

OCCURRENT VS CONTINUANT BUSINESS ENTERPRISE: AN ONTOLOGICAL APPROACH

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ABSTRACT

Even though business is defined as being an organization where goods and services are exchanged for making profit, there is some confusion concerning its conceptualization, for it presupposes the formulation of an abstract and simplified view of what it really means. Explicitly specifying concepts that are presumed to be of interest for some particular purpose and the relationships between them, facilitates knowledge sharing and reuse. The crucial point of this work is to explicitly and formally represent all the dimensions of a business by using the upper level ontology BFO (Basic Formal Ontology), which is widely accepted and is used as a valuable reference for many scientific fields. Numerous research groups are now utilizing BFO to assist in the organization and integration of information. In this perspective, we intend to develop an ontological framework, which will categorize business enterprises as occurrents or continuants, according to their plans, models and strategies.

Keywords: business, conceptualization, ontologies, occurrent, continuant.

JEL Classification: A12, L86

1. Introduction

Business conceptualization, on the grounds of the emerging field of Enterprise Engineering, provides a means for a shared understanding among the stakeholders with different interpretation of its meaning [3].

Traditionally, the term ontology has been defined as the philosophical study of what things exist, but in recent years, it is used as a computational artifact in any computer-based application, where knowledge representation and management are required [6], [9], [1]. In that sense, it has the meaning of a standardized terminological framework in terms of which the information is organized.

Our focus on the ontological modeling of a business emerges from the need to support reasoning in nowadays industrial environments, where information systems play a more active role in the management and operation of an enterprise [5]. Thus, there is a need for a shared semantic agreement on business terms between human and computer agents.

A business conceptualization can provide the common understanding of the organization and the operation of the business to all stakeholders, such as managers, designers, employers, employees and customers [2], [4]. Thus, business process re-design, intra- and inter- business collaboration, interoperability of information systems used, human resources and functions management will be facilitated.

This paper aims to conceptualize business either as an occurrent, that is, an entity that happens, unfolds or develops in time, or as a continuant, that is, an entity that endures through time while maintaining its identity, in order to help understand, describe and predict qualities, dispositions, roles and functions that inhere in or are born by diverse entrepreneurship environments. This important distinction provides essential dimensions that help an innovator or potential entrepreneur to make the right choices for a successful business model and strategy. More precisely, based on an ontological framework incorporating dimensions that deal with both static/spatial and dynamic/temporal features of reality [7], we propose to formalize each business using an OWL web ontology, which facilitates data integration as well as the development of e-business applications [8].

This entire paper, apart from the introductory section 1, is organized as follows: in section 2, ontologies and their various uses are briefly presented, in section 3, related works on the ontological modeling concerning enterprises are described, in section 4, the notion of BFO (Basic Formal Ontology) [10] and its use in domain ontology engineering, by making the basic distinction between the two kinds of entities, continuants or occurrents is given. In section 5, applications of the notions continuant or occurrent on business enterprises, are shown and, finally, section 6 consists of the concluding remarks of the paper.

2. Ontologies

The word ontology first appeared in Aristotle's philosophical essays, where it was used in order to describe the nature and organization of being. It has various definitions in various texts, domains and applications. In Philosophy and Linguistics, ontology is defined as "the study of existence", "a theory of what there is in the world", or "a taxonomy of the world concepts" [9]. In Information Technology and Artificial Intelligence, the most popular definition of the term ontology originates from Gruber [6]: an ontology is an explicit, formal specification of a shared conceptualization. A conceptualization being a simplified, abstract way of perceiving a segment of the world (a piece of reality), for which we agree to recognize the existence of a set of objects and their interrelations, as well as the terms we use to refer to them and their agreed meanings and properties. It is formal and explicit, that is, it is represented using a formal language i.e. a language with a machine-understandable semantics and it uses types of primitives (concepts, axioms) which are explicitly defined. It is shared, that is, it mirrors a common understanding of the modeled domain, being the result of a consensus achieved within a (potential) community of ontology users.

