Title: The Enterprise Ontology

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Abstract

This document presents the Enterprise Ontology, a collection of terms and definitions relevant to business enterprises. It was developed as part of the Enterprise Project, a collaborative effort to provide a framework for enterprise modelling. The Enterprise Ontology will serve as a basis for this framework which includes methods and a computer toolset for enterprise modelling.

We give an overview of the Enterprise Project, elaborate on the intended use of the Ontology, and discuss the process we went through to build it. The scope of the Enterprise Ontology is limited to those core concepts required for the project, however it is expected that it will appeal to a wider audience. It should not be considered static; during the course of the project, the Enterprise Ontology will be further refined and extended.

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Contents

1 Introduction

This document presents the Enterprise Ontology, a collection of terms and definitions relevant to business enterprises. It was developed as part of the Enterprise Project, a collaborative effort to provide a method and a computer toolset for enterprise modelling.

This document served as a specification for the subsequent coding of the Enterprise Ontology in the formal language: Ontolingua. The relatively small number of changes to the Enterprise Ontology identified while coding will be reflected in a future version of this document.

1.1 Context: the Enterprise Project

The overall objective of the Enterprise Project is to improve and where necessary replace existing modelling methods with a framework for integrating methods and tools which are appropriate to enterprise modelling and the management of change. This framework is based on an ontology for enterprise modelling.

A goal of the Enterprise Project is to provide a computer-based toolset which will help capture aspects of a business and analyse these to identify and compare options for the meeting the business requirements. The toolset will provide task management support to users by helping them perform enterprise modelling activities and guiding them through the toolset facilities. These facilities will enable:

- capture and description of an enterprise (e.g. its processes, strategy, organisational structure, resources, goals, constraints and environment);
- specifications of business problems/requirements, consistent with the ontology;
- identification and evaluation of solution options and alternative design and implementation paths at strategic, tactical and operational levels;
- representations for the definition of relevant metrics and advanced simulation support.

The Enterprise Project is led by AIAI at the University of Edinburgh and the partners are IBM UK, Lloyd's Register, Logica and Unilever. The project is supported by the Department of Trade and Industry. Further information is available on the World Wide Web at: *http://www.aiai.ed.ac.uk/~entprise/enterprise/*.

1.2 The Role of the Ontology

The major role of the Enterprise Ontology is to act as a communication medium; in particular, between:

- different people, including users and developers, across different enterprises;
- people and implemented computational systems;

- different implemented computational systems (including modules of the Enterprise toolset, DBMS, spreadsheet etc.)

Also, and very importantly, the Ontology is intended to assist:

- acquisition, representation, and manipulation of enterprise knowledge; such assistance is via the provision of a consistent core of basic concepts and language constructs;
- structuring and organising libraries of knowledge;
- the explanation of the rationale, inputs and outputs of the Enterprise toolset modules.

The following are potential future uses of the Enterprise Ontology that are outside the scope of this project:

- the transition of research knowledge and systems into operational prototypes;
- the analysis of the internal structures, algorithms, and inputs and outputs of implemented systems, in theoretical and conceptual terms.

The Enterprise Ontology should not be considered static; it is an evolving definition of terms. It will be further refined and extended as the Enterprise Project progresses.

Ontologies can be thought of as codified knowledge on a library shelf. As we expect that the Enterprise Ontology will be of interest to a wider audience, it may itself be put on a library shelf in the future for use by others. However, this potential for wider use has not influenced the development of the Ontology directly.

1.3 Development of the Ontology

1.3.1 Scope

Considerable time and effort has been devoted to deciding the scope and boundaries for the Ontology. We began by brainstorming to identify as many potentially important concepts as possible. This produced a totally unstructured list of words and phrases corresponding to a wide variety of concepts relevant to Enterprises. These were then grouped into various more or less distinct work areas such that there was more similarity in meaning and a need to refer to terms within an area than between different areas (*e.g.* Activity, Marketing, Organisation). Within each work area, the terms were assigned priorities indicating the importance of including them in the Ontology. At this point many terms were discarded and duplicates (*i.e.* nearly synonymous terms) were removed.

These work areas were dealt with one by one. For each concept, terms were chosen, and definitions given. The original work areas evolved somewhat, as new terms were added, and others removed or moved to other areas. Eventually, these work areas became the major structuring element for the Ontology and is reflected in the major sections of this document.

Within each work area, various important questions were addressed. What basic or core concepts are required? What mix of terms having a wide or general meaning and terms having a narrow or specific meaning are required?

Many factors influenced the choice of terms in the Ontology. The ultimate criterion is the judgement of what concepts are likely to be sufficiently important to the Enterprise Project and be capable of a common agreement on their meaning. Many words in common use in enterprise management have been judged to have no sufficiently widely recognised or acceptable meaning to be included in the Ontology. This does not mean they cannot be used in the project. It does mean that the meaning of such words in the context of their use will have to be related to the terms in the Ontology all of whose meanings are shared. This document attempts to give guidance on how this can be done where a potential need for this has been recognised.

1.3.2 Choosing Terms

The terms in the Enterprise Ontology have been chosen as far as possible to match the natural use of English words by people managing enterprises. This is often difficult. For a term to be used in an ontology, it should ideally have one meaning precisely defined. Real people managing enterprises often use words very flexibly (*i.e.* with varying meanings). Much of the time the particular meaning of such a word used in a particular context is correctly interpreted without the hearer realising the word is potentially ambiguous. On other occasions mis-understanding may occur, but even then, will often be corrected by common sense very quickly.

Therefore some of the terms used in the Enterprise Ontology may not be the natural choice for a particular concept for a particular reader. For example, a widely used word may be given a more limited meaning, a surprisingly wide meaning, or even specifically excluded from the Ontology in favour of some other word. Sometimes important concepts are identified for which there is no obvious name; in such cases unusual words or phrases may be introduced and frequently referred to.

However, the choices for terms, far from being arbitrary, were reached only after much consideration. The main criteria for deciding were to conform to common usage and to avoid ambiguity. Ultimately there are no absolutely correct choices; they can only be the result of careful judgement.

1.3.3 Definitions

The purpose of the definitions in an ontology are very different from that of dictionary definitions. The latter report how words are used; ontology definitions have a normative role. They define how a limited set of terms are to be used in relation to each other. Each definition in an ontology requires careful understanding in relationship to the other definitions in the ontology. Therefore, to understand the Enterprise Ontology requires a willingness to suspend preconceptions based on the dictionary meaning and/or other common usage of terms.

Within each work area, the Ontology has been developed by trying to identify a small

number of concepts central to the subject of the section (this is called 'basic' in categorisation theory). For example, 'person' is basic, whereas 'teenager' is more specific, and 'living organism' is more general. A basic term is defined first and then the related terms are defined as far as possible using the basic terms already defined. These other terms may be more general or more specific. The degree to which the definition of a term depends on other terms, and whether they themselves are dependent on more basic ones, provides an indication of how far a term is from the 'core' of the Ontology. The basic terms have been defined with the minimum possible reliance on other terms, however some dependence has been unavoidable.

Very importantly, the definitions themselves, which capture the many concepts, need to be expressed in as precise a language as possible. Such precision was gained through the identification and use of a small number of building blocks including such notions as: an Entity, a Relationship, a State Of Affairs and a Role. Insofar as such terms are the language primitives used for expressing the definitions in an ontology, they are collectively referred to as a 'meta-ontology'.

The Enterprise Meta-Ontology has been kept as small as possible. Frequently, the definition of an Ontology term will be given using the meta-ontological terms: *e.g.* an Activity is an Entity; Legal Ownership is a Relationship between a Legal Entity (owner) and an Entity (owned). However, sometimes the technical precision of this approach was sacrificed for readability and the relevant meta-ontological categories are implicit.

The natural langauge definitions in this document served as a specification for the subsequent coding of the Ontology in a formal language. In the code, all terms are defined using the concepts in the Meta-Ontology.

The coding effort identified a relatively small number of changes to the Ontology which will be reflected in a future version of this document.

