something else (a property, for example).
Therefore the *word* color is an entity, but in the *physical domain*a color is only a *property* of an entity.

Entity type

A class of entities with a common property.

Environment

A set of persons, systems, organizations, and the like,
that can interface with the system being considered.

- Inputs originated from the environment may be grouped
  into sets of *constraints*, *triggers* / events, *raw data*, and *advisory data*.
- Outputs for the environment may be grouped into sets of
  feedback / reports, requests, results / products, and waste / scrap.

Event
A noteworthy happening that may invoke actions within a system.
See: Trigger

External
Not a part of a structure being considered, but of its environment.

Factor
In the context of SIM, a factor is a physical object that can have or execute a function or process.
This meaning is comparable with production factor: a means of production, capital or labor.

Factor Environment Model
A mapping of a factor and its environment, separately depicted as inputs and outputs.

Factor structure
The material embodiment of functions and entities.

Feedback
- As a verb: to pass on stored data to a point of control.
- As a noun: data stored in a memory, which is passed on to a point of control.

Feedback cycle
The loop of getting information, making a decision, executing action, supplying feedback.

Flow data
Data in transition from a process to another process. Flow data may be collected and stored as sets.

Frame of consideration
A set of dimensions with which aspects and values of objects considered can be determined. This frame consists of three parts:
- *Way of consideration*
- *Domain of consideration*
- *Level of consideration.*

See also: Object of consideration, Technique of consideration.

Function
A *transformation* of a *property* of an *entity*.
A function is an abstract or representational *teleological* object: something to be achieved.
For example: ‘sell bicycles’, ‘collect customer data’, ‘paint frames’.

Functions can be executed by allocated human or non-human factors.
A function is described with a transitive verb (possibly characterized by adverbs) in conjunction with a noun (possibly characterized by adjectives), where the nouns represent the direct object.

In some methodologies a distinction is made between the concepts of function and *process*.
In SIM no fundamental distinction is made.
Therefore these terms are used interchangeably.

Function Environment Model
A mapping of a function and its environment, separately depicted as inputs and outputs.
Same as: *Process Environment Model.*

Function Model
A mapping of a function *structure*.

Function structure
Hierarchical composition of functions, with a single all-comprising top, *teleologically* arranged by main functions and subfunctions.
Procedures can be derived from function structures by an arrangement in a *serial* or in a *parallel* order of execution.
See also: Function Model, Workflow Model.

Functional analysis
The examination of actual elements, relations, and properties in a *teleological* view.

Functional design
The description of desired elements, relations and properties in a teleological view, regardless of physical characteristics.

Generalize
To group into a whole, or to comprise according to a single denominator.
To generalize is the opposite of to *particularize*.
See also: Bottom-up, Level of consideration, Integrate, Parallel.

Goal
What is attempted to be achieved.
For example: ‘sell bicycles’, ‘import spare parts’.

Heterarchy
A *multi-top* hierarchical arrangement of parts.

Hierarchy
An arrangement of objects on more than one level according to specific values for each level.
Three kinds of hierarchies are distinguished:
- Business process hierarchies contain sets, subsets, sub-subsets, and so on, of business processes.
- Data hierarchies represent sets, subsets, sub-subsets, and so on, of business items.
- Control hierarchies represent scope, subscope, sub-subscope and so on, of control or authorization to make decisions.

See also: Holarchy.

Hierarchical Data Model
Hierarchical composition of data, with a single all-comprising top,
with data on lower *levels* of the hierarchy as subsets of the higher levels.
The arrangement of the structure corresponds to the related hierarchical process model.
The contents of the hierarchy is according to *co-ordinate* or *sub-ordinate* values
obtained in a *teleological*, *analogical* or *causal* view.

Hierarchical Process Model
Hierarchical composition of processes, with a single all-comprising top,
teleologically arranged by processes and subprocesses.
Same as: *Function Model.*

Higher
Comprising more.

Holarchie
A single-top hierarchical arrangement of parts, where the object at the top comprises all lower levels.

Horizontal
On the same level within a structure being considered.

Identification
- The determination of the identity of an object.
- Also: the means with which the identity of an object is uniquely recorded.