There are many other definitions and descriptions that expound the value of ontology development and use. In practice, ontologies consist of: (a) classes (anything that can be said about something. They represent the entities of a domain), (b) instances (concrete elements of a certain class), relations (interactions between classes), functions (relations, where an element is uniquely defined by n other elements), and axioms (used to model sentences. They represent facts that are always true in the topic area of the ontology) [12].

In general, the role of an ontology is to support knowledge sharing and reuse within and among groups of agents (people, software programs, or both). In their computational form, ontologies often comprise definitions of terms organized in a hierarchy lattice, along with a set of relationships that hold between these definitions. These constructs collectively impose a structure on the domain being represented and constrain the possible interpretations of terms. Thus, ideally, an ontology capture a shared understanding of a domain of interest and provide a formal and machine manipulable model of the domain.

The more common reasons for developing ontologies, are in order to: Share common understanding of the structure of information among people or software agents; Enable reuse of domain knowledge; Make domain assumptions explicit; Separate domain knowledge from the operational knowledge; Analyze domain knowledge; Enhance decision support systems; Provide a basis for more adaptable systems; Improve model design and adaptability; Enable integration among systems and data through semantic interoperability [13], [8]. Depending on the intended use, ontologies are engineered in order to represent aspects of reality for a particular purpose.

Ontologies may exist at many levels of abstraction and they can be grouped into three broad categories: upper level, mid-level and domain ontologies. The most rigorous and reusable ones are the upper level ontologies. They provide general concepts which are common to all domains and they also can provide a common ontological foundation for mid-level and domain ontologies. Basic Formal Ontology (BFO), Suggested Upper Merged Ontology (SUMO) and Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE) are some prominent examples of upper level ontologies [7].

3. Related work on ontological modeling of enterprise

Within the last few years, many researchers focused on the development of conceptual models named ontologies for providing a formal and explicit representation of business knowledge. These domain ontologies mainly capture in a machine-readable manner the organization-related information, such as processes that must be carried out within a business, actors involved, permitted functionality of a business, dependency with other social activities, means that are needed in order for a business to succeed, etc.

One of the most well known initiatives was the development of the TOVE Common Sense Model of Enterprise [5]. The proposed ontology has been viewing organizations as composed of agents playing roles in which they are acting to achieve specific goals according to various constraints imposed by a specific organization policy. The main drawback of adopting this ontology in applications or real life enterprise environments is the level of granularity in modeling the specific domain.

The REA enterprise ontology was another business domain ontology which was based on the Resources/Events/Agents model. Although the initial design of this ontology aimed at formally represent enterprise as a whole, at last it has been focused only on accounting information [2]. It is not widely used for enterprise applications due to its lack of clarity and inconsistency.

The 3-value ontology has been created in order to explain the basic concepts used to represent e-commerce ideas [1]. It mainly describes economic exchange among partners, as well as other organizational aspects, such as control, strategy and provided services.

The enterprise ontology proposed in [3] is defined as an understanding of an enterprise operation, which is considered completely independent of the realization of the specific enterprise. A peculiarity of this proposal is that the notion of business is defined conjunctively from the notion of enterprise as the function perspective on the enterprise.