1.4 Document Structure

The central content of this document is in the sections containing definitions of terms forming the Ontology. As noted above, the structure corresponds directly to the work areas. Within each section, the terms have been grouped so that terms closely related to each other appear close together as far as possible. This is largely a pragmatic judgement. The relationships are a complex web and there is no perfect way to organise the terms to avoid references between sections. However, the groupings were first chosen by experience and common sense and have continued to appear valid and useful with minor modification as the Ontology has developed. These sections exist only for convenience of exposition; no meaning is to be inferred from the fact that a particular term appears in one section rather than another. The sections are as follows:

§ **2:** *Meta-Ontology* – terms used to define the terms of the Ontology
e.g. Entity, Relationship, Role;

§ **3:** *Activity, Plan, Capability and Resource* – terms related to processes and planning
e.g. Activity, Planning, Authority, Resource Allocation;

§ **4:** *Organisation* – Terms related to how Organisations are structured

e.g. Person, Legal Entity, Organisational Unit, Manage, Ownership;

§ **5:** *Strategy* – Terms related to high level planning for an enterprise
e.g. Purpose, Mission, Decision, Critical Success Factor;

§ **6:** *Marketing* – Terms related to marketing and selling goods and services
Sale; Customer; Price; Brand; Promotion

§ **7:** *Time* – Terms related to time
e.g. Time Point, Duration, Date, After, Earliest Start Time.

1.5 Presentation

In the main sections presenting the Ontology, each term is introduced with a definition. Within each section, we proceed by defining the terms that we regard as most basic first. We define other terms using these basic ones.

The definitions are written in carefully chosen English with other Ontology terms in UPPER case. A term is defined using a base word, however for convenience of exposition, we use grammatical variations also in upper case as if they were themselves formally defined (*e.g.* ACHIEVE, ACHIEVEMENT).

In general, any officially defined term will be presented in upper case throughout the document. However, in § 2, which describes the Meta-Ontology, terms defined in the main Ontology sections are Capitalised rather than being in full upper case (*e.g.* 'Activity' not 'ACTIVITY'). Conversely, terms defined in the Meta-Ontology are capitalised when used in the main Ontology definitions (*e.g.* 'Role' not 'ROLE').

Occasionally, we will use a word informally that is also used as an official term in the Ontology. The general rule is that official terms that appear in lower case, and all other words, should be interpreted in their dictionary sense in the light of their context.

The definition of each term is intended to be necessary and sufficient as far as this is possible in natural language. However, in many cases it is felt essential to provide clarification or additional information. This is done as notes following the definition.

1.5.1 Related Terms

To better understand the Enterprise Ontology, it is helpful to know how its terms and concepts relate to the terms and concepts that the reader is already familiar with as used in other contexts (*e.g.* other ontologies). Therefore, at the end of each section we list a number of related terms that are fairly commonly used but are *not* defined in the Enterprise Ontology. Where possible, we specify the relationship between these terms and those in the Enterprise Ontology. These related terms fall into three categories:

1. *Synonyms*: Commonly used terms that are not defined in the Ontology, but which are identical or very similar in meaning to specific defined terms.

2. *Unofficial Terms*: Terms for concepts that are not defined in the Ontology, but for which an attempt is made to indicate how such concepts might be defined using Ontology terms.
3. *Other Commonly Used Terms*: A list of commonly used terms that were not defined.

1.6 Ontology Overview

As already mentioned, the sections are as follows:

- Meta Ontology
- Activity, Plan, Capability, and Resource
- Organisation
- Strategy
- Marketing
- Time

See figure 1 for a table listing of all the concepts defined in the Enterprise Ontology organised by major section.

For initial understanding, the Meta-Ontology will be dealt with last in this overview. The main concepts of each section and the main relationships between them are given in the following sections. Some readers may prefer to go directly to the main sections, and read this section as a summary.

1.6.1 Activities and Processes

The central term is ACTIVITY. This is intended to capture the notion of anything that involves doing, in particular including action. The concept of ACTIVITY is closely linked with the idea of the DOER, which may be a PERSON, ORGANISATIONAL UNIT or MACHINE. These terms are defined in the Organisation section and may collectively be referred to as ACTORS (see § 1.6.6). The ability to be the DOER of an ACTIVITY is denoted by CAPABILITY (or SKILL if the DOER is a PERSON). ACTORS may have other Roles in respect of an ACTIVITY such as ACTIVITY OWNER.

Also closely related to ACTIVITY is RESOURCE, which is something used or consumed in an ACTIVITY. An ACTIVITY can also have outputs or EFFECTS. An ACTIVITY is linked to a TIME INTERVAL, which is defined in the Time section (§ 7). An ACTIVITY may be large and complex and take a long time. This may be represented as composition of many SUB-ACTIVITIES.

An ACTIVITY can obviously have happened in the past and may be happening in the present. The term can also be used to refer to a hypothetical future ACTIVITY. However, there is a need to refer explicitly to specifications or plans for ACTIVITIES. This is

ACTIVITY etc.	*ORGANISATION*	*STRATEGY*	*MARKETING*	*TIME*
Activity	Person	Purpose	Sale	Time Line
T-Begin	Machine	Hold-Purpose	Potential Sale	Time Point
T-End	Corporation	Purpose-Holder	For Sale	Calendar Date
Pre-Condition	Partnership	Objective	Vendor	Relative Time Point
Effect	Partner	Vision	Actual Customer	Duration
Doer	Legal Entity	Mission	Potential Customer	Duration Bounds
Sub-Activity	Organisational Unit	Goal	Customer	Time Interval
Activity Decomposition	Manage	Achieve	Reseller	Before
Authority	Delegate	Help Achieve	Product	Same or Before
Activity Owner	Management Link	Strategy	Asking Price	After
Event	Organisational Structure	Strategic Planning	Sale Price	Same or After
Plan	(Non-)Legal Ownership	Strategic Action	Market	Distance
Execute	Ownership	Decision	Segmentation Variable	Earliest Start Time
Sub-Plan	Owner	Assumption	Market Segment	Latest Start Time
Planning	Asset	(Non-) Critical Assumption	Market Research	Earliest End Time
Process Specification	Stakeholder	Influence Factor	Brand	Latest End Time
Capability	Contract of Employment	(Non-) Critical Influence Factor	Image	Interval Before
Skill	Share	Critical Success Factor	Feature	Interval During
Resource	Shareholder	Risk	Need	Interval Overlaps
Resource Allocation			Market Need	Interval Disjoint
Resource Substitute			Promotion	
			Competitor	

This table contains all terms formally defined in the Enterprise Ontology. Within each column, the terms are listed in the same order as they appear in the main sections of this document. There is no relationship between terms that happen to be in the same row.

Figure 1: Overview of Enterprise Ontology

provided by the term PLAN. A PLAN specifies at some level of detail one or more possible ACTIVITIES and will normally be related to a PURPOSE, which is defined in § 5 on Strategy. The concept of repeatability of an ACTIVITY or PLAN is captured in the term PROCESS SPECIFICATION.

Control of doing of ACTIVITIES is important to enterprises. This is provided by the term AUTHORITY which is defined as the right to authorise a DOER (including the holder of the right themselves) to perform the ACTIVITY.

1.6.2 Organisation

Central to the Organisation section are concepts of LEGAL ENTITY and ORGANISATIONAL UNIT (abbreviated as OU). Both of these refer to things which have a "gestalt" whether they are individual or composite. They differ in that a LEGAL ENTITY is recognised as having rights and responsibilities in the world at large and by legal jurisdictions in particular, whereas ORGANISATION UNIT need only have full recognition within an organisation.

LEGAL ENTITY includes PERSON and CORPORATION. Larger LEGAL ENTITIES may wholly own other smaller LEGAL ENTITIES. ORGANISATION UNITS may be large and complex, even transcending LEGAL ENTITIES. Large OUs will normally be seen as being made up from smaller ones. The smallest may correspond to a single PERSON, in fact a particular PERSON could be seen as corresponding with more than one small OU.

A MACHINE is a non-human, non-legal ENTITY that may play certain Roles otherwise played by a PERSON or OU (*e.g.* perform an ACTIVITY).

The OWNERSHIP of rights and responsibilities may only, from the legal point of view, lie with a LEGAL ENTITY. Within an organisation, rights and responsibilities for RESOURCES may be allocated to OUs. Therefore OWNERSHIP is defined to include this, with LEGAL and NON-LEGAL OWNERSHIP defined to enable the distinction where needed. OUs may be responsible for ACTIVITIES.

Within an organisation the management structure is represented by MANAGEMENT LINKS. The term MANAGE represents assigning PURPOSES to OUs. An ORGANISATIONAL STRUCTURE will be defined as a pattern of MANAGEMENT LINKS between OUs. This can include multiple MANAGEMENT LINKS into any one OU with constraints on the different type of PURPOSES assigned through each link.