Identity
That which determines the existence of a unique object.

Index
A set of *keys*.

Information
Data with the specific property of reducing uncertainty for making *decisions*.

Information Model
A hierarchical model, consisting of a Hierarchical Data Model
and a complementary Hierarchical Process Model.
These corresponding models reflect each other's contents,
one representing classes of data and attributes,
the other portraying processes that act on these data.
An Information Model represents a *conceptual* view of the real business,
and can therefore be used as a basis for business re-engineering,
as well as a blueprint for *technical design*.

Information system
A tool used to collect, process, store, retrieve, and deliver data to decision makers.

Integrate To join together differentiated processes into a single process.
To integrate is the opposite of to *differentiate*.
See also: Bottom-up, Level of consideration, Parallel.

Interface
- The common element between two or more elements, which relate or connect these elements.
- More specifically: the description in terms of format, frequency, transfer time, medium, encoding, and the like, of output/input that connects two processes.

Internal A part of a structure being considered, not of its environment.

Key A means to find the location of an object.

Level *See: Level of consideration.*
The relationship between levels is defined with transitive verbs such as to particularize, to decompose (top-down) or to compose, to group, to generalize (bottom-up).

Level of consideration A dimension where in a *top-down* direction objects can be classified, distinguished, discerned, particularized, decomposed, broken down, parsed, detailed, and specialized, according to a chosen value.

In a *bottom-up* direction, objects can be grouped, composed, and generalized, according to a chosen value.

Level of consideration is part of the *Frame of consideration.*
See also: Object of consideration, Technique of consideration.

Life cycle
- The circular course through the phases of: coming into being, growing, being mature, declining, and vanishing.
- In transformational terms: be defined, be obtained, be changed, be stored, be supplied, and be destroyed.

Logical According to a specific *way of consideration* or reasoning, so that all *relations* between elements are of the same kind.
See also: Analogical, Causal, Teleological.

Lower Comprising less.

Mapping
Representation of an abstract or physical object.
See also: Description, Model.

Meta
On a higher *level of consideration*; concerning.

- A meta-notion is an idea about an idea.
- A meta-mapping is a mapping of a mapping.
- A meta-transformation is a transformation of a transformation.
- Meta-data is data about data.

Model
Mapping of an existing or not yet existing object.
Essentially the concept of model means the same as:
representation, description, simulation, show, mock-up.

Multidimensional Organization Model
A scheme describing *physical* production factors on one axis, such as people, hardware, media.
On the other axis of this matrix, *conceptual* objects are represented: processes and conceptual data.

The relationships between these two dimensions can be described in terms of:
to perform, to embody, to trigger, to decide, to approve,
to get output from performer, to supply performer with input.

From the perspective of the conceptual axis these relationships are called *allocations.*
From the perspective of the physical axis they are *assignments.*
See also: Organizational design.

Multi-top
With different, non-joinable objects on the highest level of a *hierarchy*.
See also: Heterarchy, Diversify.

Module
A unit within a program, containing definitions of variables, transforming instructions, and conditions.

Normalize
To reduce redundancy.

Object

What one considers, describes or fabricates.
See also: Object of consideration.

Note: the meaning of object in a pure object-oriented (OO) approach is more specific than in SIM.
However, the SIM concept of *process*covers the OO concept closely.
This may become clear in OO analysis,
using *process environment models* and SIM *particularizing techniques*.

If characteristics of object-oriented languages dominate a conceptual view of the real world,
then object orientedness, in fact, deals with *formal analogical* reasoning
instead of *substantive analogical* reasoning.

Objective

A goal with measurable properties.

Object of consideration

That which is considered, using a *technique of consideration*, within a frame of consideration.
Three categories of elementary objects are distinguished:

- *Entities*
- *Transformations*
- *Decisions.*

These elementary objects are building bricks for construing composite objects such as:
process, structure, information, control, and system.

Organizational design

Description of desired allocations and assignments, authorizations, and responsibilities.
See also: Multidimensional Organization Model.

Organize

To determine the pattern of allocations/assignments between physical resources (*factors*)
and conceptual objects (*processes*, *data*, *control*).