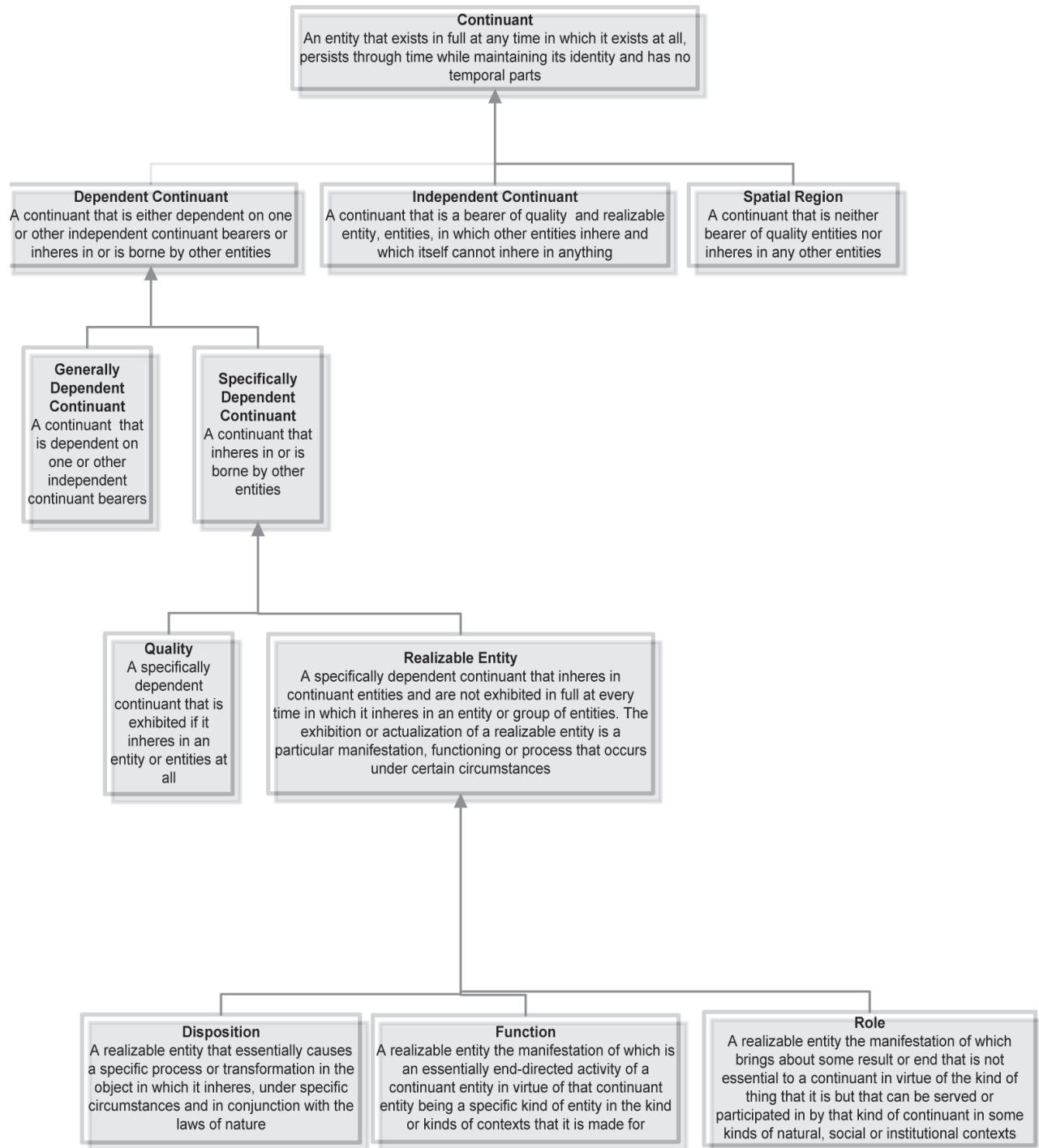
In [4], a set of organizational ontologies used in semantic representation of all the phases of business process management has been proposed. These ontologies provide a basic vocabulary and structure for describing hierarchy of a company, roles in the organization, typical units that may be found in a company, hierarchy of different functions that may be carried out within the company, resources spent when carrying out certain processes and hierarchy of business goals.

Although significant effort was already committed to the creation of business ontologies describing the static and dynamic aspects of a business structure and operation, there is no commonly accepted model that can be reused in any enterprise environment. The goal of this paper is to categorize the notion of business as occurrent or continuant, according to definitions provided by the widely accepted upper level Basic Formal Ontology.

4. Basic Formal Ontology

The Basic Formal Ontology (BFO) is a formal upper level ontology that is widely used in domain ontology engineering, thus reducing possible errors and inconsistencies during the conceptualization of the domain. It recognizes a basic distinction between two kinds of entities: substantial entities or continuants and processual entities or occurrents. Continuants represent entities that endure through time, while maintaining their identity, whereas occurrents represent entities that happen, unfold and develop in time. Both entities are extended in space and time and their distinction allows classifying real world entities, such as objects, processes, events and states.