1.6.3 Strategy

The central concept of the Strategy section is PURPOSE. PURPOSE captures the idea either of something which a PLAN can HELP ACHIEVE or that an ORGANISATION UNIT can be responsible for (defined in the Organisation section). In fact it includes any kind of PURPOSE, whether on a level of organisation and time scale which will normally be called strategic, or detailed and short term.

Like an OU, a PURPOSE can be composed or decomposed. That is, one statement of PURPOSE may relate to something which can also be seen to HELP ACHIEVE some

grander PURPOSE. By this means, a spectrum of widely used terms like VISION, MISSION, GOAL, and OBJECTIVE can be represented without there being shared agreement on precisely how these terms are used.

STRATEGY is defined as a PLAN to ACHIEVE a high-level PURPOSE. Based on the concept of PLAN from the Activity section, the concepts key to STRATEGIC PLANNING can be represented with the terms DECISION, ASSUMPTION, RISK, and various types of FACTOR.

1.6.4 Marketing

The central concept of the Marketing section is SALE. A SALE is an agreement between two LEGAL ENTITIES for the exchange of a PRODUCT for a SALE PRICE. Normally the PRODUCT is a good or service and the SALE PRICE is monetary, however other possibilities are included. The LEGAL ENTITIES play the (usually distinct) Roles of VENDOR and CUSTOMER. A SALE can have been agreed in the past, and a future POTENTIAL SALE can be envisaged, whether or not the actual PRODUCT can be identified, or even exists.

The MARKET is all SALES and POTENTIAL SALES within a scope of interest. The MARKET may include SALES by COMPETITORS. The MARKET may be decomposed into MARKET SEGMENTS in many ways in many levels of detail. This can be done by any properties of the PRODUCT, VENDOR, CUSTOMER, SALE PRICE or of anything else associated with a SALE. These properties are SEGMENTATION VARIABLES.

Analysis of a MARKET may involve understanding of FEATURES of PRODUCTS, NEEDS of CUSTOMERS, and IMAGES of BRANDS, PRODUCTS, or VENDORS. PROMOTIONS are ACTIVITIES whose PURPOSES relate to the IMAGE in a MARKET.

1.6.5 Time

The basic concepts of the Time section are TIME LINE and TIME POINT. From these are derived DURATION, TIME INTERVAL, CALENDAR DATE, and other concepts which may be required to relate to the other terms of the Ontology. The important notions of before and after are represented as Relationships between TIME POINTS; the notions of disjoint, during, overlaps are represented as Relationships between TIME INTERVALS.

1.6.6 Meta-Ontology

The basic concept of the Meta-Ontology is ENTITY. This is in a sense the catch-all for all other concepts. In creating the Ontology, some concepts will be seen as standing in their own right independent of others (e.g. PERSON). These will be directly classed as ENTITIES. Other concepts will more naturally be seen as a RELATIONSHIP between two or more other ENTITIES (e.g. SALE). Thus though SALE could legitimately be described as an ENTITY, it is more precisely characterised by being described as RELATIONSHIP.

Within a RELATIONSHIP, an ENTITY may have a ROLE (e.g. a Person may be Customer in a Sale). Alternatively, an ENTITY may be seen as an ATTRIBUTE of another ENTITY (e.g. Date of birth of a Person).

Certain ROLES in RELATIONSHIPS are special in that the playing of these ROLES entails some notion of doing or cognition (*e.g.* performing an Activity, or holding an Assumption). Only certain ENTITIES can play such ROLES; currently this includes Persons, OUs and in some cases Machines.

We refer an ENTITY playing such a ROLE as a ACTOR (roughly synonymous with 'agent' in other ontology work). A ROLE played by an ACTOR is an ACTOR ROLE.

Too accommodate the needs of a multiplicity of users and viewpoints now and in the future, new ACTOR ROLES may commonly arise, as new RELATIONSHIPS are introduced into or used in conjunction with the Ontology. New major types of ACTOR ENTITIES may also arise, though perhaps less frequently.

As has previously been mentioned, the terms in the Ontology have not been explicitly defined in terms of this Meta-Ontology unless this has seemed the most natural choice for a particular term. However, the Meta-Ontology has been implicit in much of the work leading to the choice of terms and definitions. When the Ontology is coded in a formal language, it is expected that the relationship between the terms and the Meta-Ontology will become more explicit.

2 Meta Ontology

In this section, we present the main terms and concepts used to define the Enterprise Ontology itself. In § 2.1, we introduce the main concepts and building blocks: ENTITIES, RELATIONSHIPS, and STATE of AFFAIRS. In § 2.2 we introduce RELATIONSHIPS and ENTITIES which entail some notion of doing or cognition.

2.1 Entities, Relationships and States of Affairs

The Enterprise Ontology is composed of a set of ENTITIES and a set of RELATIONSHIPS between ENTITIES. ENTITIES can play ROLES in RELATIONSHIPS. An ATTRIBUTE is a special kind of RELATIONSHIP. A STATE OF AFFAIRS is a situation characterised by any combination of ENTITIES being in any number of RELATIONSHIPS with one another.

ENTITY: a fundamental thing in the domain being modelled. *Examples:*

- a human being is an ENTITY
- a plan is an ENTITY

Notes:

1. An ENTITY may participate in RELATIONSHIPS with other ENTITIES.

RELATIONSHIP: the way that two or more ENTITIES can be associated with each other.

Examples:

- Have-Capability is a relationship between a Person and an Activity denoting that the Person is able to perform the Activity.
- a Sale is a relationship constituting an agreement between two Legal Entities to exchange a Product for a Sale Price.

Notes:

1. A RELATIONSHIP is itself an ENTITY that can participate in further RELATIONSHIPS.
2. In natural language the word 'relationship' as many meanings. The following are important but logically distinct concepts that 'relationship' commonly refers to:
   - the type of relationship (closest to above definition);
   - a name given to the type of relationship (e.g. 'Marriage', 'Have-Capability');
   - a particular relationship between particular ENTITIES.
     Examples:
     - Bill and Hillary Clinton are in a Marriage relationship.
     - Einstein was in a Have-Capability relationship with the Activity of thinking.

   Further distinctions can be made reflecting the use of the mathematical concept of a tuple. For example, in mathematics, the set of all tuples related in a certain way is a useful concept (e.g. the set of all married couples). This is similar to the idea of a class or a type which may refer to the set of all ENTITIES of a certain kind.

   In this document, these distinctions are ignored; however they will be very significant during the formal coding of the Ontology. The way in which these distinctions are handled will depend on the representation language used for coding.

ROLE: the way in which an ENTITY participates in a RELATIONSHIP.

Examples:

- Vendor is a ROLE played by an ENTITY in a Sale RELATIONSHIP (see § 6).

Notes:

1. A participating ENTITY is said to be *playing* the ROLE.
2. Strictly speaking, the correct way to refer to an Entity playing a particular ROLE, is to use a phrase like 'the Entity playing the Vendor ROLE'. However, for convenience – where ambiguity will not arise – we will often use an abbreviated form such as: 'the Vendor'.

ATTRIBUTE: an asymmetric RELATIONSHIP between two ENTITIES (referred to as the 'attributed' and 'value' ENTITIES) with the following property:

- within the scope of interest of the model, for any particular attributed ENTITY the RELATIONSHIP may exist with only one value ENTITY.

Examples:

- Date of Birth is an ATTRIBUTE associating only one Date with a given Person.

Notes:

- From a mathematical perspective, an ATTRIBUTE is a function.

STATE OF AFFAIRS: a situation; the following is necessarily true of a STATE OF AFFAIRS:

- it is described by or consists of one or more statements asserting that a RELATIONSHIP holds between particular ENTITIES;
  E.g. 'Joe Bloggs can lay bricks' (*i.e.* is in the Have-Capability RELATIONSHIP with the Activity: bricklaying.')
- it can be said to hold, or be true.

2.2 Actors

Certain ROLES in RELATIONSHIPS are special in that the playing of these ROLES entails doing or cognition. These are called ACTOR ROLES; ENTITIES playing such roles are called ACTORS.

ACTOR ROLE: A kind of ROLE in a RELATIONSHIP whereby the playing of the ROLE entails some notion of doing or cognition.