Paradigm

A framework of concepts, lines of thought, and standard examples
of a scientific community in a specific field.

Parallel

- As an adjective: a type of arrangement that allows processes to execute concurrently.
  Only specialized processes, without interdependence, can be arranged in this way.
- As a verb: to unify specialized processes.

See also: Bottom-up, Level of consideration, Integrate.

Particularize To break down in constituent parts or classes.
Compare: to specify, to decompose, to parse, to detail.
To particularize is the opposite of to *generalize*.
See also: Top-down, Level of consideration, Differentiate, Specialize.

Physical Observable by sensory perception.

Physical system A controlled factor structure.

Plan To project the execution of processes in the dimension of time.

Policy A set of constraining rules.

Practical What one does.

Pragmatic What one tries to achieve.

Procedure A set of (one or more) sequentially arranged processes, on a specific level of detail, with predetermined *decisions by type* and control conditions.
See also: Workflow Model.

Process A *transformation* of a *property* of an *entity*.

A process is an abstract or representational *teleological* object: something to be achieved.
For example: ‘sell bicycles’, ’collect customer data’, ‘paint frames’.
Processes can be executed by allocated human or by non-human (production) factors.

A process is described with a transitive verb (possibly characterized by adverbs) in conjunction with a noun (possibly characterized by adjectives), where the nouns represent the direct object.

In some methodologies a distinction is made between the concepts of *function* and process.
In SIM no fundamental distinction is made. Therefore these terms are used interchangeably.

Process Environment Model A mapping of a process and its environment, separately depicted as inputs and outputs.

Process Model A mapping of a process structure.

Process structure Hierarchical composition of processes, with a single all-comprising top, *teleologically* arranged by main processes and subprocesses.

Procedures can be derived from process structures by an arrangement in a *serial* or *parallel* order of execution.
See also: Workflow Model.

Production Adding value to input.

Production factor *See: Factor.*

Program A unit consisting of one or more *modules*.

Project
- To map out in the dimension of time.
- A defined set of activities aimed at achieving a determined objective.

Property A qualitative or quantitative *aspect* of an *entity* or a *transformation*.
A property is determined according to a given denominator or point of view.
In the physical domain, properties cannot exist independently, like entities.

Properties can be evaluated or measured, entities are countable.
Properties are denoted with adjectives or adverbs, or with equivalent clauses.
See also: Aspect, Value.

Raw data Inputs that are ingredients for a transforming process, which produces specific results.

Realization The implementation of the *technical design* by recording and executing system software-oriented and hardware-oriented definitions, statements, and commands, and by implementing the organizational design.

Relation

An object that connects two or more objects of another category.

Entities are related by *transformations*. For example: ‘customer- buy – bicycle’
Transformations are related by *entities*. For example: ‘buy - bicycle – sell’.
Processes are related either by *entities* or by tr*ansformations*.

Relations between *conceptual* and *physical* objects are called *Allocations* or *Assignments*.
See also: Organize.

The terms *relationship, association, link, join, reference, connection, and coupling,*
are instances of a class with common properties.

Serial

Sequentially arranged.
Such an arrangement is mandatory for execution of differentiated processes
with input/output dependency.

Set

A collection of elements with a common property.

Single-top

With a single all-comprising object on the highest *level* of a *hierarchy*.

Specialize

To break down a *process* in subprocesses by *particularizing* the *entity* part of the process.
For example: the process ‘sell bicycles’ is specialized
by specifying details about bicycles, in functional relationship with selling.

Specialization can be done *co-ordinately* (by specifying the kind of bicycle)
or *sub-ordinately* (by specifying parts of a bicycle),
according to *teleological, analogical* or *causal* values.

To specialize is the opposite of to *parallel.*
See also: Top-down, Level of consideration, Differentiate.

Standardize

To determine and accept specific equal shapes, measures, contents, assembly, denotation,
and the like, for an object, so that general validity is obtained for this object.

State

A set of valued properties of an object.

Static system

A structure that is not in action, or cannot be put into action.

Strategy

Policy on the highest level with a long time span.