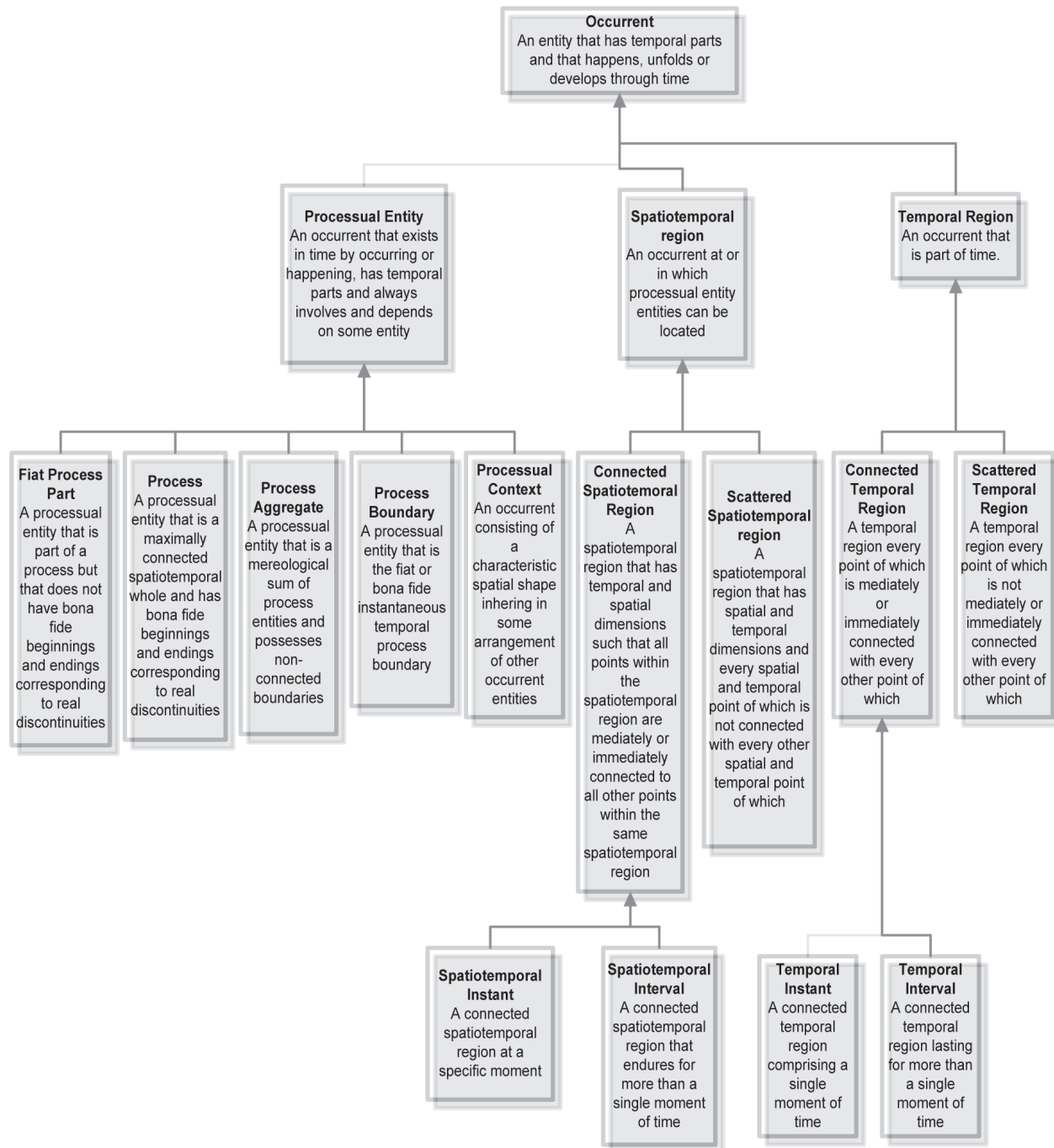
Figure 1. The structure and definition of continuant in BFO



According to the definitions that formally and explicitly describe the continuant in BFO, it is a three-dimensional entity (entity extendent in three spatial dimensions). In contrast to the conceptualization of the the continuant, the definition of the occurrent in the same upper ontology (as it is depicted in figure 2) it is a four-dimensional entity (entity also extendent in the dimension of time) [10].