Notes:

1. Currently, only the following RELATIONSHIPS in the Enterprise Ontology have ACTOR ROLES:

RELATIONSHIPS:	*ACTOR ROLES:*
Perform-Activity	performer
Have-Capability	haver
Have-Authority	haver
Delegate	delegator
	delegatee
Hold-Purpose	holder
Hold-Assumption	holder
Ownership	owner

2. Users of the Ontology may define other RELATIONSHIPS that have one or more ACTOR ROLES.

ACTOR: an ENTITY that plays an ACTOR ROLE in a RELATIONSHIP.

Notes:

1. the types of ENTITY that play the ACTOR ROLE (*i.e.* ACTORS) are (by definition) limited to those for which some notion of doing or cognition is possible. Currently, this includes, but is not necessarily limited to (including subtypes):
   - Person
   - Organisational Unit (example subtype: Corporation)
   - Machine

2. If users of the Ontology require other other ENTITIES to be ACTORS, they should review the Ontology RELATIONSHIPS using the ACTOR ROLE to ensure the addition is valid for them.
3. A more elaborate classification of ACTORS might consist of two main types: *Natural* and *Artificial*, the latter being synonymous with Machines. *Animals*, of which Person could be a special type would come under the former category as would *Gravity* which is rather different, and might be classified separately as *In-Animate*. *Artificial* ACTORS might be further classified, *e.g.* into physical and conceptual Machines.
4. Some ACTOR ROLES can be played by only *some* of the above ACTORS. For example, it may not be allowed for a machine to own something. Where agreement exists, such restrictions may be specified in the Ontology itself; alternatively they may be specified later by individual users.

2.3 Related Terms

2.3.1 Synonyms

- *Class* (in Object-Oriented systems *e.g.*: Ontolingua) &
  Concept (in Description Logics): type of ENTITY
- *Instance, Individual*: ENTITY
- *Relation, Predicate*: RELATIONSHIP
- *State*: STATE OF AFFAIRS
- *Slot* (in Object-Oriented systems) &
  Role (in Description Logics): ATTRIBUTE
- *Agent*: ACTOR

2.3.2 Unofficial Terms

1. (mathematical) *Function*: an ATTRIBUTE is a function, though not all functions need be ATTRIBUTES.

3 Activity, Plan, Capability and Resource

In this section, we present the central concept of an ACTIVITY along with various important Relationships between ACTIVITIES and other ENTITIES. Important related concepts are: PLAN, which is a specification of one or more ACTIVITIES for some PURPOSE; CAPABILITY to perform ACTIVITIES, and RESOURCE which is something used or consumed during an ACTIVITY.

3.1 Activities

ACTIVITY: something done over a particular TIME INTERVAL. The following may pertain to an ACTIVITY:

- has PRE-CONDITION(S);
- has EFFECT(S);
- is performed by one or more DOERS;
- is decomposed into more detailed SUB-ACTIVITIES
- entails use and/or consumption of RESOURCES
- has AUTHORITY requirements
- is associated with an [ACTIVITY] OWNER
- has a measured efficiency

Notes

1. an ACTIVITY can have happened in the past, may be happening in the present, and a hypothetical future ACTIVITY may be envisaged;
2. The word 'something' in the above definition is deliberately general; we mean to include mental activities, for example.
3. We wish to allow PURPOSE-free ACTIVITY, such as water flowing down a hill. An association between an ACTIVITY and a PURPOSE can be made by matching the PURPOSE of a PLAN to the EFFECT(S) of ACTIVITIES specified in the PLAN.
4. ACTIVITIES may be informally classified as 'strategic', 'tactical' or 'operational' depending on the 'level' of an associated PURPOSE as characterised by the HELP ACHIEVE Relationship between PURPOSES.

T-BEGIN and T-END: the two TIME POINTS that define the TIME INTERVAL over which an ACTIVITY is done;

PRE-CONDITION: a State Of Affairs required to be true in order for the ACTIVITY to be performed.

Notes:

1. The requirement may be specified to hold immediately before T-BEGIN, immediately before T-END, or throughout the whole TIME INTERVAL.

EFFECT: State Of Affairs that is brought about [i.e. made true] by the ACTIVITY.

Notes:

1. The EFFECT may be specified to hold immediately after T-BEGIN, immediately after T-END, or throughout the whole TIME INTERVAL. For example, ringing a door buzzer has EFFECT of producing noise during but not before or after the TIME INTERVAL of the ACTIVITY.

DOER: the Role of an Actor in a Relationship with an ACTIVITY whereby the Actor performs (all or part of) the ACTIVITY.

Notes:

1. There may be more than one DOER for a given ACTIVITY.
2. Not all ACTIVITIES need have an explicit DOER; *e.g.* flowing water; In such cases, it may be more natural to think of the DOER as the supplier of force behind an ACTIVITY (*e.g.* the environment, gravity).

SUB-ACTIVITY: The Role of an ACTIVITY in a Relationship with another ACTIVITY such that performance of the first ACTIVITY is considered to be part of the performance of the other ACTIVITY.

Examples:

- performing each of the following SUB-ACTIVITIES may be considered to be part of performing the ACTIVITY "go to Edinburgh"
  - go to Heathrow
  - fly to Edinburgh airport
  - go to Edinburgh city centre

Notes:

1. Typically an ACTIVITY will be decomposed into SUB-ACTIVITIES to provide more detail.

ACTIVITY DECOMPOSITION: The specification of how an ACTIVITY is decomposed into one or more SUB-ACTIVITIES; this may include the specification of constraints on and between the SUB-ACTIVITIES.

Notes:

1. There is a lot more structure in an ACTIVITY DECOMPOSITION than a simple set of SUB-ACTIVITIES; e.g. temporal constraints may define a partial order.

AUTHORITY: The right to authorise a DOER to perform an ACTIVITY.

Notes:

1. The holder of AUTHORITY need not have the CAPABILITY to perform the activity;
2. The holder of AUTHORITY may be self-authorised as DOER;
3. The holder of AUTHORITY may DELEGATE some or all of it to other DOERS;
4. This definition allows for the case of a MACHINE having AUTHORITY.
5. The idea of CAPABILITY vs AUTHORITY is analogous to that of 'can' vs 'may'.

ACTIVITY OWNER: Actor responsible for an ACTIVITY.

Notes:

1. May be identified indirectly via Role (e.g. project manager) or directly as a named PERSON.
2. This will normally be NON-LEGAL OWNERSHIP

Depending on their requirements, users of the Ontology may find the need to define a variety of specific kind of ACTIVITIES. We introduce EVENT as one kind of ACTIVITY, but give no details. This allows users of the Ontology to distinguish EVENT from an arbitrary ACTIVITY, while ensuring that it inherits all the properties of ACTIVITY as defined in the Ontology.

EVENT: a kind of ACTIVITY a *Notes:*

1. One common distinction between event and ACTIVITY is that the former is seen as outside the scope of interest of the model apart from its EFFECTS. In particular, the model will not recognise the DOER, the DURATION, or choice or control over its occurrence (*e.g.* a hurricane which is performed by the 'environment').
2. Another common distinction between event and ACTIVITY is that the former is seen as instantaneous and the later as having duration. In fact, it is arguable that any event has some duration even if it is not measured, and the duration of ACTIVITY can be made arbitrarily small. Therefore, this is not considered a valid distinction to include in the Ontology.

3.2 Plans

PLAN: a specification of one or more ACTIVITIES for some PURPOSE. A PLAN may or may not be EXECUTABLE.

Notes:

1. The term PLAN is deliberately intended to include any degree of specification of ACTIVITIES; for example:
   - a trivial level of specification: 'go to Edinburgh';
   - a comprehensive and detailed set of instructions involving many ACTIVITIES.
2. Possible reasons that a PLAN may not be EXECUTABLE are:
   - it is underspecified and/or ambiguous, so the DOER has insufficient information to proceed with EXECUTION;
   - it contains constraints that cannot be met (*e.g.* regarding RESOURCE usage or timing)

EXECUTE: a Relationship between one or more DOERS and a PLAN whereby the one or more DOERS perform the ACTIVITIES as specified in the PLAN.

Notes:

1. A PLAN has been EXECUTED when all the ACTIVITIES in a PLAN have been performed as specified. This should result in the ACHIEVEMENT of the PURPOSE of the PLAN.

SUB-PLAN: a PLAN whose PURPOSE HELPS ACHIEVE the PURPOSE of another PLAN.

PLANNING: an ACTIVITY whose major EFFECT is to produce a PLAN.

PROCESS SPECIFICATION: a PLAN that is intended to be or is capable of being EXECUTED more than once.