Structure A set of related parts on one or more *levels*.

Structured Containing relationships.

Structured Information Modeling SIM is a technique for developing a *Hierarchical Data Model* together with a *Hierarchical Process Model*.

These complementary models are corresponding parts of an *Information Model*.
The underpinning methodology incorporates both traditional techniques as well as concepts from the object-oriented approach.
See also: Technique of consideration.

Subprocess A part of a process.
Different kinds of subprocesses can be found by particularizing a process in different ways:

- A particular *transformation* of a *property* of an *entity*.
  For example: frequent updating of a record (*differentiated*).
- The t*ransformation* of a particular *entity type*.
  For example: updating of an old record (*specialized*).

Subsystem A *differentiated* or *specialized* part of a system.

Sub-ordinate The positioning of objects on different *levels*.
Apples and pears are coordinate on the same level under fruit.
Skin, flesh, and core are sub-ordinate of fruit.

Symbol A representational element.
See also: Code.

System A *structure of entities*, *transformations*, and *controls*, with which a goal or objective can be approached or achieved.

Task An assigned or accepted process or subprocess, seen from the perspective of the *factor* (resource).

Technical

According to the means used.

If the means are human, then psycho-technical and socio-technical disciplines will dominate.
If the means used are software or hardware, other technical disciplines will be relevant.

In SIM, the means used (resources) are viewed as production factors.
Therefore technical is to be understood as factor-technical.

Technical design

The description of desired elements, relationships, and properties of an object,
according to characteristics of resources to be used.

Technique of consideration

An ordered set of mental actions, with which an object may be identified and characterized,
using a determined *frame of consideration*.

The order in the set of mental actions may be:

1. In a *top-down* or *bottom-up* direction
2. In a *differentiating* or *specializing* manner
3. On *co-ordinate* or *sub-ordinate levels*
4. According to different values in a *causal*, *analogical*, or *teleological* perspective.

Thus a process like ‘repair broken chain’ can be found on a low level
under a main process called ‘sell bicycles profitably’.
Another variant may end up in ‘mail promotional material to early retired persons in the Netherlands.’
See also: Frame of consideration, Structured Information Modeling.

Teleological

A specific way to consider, describe or explain objects, by viewing them as means and ends.
Teleological reasoning deals with the question: ‘what for’.
See also: Analogical, Causal.

Theoretical

What one sees or perceives.

Top-down

A downward technique, taking an object as a whole first,
and subsequently viewing it as a structure of parts,
during analysis, design and realization.
See also: Level of consideration, Particularize, Differentiate, Specialize.

Transformation

A converting operation that creates, changes or destroys a *property* of an object.

For example: properties of form, place, time, frequency, medium, value,
encoding, sequence, definiteness, and the like.

Transformations are denoted by transitive verbs.
Properties of transformations are described with adverbs.

Transformation structure

A composite set of changes of the state of an object.

Trigger

A noticeable event that may invoke actions within a system.

Value

The magnitude or the unique meaning of a *property*, which can be assessed in three ways:

- As a means to a goal (teleological)
- By its caliber (analogical)
- As a result of a transformation (causal).

A value is an elementary property, not to be broken down any further
for practical or theoretical reasons.

Therefore *red* may be a value of the property *color*,
but *red* may also be a property with the value *light red*.
See also: Property.

Variable

Changeable during a specific period, which may be shorter or longer
than the cycle time or *life cycle* of a system or object, being considered.

Vertical

Between different *levels* within a *structure* being considered.

Way of consideration The way one develops an image in one's mind of objects that exist or do not yet exist.
In SIM three different ways of consideration are distinguished:

- *Teleological*
- *Analogical*
- *Causal*

Way of consideration is part of the *Frame of consideration.*
See also: Object of consideration, Technique of consideration.

Workflow Model A mapping of the flow (life cycle) of a particular object across a *Hierarchical Process Model* and the complementary *Hierarchical Data Model* on a chosen level of detail.
Such a flow contains *serial* and *parallel* arrangements of execution of processes.

Workflow Models can be depicted for representational objects (data and processes) and for physical objects (materials and production factors).
See also: Procedure.

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