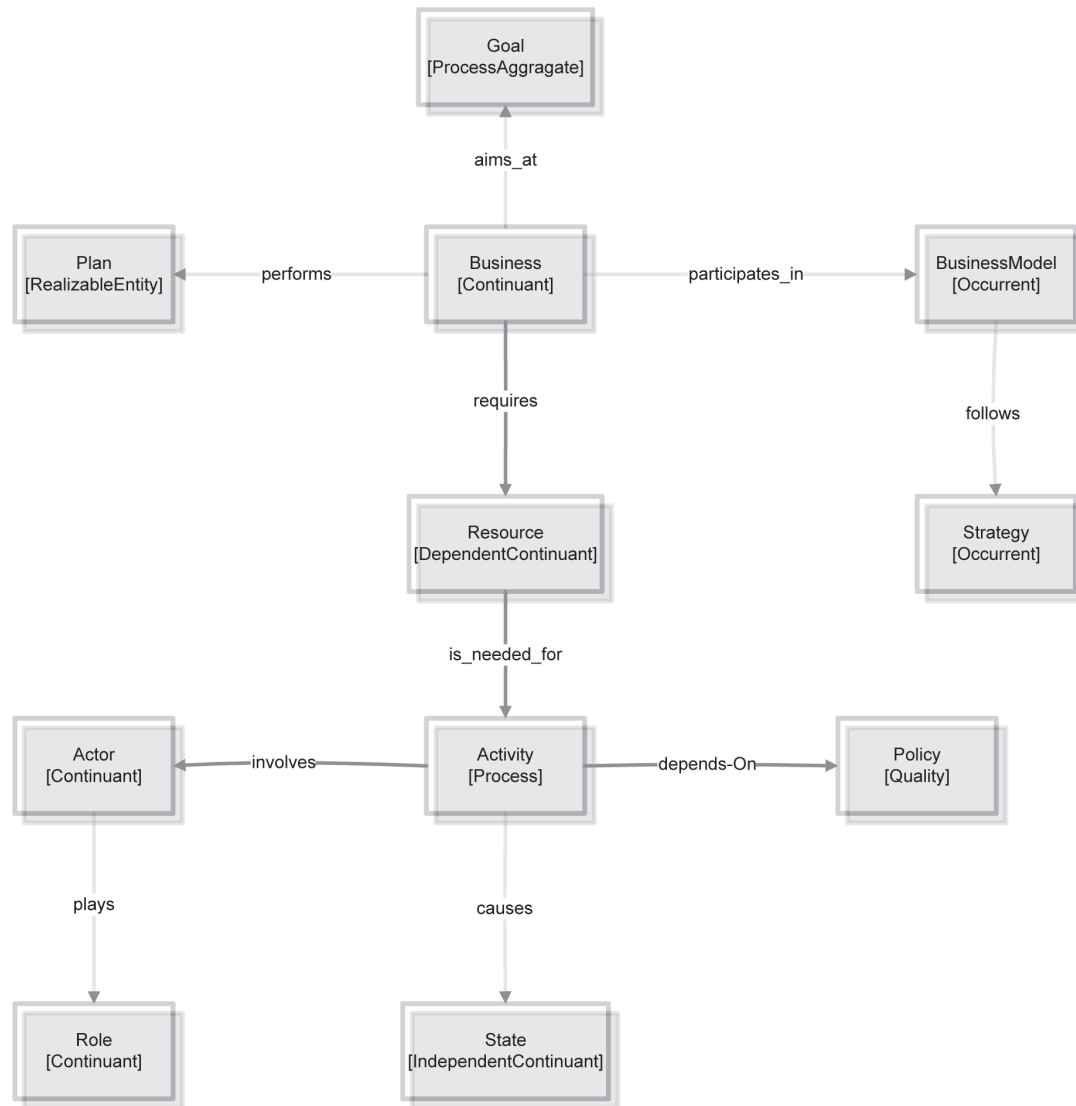
According to the ontological structure and definition of continuants and occurrents, in general, objects can be classified as continuants and are closer to independent continuants and events as occurrents. Moreover, since an event is generally considered as an instance of a process in a specific interval of time and does not change,

Figure 2. The structure and definition of occurrent in BFO



processes are modeled as occurrents. Furthermore, states can be modeled as values of dependent continuants. Except the definitions of continuants and occurrents, for ontological modeling, there is a need for several semantic relations. These are provided by the Relation Ontology (RO) [11] which is used with the BFO concepts. “A continuant participates in an occurrent”, “a process is made of sub-processes”, “a process is internal or external to an object”, “an event causes another event”, “a state allows an event”, “an event initiates a state”, “a state enables another state”, “an object enacts an occurrent” are some of the main relations defined between the BFO concepts.