Notes:

1. We intentionally do not define the term 'process', as it means so many things to so many people. The terms in this Ontology should be sufficient to define whatever specific notion of 'process' is required.

2. Typically, a PROCESS SPECIFICATION will be parameterised to enable reusability in various forms at different times. As such, it may be viewed as a PLAN schema.

3.3 Capabilities

CAPABILITY: a Relationship between a DOER and a specification of one or more ACTIVITIES denoting the ability of the DOER to perform the ACTIVITIES as specified.

Notes:

1. The idea of CAPABILITY vs AUTHORITY is analogous to that of 'can' vs 'may'.

SKILL: a CAPABILITY such that:

- the DOER is a PERSON;
- the ability must be practised/demonstrated to some measurable degree.

3.4 Resources

RESOURCE: a Role of an Entity in a Relationship with an ACTIVITY whereby the Entity is or can be used or consumed during the ACTIVITY.

Notes:

1. a RESOURCE may have a quantifiable measure denoting how much is available for use in ACTIVITIES
   e.g. amount of fuel; number of typewriters
   - If the RESOURCE is used but not consumed, the quantity available will decrease at the beginning and return to the original level at the end of the TIME INTERVAL of the ACTIVITY.
   - If the RESOURCE is consumed, the quantity available will decrease over the TIME INTERVAL of the ACTIVITY.
2. a RESOURCE may be shared by more than one ACTIVITY
3. An Entity produced by an ACTIVITY may be viewed as a RESOURCE in that *other* ACTIVITIES may use/consume it; however such outputs are not RESOURCES with respect to the producing ACTIVITY.

RESOURCE ALLOCATION: the allocation of RESOURCES to ACTIVITIES.

Notes:

1. RESOURCE ALLOCATION is itself an ACTIVITY, though it may not be necessary to model it explicitly as such. Indeed, the ACTIVITY of RESOURCE ALLOCATION itself may have RESOURCES allocated to it (e.g. personnel).
2. RESOURCE ALLOCATION is the responsibility of OUs
3. an OU responsible for RESOURCE ALLOCATION may DELEGATE it to another OU.

RESOURCE SUBSTITUTE: a RESOURCE that can be used or consumed in an ACTIVITY instead of another RESOURCE.

3.5 Related Terms

3.5.1 Synonyms

- *Behaviour*: ACTIVITY
- *Task*: ACTIVITY
- *Action*: ACTIVITY

3.5.2 Unofficial Terms

1. *Personal Skill*: the degree of SKILL recognised for a PERSON

3.5.3 Other Commonly Used Terms

1. *Process:* see note 1 under definition of PROCESS SPECIFICATION.

4 Organisation

The central concept in this section is that of an ORGANISATIONAL UNIT, the main structural element of an organisation. Complex ORGANISATIONAL STRUCTURE is captured by the various MANAGE relationships between OUs.

First, however, we define the notions of a LEGAL ENTITY (which includes a PERSON, CORPORATION etc.) and a MACHINE, all of which themselves may correspond to a single OU.

Other important concepts defined in this section are DELEGATION, OWNERSHIP, STAKEHOLDER, SHARE, SHAREHOLDER and ASSET.

4.1 Legal Entities and Machines

PERSON: a human being

Notes:

1. For the purposes of this Ontology, PERSONS are of interest for their capacity to play various Actor Roles in an enterprise (*e.g.* perform ACTIVITIES).
2. The concepts of sole trader and a registered business are included here. For most purposes, the law makes no distinction between these things and the PERSON owning/operating them.

MACHINE: a non-human Entity which has the capacity to carry out functions and/or play various roles in an enterprise.

Notes:

1. a MACHINE is similar to a PERSON in that many functions and roles may be performed by either. However, it is anticipated that some functions and roles will be exclusive to one or the other. For example, a MACHINE may not be held responsible for anything.

CORPORATION: A group of PERSONS recognised in law as having existence, rights, and duties distinct from those of the individual PERSONS who from time to time comprise the group.

Notes:

1. Historically, in law, rights and duties apply to individual humans; rights and duties of groups are inherited from this.

PARTNERSHIP: A group of PERSONS carrying on business in common.

Notes: The following is true in English law, but not necessarily in other legal systems:

1. there is a distinction between PARTNERSHIP and CORPORATION;
2. each PARTNER may have unlimited liability for the debts of the PARTNERSHIP to other LEGAL ENTITIES;
3. the PARTNERSHIP does not have a legal identity separate from its PARTNERS; e.g. if PARTNERSHIP is sued, this means all PARTNERS are sued.

PARTNER: a PERSON who forms part of a PARTNERSHIP;

LEGAL ENTITY: the union of PERSON, CORPORATION, and PARTNERSHIP

Notes:

1. For the purposes of the Ontology, this is equivalent to the more commonly used definition of a LEGAL ENTITY: 'that which can enter into a legal contract'.

4.2 The Structure of Organisations

ORGANISATIONAL UNIT (OU): an Entity [with a defined identity] for MANAGING the performance of ACTIVITIES to ACHIEVE one or more PURPOSES. An OU may be characterised by:

- the nature of its PURPOSE(S);
- one or more PERSONS working for the OU;
- RESOURCES allocated to the OU;
- other OUs that MANAGE or are MANAGED-BY the OU;
- its ASSETS;
- its STAKEHOLDERS;
- being LEGALLY OWNED;
- its MARKET (if it is a VENDOR).

Notes:

1. The term OU is deliberately defined with no constraint on its size or place within an organisation. Furthermore, no special terms for OUs of any particular size are defined (e.g. division, department). This is because no consistent use of such terms can be found across different enterprises, or even within a single enterprise over time. Therefore the existence of a very small and simple unit, even corresponding with a single person, or a very large and complex structure (e.g. a multi-national CORPORATION) can equally be represented as an OU. The structure of an OU is represented by the set of as many other OUs and MANAGEMENT LINKS (see below) as required.
2. The term MANAGEMENT LINK leads to the concept of higher-level and lower-level OUs depending on which MANAGE and which are MANAGED.
3. The terms 'enterprise' and 'organisation' are not defined in the Ontology, but a user of the Ontology may wish to define one or other of them as a high-level OU, perhaps corresponding with highest OU in the scope of interest.
4. An individual PERSON may correspond to, or belong to, more than one OU, one for each different role or function.
5. An essential PURPOSE of most OUs is to maximise performance against financial and other organisational OBJECTIVES.

MANAGE: the ACTIVITY of assigning PURPOSES and monitoring their ACHIEVEMENT

Notes:

1. This includes RESOURCE ALLOCATION and the power to give AUTHORITY;
2. This includes managing of people, (*e.g.* skill base, career development), and of OUs. This is reflected by the nature of the PURPOSES that are set and monitored; e.g. time horizon, deliverables.
3. This gives rise to an asymmetric Relationship between the managing and managed entities. See MANAGEMENT LINK.
4. Although the visible activity of management in an enterprise may take place between PERSONS (or possibly MACHINES), where the PURPOSE assigned and monitored clearly relates to the activities of the OU, it will frequently be natural to model it as being between the OUs.

DELEGATE: a kind of MANAGING ACTIVITY whereby there is a transfer of something to a (normally lower-level) Actor.

Notes:

1. We do not formally characterise DELEGATION, this is left to the users. Details to be considered include what may be delegated, (*e.g.* task, authority, responsibility).

MANAGEMENT LINK: a Relationship whereby one Actor directly MANAGES another Actor.

Notes:

1. A single sequence of Actors directly connected via MANAGEMENT LINKS can be thought of as a management chain. More precisely, all management chains have:
   - Only one Actor (lowest level) that does not MANAGE another Actor;

- Only one Actor (highest level) that is not MANAGED by another Actor;
- No branching (*i.e.* no Actor MANAGES or is MANAGED by more than one other Actor).

2. An OU at the lower end of a Management Chain may correspond directly with one PERSON. The PURPOSES of such a PERSON may be very similar to the PURPOSES of the OU and therefore the PURPOSES may not need to be separately modelled. Higher up a Management Chain, the PURPOSES of an OU are likely to be dissimilar to the PURPOSES of a PERSON.
3. By virtue of being MANAGED by an OU, an OU may informally be thought of as being 'part of' the MANAGING OU.
4. Insofar as a MACHINE can be viewed as a MANAGED and/or MANAGING Entity, it may be considered to be an OU.

ORGANISATIONAL STRUCTURE: the MANAGEMENT LINKS relating a set of OUs

Notes:

1. Examples of common ORGANISATIONAL STRUCTURES are hierarchical (e.g. line management), matrix (for project/programme management) and flat.
2. Co-management is a situation where an OU is MANAGED by more than one OU.

LEGAL OWNERSHIP: a Relationship between a LEGAL ENTITY and an Entity whereby the LEGAL ENTITY has certain rights with respect to the Entity.

Notes:

- the Entity in such a Relationship will be said to be 'LEGALLY OWNED'

NON-LEGAL OWNERSHIP: a Relationship between an Actor and an Entity whereby the Actor is recognised within a LEGAL ENTITY as having certain rights with respect to the Entity.

Examples:

- the Relationship between an OU and the RESOURCES allocated to it.

Notes:

1. In the eyes of the law, OWNERSHIP can only be vested in a LEGAL ENTITY. For practical purposes within an organisation, rights of an Actor with respect to an Entity within the organisation will be important to model.

OWNERSHIP: the union of LEGAL OWNERSHIP and NON-LEGAL OWNERSHIP.

Notes:

1. This is equivalent to: a Relationship between an Actor and some Entity whereby the Actor has certain rights with respect to the Entity.
2. It is *rights* that are OWNED, not the Entity itself; *e.g.* one who leases a car does not own the car, but they have legal rights with respect to it.

OWNER: the Role of the Actor in an OWNERSHIP Relationship

ASSET: an Entity LEGALLY OWNED that has MONETARY VALUE.

Examples:

- MACHINE, equipment, land, building, material,
- idea, design, patent, information.

Notes:

1. 'having monetary value' is not the same as 'can appear on a balance sheet'
2. capital asset, fixed asset and liquid asset are specialisations of ASSET but are not central to our concerns. The differences between these are determined by accounting standards.
3. The two sets of entities: RESOURCES and ASSETS are overlapping, but an ASSET is not necessarily a RESOURCE, nor vice versa.

STAKEHOLDER: a Role of a LEGAL ENTITY or OU in a Relationship with an OU whereby one or more PURPOSES of the OU are included in the scope of interest of the LEGAL ENTITY or OU.

Notes:

1. the STAKEHOLDER is usually one of: OWNER, PARTNER, SHAREHOLDER, EMPLOYEE.

CONTRACT OF EMPLOYMENT: An agreement [Relationship] between a LEGAL ENTITY in the Role of EMPLOYER and a PERSON in the Role of EMPLOYEE.

SHARE: A subdivision of the rights of OWNERSHIP of a CORPORATION recognised by law and the CORPORATION.

SHAREHOLDER: A LEGAL ENTITY OWNING one or more SHARES in a CORPORATION.

4.3 Related Terms

4.3.1 Synonyms

Party: LEGAL ENTITY

Control Structure: ORGANISATIONAL STRUCTURE

Management Structure: ORGANISATIONAL STRUCTURE

4.3.2 Unofficial Terms

Company: roughly synonymous with CORPORATION; the minor legal differences between a Company and CORPORATION are ignored in this Ontology.

Registered Business that is not a CORPORATION: encompassed by PERSON

Sole Trader: encompassed by PERSON

Business: CORPORATION, or Sole Trader or Registered Business that is not a CORPORATION.

5 Strategy

The central concept in this section is PURPOSE which is either something that an Actor has, or is the main reason for executing a PLAN. PURPOSES may be decomposed into higher and lower level PURPOSES via the HELP ACHIEVE relationship. MISSION, VISION, GOAL, and OBJECTIVE are special kinds of PURPOSE. STRATEGY is a PLAN to achieve a high level PURPOSE.

Other important concepts introduced include STRATEGIC PLANNING, STRATEGIC ACTION, DECISION, ASSUMPTION, (CRITICAL) INFLUENCE FACTOR, CRITICAL SUCCESS FACTOR and RISK.

5.1 Purpose

PURPOSE: a Role of a State Of Affairs in one of the following Relationships:

- **HOLD-PURPOSE**: a Relationship between an Actor and a State Of Affairs whereby the Actor wants, intends, or is responsible for the full or partial ACHIEVEMENT of the State Of Affairs;

  Notes:
  - The Actor will usually be a PERSON or OU, however MACHINE is not excluded.

  Example:
  - Some PERSON wants to be in Edinburgh on some date;
- a Relationship between a PLAN and a State Of Affairs whereby:
  - EXECUTION of the PLAN will result in fully or partially ACHIEVING the State Of Affairs;
    and
  - one or more of the EFFECTS of the specification of ACTIVITIES associated with the PLAN is declared to be the primary reason(s) for EXECUTING the PLAN.

  Example:
  - The PURPOSE of a PLAN is to be in some particular location on some date.

Notes:

1. a PURPOSE may be effectively decomposed into more detailed PURPOSES via the HELPS ACHIEVE Relationship.
2. A Responsibility may be viewed as a special kind of PURPOSE. Being responsible for implies the PURPOSE is DELEGATED by another Actor. This contrasts with the more general case where an Actor wants or intends a PURPOSE of their own volition.
3. A PURPOSE is characterised by one or more of the following:
   - *Measurability*: extent to which it is possible to objectively determine whether ACHIEVEMENT has occurred
   - *Time Horizon e.g.* short, medium, or long term

- *Specificity*: how detailed the PURPOSE is; related to measurability in that very detailed PURPOSES will tend to be measurable.
- *Relative Priority*: degree of desirability with respect to some Actor

PURPOSE-HOLDER: the Role of the Actor in the HOLD-PURPOSE Relationship.

We introduce four different kinds or levels of PURPOSE: VISION, MISSION, GOAL and OBJECTIVE. We define OBJECTIVE, but not the other three because they are used in many different ways. It is up to the Ontology user to specify what these may mean in a given situation.

OBJECTIVE: a PURPOSE with a defined measure.

Notes:

1. The idea is that it is possible to detect the ACHIEVEMENT of an OBJECTIVE.

VISION, MISSION, and GOAL: kinds of PURPOSES

Notes:

1. They may or may not be OBJECTIVES.
2. Below we indicate some ways that these terms may be specialised:
   - Insofar as the HELPS ACHIEVE Relationship orders PURPOSES, the order will tend to be (from lowest-level): OBJECTIVE, GOAL, MISSION, VISION.
   - With respect to measurability, the order will tend to be (from most measurable): OBJECTIVE, GOAL, MISSION, VISION.
   - With respect to to time horizon, the the order will tend to be (from shortest time horizon): OBJECTIVE, GOAL, MISSION, VISION.

ACHIEVE: the realisation of a State Of Affairs; *i.e.* being made true;

Notes:

1. When the State Of Affairs is a PURPOSE, one would frequently say it is being 'accomplished'.

HELP ACHIEVE: a Relationship between two States Of Affairs whereby one State Of Affairs contributes to or facilitates the ACHIEVEMENT of the other State Of Affairs.

Notes:

1. The HELP ACHIEVE Relationship is particularly important when the States Of Affairs are PURPOSES. In this case, the HELP ACHIEVE Relationship may define a directed acyclic network of PURPOSES which gives rise to a notion of higher- and lower-level PURPOSES.
2. Users of the Ontology may wish to constrain the meaning of HELPS ACHIEVE more precisely, or even define more than one flavour. It is deliberate that the Ontology permits this while providing a basic structure that can be shared.

STRATEGY: a PLAN to ACHIEVE a high-level PURPOSE

Notes:

1. The notion of 'high-level' is with respect to the HELPS ACHIEVE Relationship (*e.g.* MISSION)

STRATEGIC PLANNING: an ACTIVITY whose PURPOSE is to produce a STRATEGY

STRATEGIC ACTION: a SUB-PLAN of a STRATEGY

Notes:

1. Strictly speaking, this is a mis-nomer in that it is not an ACTIVITY, but a PLAN. It is left as such to conform with common usage.

5.2 Decisions, Factors, Assumptions

DECISION: commitment by an ACTOR to perform an ACTIVITY.

Notes:

1. this is roughly equivalent to the traditional definition: 'commitment to a course of action'. The notion of commitment appears synonymous with 'intention' as distinct from 'want/desire'

ASSUMPTION: a Role of a State Of Affairs in a Relationship with an Actor whereby the Actor takes the State Of Affairs to be true without knowing whether it is true or not.

Notes:

1. An ASSUMPTION may or may not be critical
2. ASSUMPTIONS are typically used during PLANNING and may be associated with PLANS.

CRITICAL ASSUMPTION: an ASSUMPTION that is associated with or used in STRATEGIC PLANNING.