Figure 3. The ontological framework of business



5. Business: Occurent or Continuant

Based on the BFO basic concepts and their interrelations defined in RO, we propose a general ontological framework incorporating dimensions that deal with both static/spatial and dynamic/temporal entities, such as business plans, processes, functions, policy, models, activities, events, actors, roles, states, communication, goals, resources, etc. The most of these entities describing a business are modeled as occurrents, since they unfold through time. But, simultaneously, each entity that maintains its identity and has no temporal parts, such as the hierarchy of actors in a business, participates in each occurrent. In that sense, a business is modeled as a continuant that participates in an occurrent.

Attempting to categorize the notion of business as continuant or occurrent, we align the mutually accepted terms, provided by BFO, with the basic notions that univocally define it. Based upon this, we describe in the proposed ontological framework of figure 3, these basic notions as well as their interrelations:

- Every Business performs a Plan. The plan of a business constitutes a RealizableEntity, since its actualization is a particular manifestation, functioning or process that occurs under certain circumstances.
- Every Business participates_in a BusinessModel, where a BusinessModel is characterized as an Occurrent, since it has temporal parts and unfolds or develops through time.
- Every Business aims at a Goal. In this ontological approach, Goal is conceptualized as ProcessAggregate, since it possesses non-connected boundaries.

<https://sites.google.com/site/icqqmeas 2015>

- Every Business requires Resource, which is characterized as DependentContinuant, for it is an entity that maintains its identity and it is either dependent on one or other independent bearers.
- Every BusinessModel follows a Strategy. The notion of Strategy is categorized as Occurant, since it unfolds or develops through time.
- Every Resource is needed for an Activity. In this statement, the Activity is considered as Process in BFO modeling, since it is an entity with temporal parts that exist in time by occurring or happening.
- Every Activity depends On Policy. The crucial notion of Policy in the business conceptualization, it is characterized as Quality, for it is an entity that exists in full at any time in which it exists at all and it is exhibited if it inheres in an entity.
- Every Activity involves Actor. Actor is a Continuant, since it is an entity that maintains its identity.
- Every Activity causes State, which is conceptualized as an IndependentContinuant, since it is an entity that is a bearer of quality.
- Every Actor plays a Role, which is a Continuant, in the sense of an entity that persists through time while maintaining its identity.

By instantiating the proposed ontological framework with a hypothetical business enterprise, we are able to answer questions, such as: What role does an actor play? What are the goals of the organization? What resources are available to achieve a particular goal? In order to perform a certain activity, which is the policy to be followed? And so on.

6. Conclusion

Within the last few years, many researchers focused on development of conceptual models for providing a formal and explicit representation of business knowledge. These models, called ontologies, mainly capture in a machine-readable manner the organization-related information, such as processes that must be carried out within a business, actors involved, permitted functionality of a business, dependency with other social activities, means that are needed in order for a business to succeed, etc.

In this paper, we propose a general ontological framework, based on the widely accepted BFO upper level ontology, aiming at categorizing the notion of business either as an occurrent or as a continuant one. The proposed framework incorporates dimensions that deal with both static/spatial and dynamic/temporal entities, such as entrepreneurial plans, processes, functions, policy, models, activities, events, actors, roles, states, communication, goals, resources, etc. Most of these entities, describing a business, are modeled as occurrents, since they unfold through time, but simultaneously, each entity that maintains its identity and has no temporal parts, such as the hierarchy of actors in a business, participates in each occurrent. In that sense, a business is modeled as a continuant that participates in an occurrent.

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