NON-CRITICAL ASSUMPTION: an ASSUMPTION that is not associated with or used in STRATEGIC PLANNING.

INFLUENCE FACTOR: a State Of Affairs known to be true which is within the scope of interest of an Actor.

Example:

- current rate of inflation

CRITICAL INFLUENCE FACTOR: an INFLUENCE FACTOR that is associated with or used in STRATEGIC PLANNING.

(NON-) CRITICAL INFLUENCE FACTOR: an INFLUENCE FACTOR that is *not* associated with or used in STRATEGIC PLANNING.

CRITICAL SUCCESS FACTOR (CSF): A PURPOSE declared by an Actor to be critical to the success of one or more higher-level PURPOSES.

Notes:

1. the practical significance of this is that CSFs provide the central focus for STRATEGIC PLANNING.

2. it is important to note that the declaration is arbitrary in the sense that there is no set of Attributes that can objectively determine whether a PURPOSE is a CSF or not.

RISK: the Role of a State Of Affairs in a Relationship with an Actor whereby the Actor regards the State Of Affairs as a potential hindrance to the ACHIEVEMENT of one or more of PURPOSES of the Actor.

5.3 Related Terms

5.3.1 Synonyms

Threat: RISK

Programme: STRATEGY

Target: PURPOSE, GOAL

Measurable Target: OBJECTIVE

5.3.2 Unofficial Terms

Contingency Plan: a PLAN which is used when a specified State Of Affairs occurs.

Notes:

1. usually associated with a RISK

6 Marketing

The central concept in this section is the SALE relationship, which is an agreement between a VENDOR and CUSTOMER to exchange a PRODUCT for a SALE PRICE. The MARKET is defined in terms of all SALES and POTENTIAL SALES, and may be subdivided into MARKET SEGMENTS using SEGMENTATION VARIABLES.

Other important concepts related to a MARKET include: BRAND, IMAGE, PROMOTION and COMPETITOR.

6.1 Sales

SALE: an agreement [Relationship] between two LEGAL ENTITIES to exchange one good, service or quantity of money for another good, service or quantity of money.

Notes:

1. A SALE may be characterised by a number of things, including: sales type, volume, value

POTENTIAL SALE: a possible future SALE.

FOR SALE: a State Of Affairs whereby one LEGAL ENTITY offers to enter into a SALE.

Notes:

1. The definition for FOR SALE entails a necessary distinction between the seller (VENDOR) and the buyer (POTENTIAL CUSTOMER), in that only the former is offering something.
2. It is correct to say that the PRODUCT (the item being offered for exchange) is FOR SALE;
3. Informally, we may refer to the FOR SALE State Of Affairs as a Relationship between the various parties and things exchanged.

6.1.1 Roles in Sales Relationships

The notions of customer, vendor, product and price are usually associated with sales. They are essentially roles that distinguish between the entities exchanged and the LEGAL ENTITIES involved. We reflect this in the Ontology by formally defining ACTUAL CUSTOMER, VENDOR, PRODUCT, ASKING PRICE, and SALE PRICE as Roles in the SALE and FOR SALE Relationships.

The Ontology caters for exceptional cases, where both things are goods (barter) or both money (currency exchange). However, in these cases the SALES Relationship is symmetric and there is no obvious way to distinguish between the Roles. Because of this, special care may be required in defining such SALES Relationships.

VENDOR: the Role of the LEGAL ENTITY who

- offers a PRODUCT, FOR SALE for an ASKING PRICE –or–
- agrees to exchange a PRODUCT for a SALE PRICE in a SALE.

Notes:

1. From the VENDOR's perspective, the exchange is referred to as 'selling'.

ACTUAL CUSTOMER: the Role of the LEGAL ENTITY agreeing to exchange a SALE PRICE for a PRODUCT in a SALE.

Notes:

1. From the ACTUAL CUSTOMER's perspective, the exchange is referred to as 'buying'.

POTENTIAL CUSTOMER: any LEGAL ENTITY who may become an ACTUAL CUSTOMER.

Notes:

1. This definition includes both LEGAL ENTITIES to whom PRODUCTS *are* offered FOR SALE, and LEGAL ENTITIES who might purchase something which is not but could be FOR SALE.
2. Various conditions are possible any of which, singly or in combination, may or may not be true in a particular case:

- the actual offer of a PRODUCT to the LEGAL ENTITY [i.e. a FOR SALE Relationship];
- the ability of POTENTIAL CUSTOMERS to afford the ASKING PRICE;
- the LEGAL ENTITY having a NEED;
- the existence of a PRODUCT having a FEATURE capable of satisfying a NEED;
- the existence of a marketing PROMOTION aimed at POTENTIAL CUSTOMERS.

CUSTOMER: The union of POTENTIAL CUSTOMER and ACTUAL CUSTOMER.

One special type of CUSTOMER is described below:

RESELLER: CUSTOMER who enters into a SALE agreement for the PURPOSE making further SALES of the PRODUCT (or a derivative of it).

Notes:

1. A RESELLER is a CUSTOMER in one SALE and a VENDOR in another.

PRODUCT: the Role of the good, service, or quantity of money that is:

- offered FOR SALE by a VENDOR –or–
- agreed to be exchanged by the VENDOR with the ACTUAL CUSTOMER in a SALE.

Notes:

1. There is possible confusion with the use of the term 'product' when referring to something produced/manufactured but which is not sold (*i.e.* an intermediate product internal to a manufacturing process). It may become necessary to introduce two terms for this, such as 'Market Product' and 'Manufactured Product'.

ASKING PRICE: the Role of the good, service, or quantity of money being asked for by a VENDOR in exchange for a PRODUCT that is FOR SALE.

SALE PRICE: the Role of the good, service or quantity of money agreed to be exchanged by the ACTUAL CUSTOMER with the VENDOR for the PRODUCT in a SALE.

Notes:

1. We specifically chose not to define the price as the 'value' of the PRODUCT, because value is relative, the price is the actual thing exchanged. (usually money).

6.2 Market

MARKET: All SALES and POTENTIAL SALES within a scope of interest.

Notes:

1. A MARKET can be characterised by any number of SEGMENTATION VARIABLES

2. A MARKET may be measured in various ways. For example: the number of SALES, the sum of the SALE PRICE of the SALES, or ratios between one set of SALES and another.

SEGMENTATION VARIABLE: Any Attribute determinable from a SALE or POTENTIAL SALE in a MARKET. Examples include:

- PRODUCT: identity, size, shape, colour, sex appeal
- VENDOR: geographical location, size
- CUSTOMER: socio-economic class, age, sex
- SALE: geographical location, TIME POINT of occurrence (e.g. date and time)

MARKET SEGMENT: All SALES and POTENTIAL SALES in a MARKET having defined values of one or more SEGMENTATION VARIABLES.

Examples:

- Geography = Asia;
- Socio-economic class of CUSTOMER = yuppie.

Notes:

1. One person's MARKET may be another person's MARKET SEGMENT

MARKET RESEARCH: An ACTIVITY whose

- PURPOSE is to better understand a MARKET
- EFFECTS includes the existence of information about a MARKET

BRAND: A name identifiable by CUSTOMERS associated with one or more PRODUCTS of a VENDOR.

IMAGE: a set of properties that a CUSTOMER believes to be true of a BRAND, PRODUCT or VENDOR.

Example:

- Rolls Royce automobiles are believed by CUSTOMERS to be reliable

FEATURE: An Attribute of a PRODUCT which may satisfy a NEED of a CUSTOMER.

NEED: A physical, psychological or sociological requirement of a CUSTOMER.

MARKET NEED: an identifiable NEED of CUSTOMERS which is not fully satisfied by PRODUCTS currently FOR SALE.

PROMOTION: An ACTIVITY whose primary PURPOSE is to improve the IMAGE [of a PRODUCT, BRAND and/or VENDOR].

Notes:

1. A PROMOTION may have additional PURPOSES, all normally related to the MARKET.

COMPETITOR: a Role of a VENDOR in a Relationship with another VENDOR whereby one offers one or more PRODUCTS FOR SALE that could limit the SALES of one or more PRODUCTS of the other VENDOR.

Notes:

1. this competition is a symmetric Relationship; *i.e.* each VENDOR is a COMPETITOR of the other in the same manner.

6.3 Related Terms

6.3.1 Synonyms

Consideration: SALE PRICE

Reputation: IMAGE

Supplier: VENDOR

Trading Entity: VENDOR

6.3.2 Unofficial Terms

Buyer: the LEGAL ENTITY approving the SALE. In many cases the Buyer will be the ACTUAL CUSTOMER; alternatively, if the ACTUAL CUSTOMER is a high-level OU, the Buyer may be a PERSON or OU within that OU.

Consumer: the LEGAL ENTITY who will use the PRODUCT in a SALE; In many cases, the Consumer will be the ACTUAL CUSTOMER; alternatively, if the ACTUAL CUSTOMER is a high-level OU, the Consumer may be a PERSON or OU within that OU.

Product Substitute: a PRODUCT that may be offered by a VENDOR in place of a PRODUCT previously offered. Planning tools may need knowledge of the FEATURES of PRODUCTS to plan or optimise substitution.

Customer Base: A group of existing CUSTOMERS. These may be segmented by geography, demographics etc. Should be considered as part of MARKET RESEARCH and/or PROMOTIONS.

6.3.3 Other Commonly Used Terms

- *Product Portfolio*
- *Target Customer*
- *Target Market Segment*

7 Time

The concept of time is not specific to Enterprises, but is used by them. We have made no attempt to re-think existing work on representing time; instead, we merely imported it.

The central concepts are a TIME LINE and a TIME POINT, where the latter is comprised of the former. We define the concepts of DURATION, and TIME INTERVAL; we also define various relationships between TIME POINTS and TIME INTERVALS.

7.1 The Fundamentals

There are two fundamental concepts:

TIME LINE: an ordered, continuous, infinite sequence of TIME POINTS.

TIME POINT: a particular, instantaneous point in time;

Notes:

1. a TIME POINT can exist independently from knowing where it is on the TIME LINE (*e.g.* 'when the next big earthquake hits California'). You can still talk about it and perhaps constrain it to some extent.

We define two special kinds of TIME POINTS:

CALENDAR DATE: a kind of TIME POINT characterised by being represented as a specific calendar year, month, day, hour, and minute.

Examples:

- (e.g. 11:33 am 7 July 1654)

RELATIVE TIME POINT: a kind of TIME POINT characterised by being represented as a durational offset from an origin.

Examples:

- tomorrow may be represented as 'the day after today'

7.2 Durations and Intervals

Using the above two fundamental concepts, we characterise various other useful notions:

DURATION: an absolute distance between two TIME POINTS.

Notes:

1. A DURATION will typically be measured in some units (e.g. years, weeks, etc).
2. The following are special cases of a DURATION:
   - Infinity: arbitrarily large DURATION
   - Epsilon: arbitrarily small DURATION
   - Zero: DURATION of zero length

DURATION BOUNDS: a specification of an upper and lower bound on a length of time consisting of two DURATIONS.

Examples:

- the process time takes between 1 and 3 weeks

Notes:

1. A DURATION is a special case of a of a DURATION BOUND where an exact length of time is required. This can be represented by having the upper and lower bound be the same DURATION.

TIME INTERVAL: an interval of time specified as two TIME POINTS and bounds on the distance between the two time points.

Notes:

1. The bounds imply that the interval is in a sense fuzzy; you do not know how long it is or necessarily where on the TIME LINE the TIME POINTS are.
2. The following is a special case of a TIME INTERVAL:
   - Always: the interval from infinitely far into the past to infinitely far into the future.

7.3 Time Relationships

We define a number of useful Relationships between TIME POINTS:

BEFORE: a Relationship between two TIME POINTS where by one precedes the other on the TIME LINE with a minimum distance of Epsilon.

SAME-OR-BEFORE: a Relationship between two TIME POINTS where by one precedes the other on the TIME LINE with a minimum distance of Zero.

Notes:

1. If the distance is Zero, the two TIME POINTS are identical

AFTER: a Relationship between two TIME POINTS where by one succeeds the other on the TIME LINE with a minimum distance of Epsilon.

SAME OR AFTER: a Relationship between two TIME POINTS where by one succeeds the other on the TIME LINE with a minimum distance of Zero.

Notes:

1. If the distance is Zero, the two TIME POINTS are identical

SAME: a Relationship between two TIME POINTS whereby the distance between them is Zero.

DISTANCE: between two TIME POINTS specified as a DURATION

We define a number of useful Relationships defined on TIME INTERVALS:

EARLIEST START TIME: an Attribute of a TIME INTERVAL whose value is a RELATIVE TIME POINT denoting the earliest time that the TIME INTERVAL may begin.

LATEST START TIME: an Attribute of a TIME INTERVAL whose value is a RELATIVE TIME POINT denoting the latest time that the TIME INTERVAL may begin.

EARLIEST END TIME: an Attribute of a TIME INTERVAL whose value is a RELATIVE TIME POINT denoting the earliest time that the TIME INTERVAL may end.

LATEST END TIME: an Attribute of a TIME INTERVAL whose value is a RELATIVE TIME POINT denoting the latest time that the TIME INTERVAL may end.

INTERVAL-BEFORE: a Relationship between two TIME INTERVALS whereby one TIME INTERVAL is wholly before the other.

INTERVAL-DURING: a Relationship between two TIME INTERVALS whereby one TIME INTERVAL is a sub-interval of another TIME INTERVAL.

INTERVAL-OVERLAPS: a Relationship between two TIME INTERVALS whereby one TIME INTERVAL overlaps another TIME INTERVAL.

INTERVAL-DISJOINT: a Relationship between two TIME INTERVALS whereby the two TIME INTERVALS do not overlap.

7.4 Example

TIME POINTS:

- MidnightToday,
- Actual-Takeoff-Time,
- Actual-Landing-Time

RELATIVE TIME POINTS: (defined relative to MidnightToday)

- Scheduled-Takeoff-Time (= 8 hrs 10 min)
- Scheduled-Landing-Time (= 16hrs 30 min)

DURATION BOUNDS:

- Time-Delta: defined to be plus or minus 15 minutes

TIME INTERVAL:

- Flight-Time: defined by the two time points
  - Actual-Takeoff-Time
  - Actual-Landing-Time

DISTANCE: Relationships are defined stating that the time between scheduled and actual takeoff (and landing) are both limited by Time-Delta.

What this means is that the flight is scheduled to take off at 8:10am and land at 4:30 pm plus or minus 15 minutes in each case. You can then assert things like 'state of flight is in-the-air' during Flight-Time.

8 Conclusion

This document contains Version 1 of the Enterprise Ontology developed as part of the Enterprise Project. Its scope is limited to those core concepts required for the project, however it is expected that it will appeal to a wider audience.

The development of the Ontology has taken account of other external ontology developments whenever possible. This is particularly true for the Activity ontology, which is broadly consistent with two major external ontologies: TOVE and KSRL. The Time and Meta-Ontology both have input from external activity. For other parts, (eg Market, Organisation), it has not yet been possible to do significant benchmarking against external activities, however the goal is always to be compatible with existing ontologies where possible.

This Ontology will be further refined and extended during the lifetime of the Enterprise Project. In addition to development of this core Ontology, each user of the Enterprise toolset may require their own specific ontological extensions.

The Enterprise Ontology, here described in natural language, has subsequently been coded in the formal language: Ontolingua. This document served as a specification for this coding effort. The relatively small number of changes to the Enterprise Ontology identified while coding will be reflected in a future version of this document.

Acknowledgements and References

The Enterprise Ontology has been developed largely from scratch; however it was inspired and influenced by many other projects and efforts, too numerous to mention. The main influences are listed below, together with references:

TOVE: TOronto Virtual Enterprise project, University of Toronto.

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O-Plan: Planning and Scheduling group, AIAI;

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- Knowledge Representation Specification Language (KRSL) Reference Manual – Version 2.0.2; edited by Nancy Lehrer; February 1993
- A. Tate, 'Plan Ontology' - a paper to the Workshop on Ontology development and use, San Diego, California, USA, November 1994

The Time section of the Enterprise Ontology was imported from KRSL and is largely unchanged; the Plan Ontology influenced the development of the Activity section. Both documents are available through the world-wide web:

http://isx.com/pub/ARPI/ARPI-pub/krsl/krsl-info.html

ORDIT: Esprit project No. 2301

- A.J.C.Blyth, J.Chudge, J.E.Dobson snf M.R.Strens, 'ORDIT: A new methodology to assist in the process of eliciting and modelling organisational requirements', Proceedings on the Conference on Organisational Computing Systems, Nov, San Jose, California, 1993.

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