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A Domain-Specific Modelling Language for Corporate Social Responsibility (CSR)

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ABSTRACT

Corporate Social Responsibility (CSR) has become a strategic critical subject in many business processes, since enterprises not only need to provide good products or services, but they also have to demonstrate that they are environmentally and socially responsible. In this context, enterprises should use appropriate computer systems in order to manage CSR ensuring the adoption of best practices with the aim of obtaining competitive advantages. On the other hand, Model-Driven Engineering is a proven and accepted paradigm that provides sound mechanisms to develop quality and reliable computer systems in an efficient way starting from business models. The main results presented in this paper are a CSR Metamodel and a CSR UML profile that provide a Domain-Specific Modelling Language (DSML) to represent CSR. This DSML supports the design of CSR Computer Independent Models (CIM) that are the starting point for Model-Driven Engineering development. To propose this DSML to represent CSR we analysed international standards, guides and regulations on CSR and we reviewed CSR strategies developed by different companies in order to define the artifacts of the CSR Metamodel. Finally, a practical case study using this DSML is provided in order to improve and to validate the defined CSR Metamodel, and to show how to apply the proposal in an actual company.

1. Introduction

Corporate Social Responsibility (CSR) implies that managers must be responsible for the consequences of their actions not only in front of stakeholders but also in front of society [1]. This idea has gained importance in recent years and it has become a need for enterprises beyond a competitive advantage [2].

Many factors contribute to this increasing demand. First, governmental organisations are working on mandatory policies, regulations and reporting regarding sustainability, human rights and ecological commitments [3]. Moreover, an increasing social pressure regarding ecological, ethical and sustainable behaviours drives companies to initiate or improve actions in the field of CSR with more or less success [4]. Finally, studies that show how companies improve their results by implementing CSR actions and policies [5] encourage other companies to include actions in its company's strategy.

As a consequence, enterprises all over the world are concerned with the management and disclosure of their actions on CSR considering many standards and regulations that international organisations publish and promote [6–8]. However, enterprises usually apply ad hoc processes integrated with their control management systems [9] or connect CSR results with quality management indicators [10], but they generally do not use specific computer systems to manage CSR.

Information systems and ICT must be continuously aligned with the CSR strategy in order to provide the necessary technological support to accomplish regulations and to manage CSR processes and actions efficiently [5,11]. Model-Driven Engineering (MDE) is a way to produce software which tries to establish links between conceptual and technological levels, not only with approaches like the OMG's proposal Model Driven Architecture (MDA) [12], but also as Grammarware [13] and others [14]. The application of MDE [15] to implement CSR Computer Systems could provide advantages such as, for example, a more efficient way to develop a computer system, or the capability to incorporate new requirements from the conceptual level where users are more comfortable performing enterprise models [16].

In this field, there are a lot of Enterprise Modelling Languages suitable to model enterprise dimensions like processes, product, organisation or decisions at conceptual level [17,18]. There are also other initiatives such as Unified Enterprise Modelling Language (UEML) which tries to make these languages more interoperable [19]. However, there is no specific modelling language to represent

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CSR, although some researchers agree that CSR is a key issue which should be modelled in the same way as other enterprise dimensions in order to obtain some of the benefits of MDE [20] as for instance, advantages for interoperability and portability [21–23].

Therefore, it would be useful to define a Domain-Specific Modelling Language (DSML) to develop enterprise models focused on the CSR dimension. This DSML would be suitable for: (1) representing how enterprises currently manage CSR; (2) identifying what CSR improvements are needed in business reengineering projects; and (3) applying MDA to implement computer systems to manage CSR actions and information in an integrated way.

The research work presented in this paper, jointly with the proposal of an Agile Model-Driven Methodology to guide the implementation of CSR Computer Systems, are the two phases included in the project we carried out to define a Model-Driven CSR Framework [20]. The methodology enables the application of Model-Driven Engineering to generate CSR Computer Systems. The definition of the CSR Metamodel, described in this paper, provides a Domain-Specific Modelling Language for CSR (DSML4CSR) that can be used to develop models at conceptual level and apply the aforementioned methodology.

Regarding the method of work used in this stage of the project, we applied a systematic proposal to identify strategic requirements [24] that was conducted out by means of a review of the domain. Therefore, we analysed some recognised international standards on CSR [6–8], newer research works in CSR and current practices on CSR management in actual companies, in order to identify the concepts of this metamodel.

The paper is organised as follows. Section 2 describes a literature review focused on Model Driven Engineering as a paradigm useful to develop computer systems from business models and metamodelling background. Section 3 shows the method of work used to conduct the research presented in this paper. Section 4 collects the domain analysis performed in order to obtain the requirements for the metamodel. In Section 5, we define a CSR Conceptual Map to understand the requirements, the CSR Metamodel and the CSR UML profile in order to implement the DSML4CSR. Finally, Section 6 outlines the final step of the method of work showing a case study as a proof of concept for the validation of the CSR Metamodel, and Section 7 outlines the main conclusions of the research.

2. Literature review

2.1. Model-Driven Engineering

Model-Driven Engineering (MDE) is a software development paradigm that can be useful to develop integrated computer information systems [25–27]. The main objective of this paradigm is to promote the use of models and their transformations in order to generate maintainable software that can easily incorporate new requirements and evolve at the same time as new needs arise [15].

MDE principles are implemented by the Object Management Group (OMG) [28] by means of the Model Driven Architecture (MDA) [12] around a set of OMG standards such as MOF, XMI, OCL, UML, etc. Other proposals like Microsoft Domain-Specific Language tools (MS/DSL) [29] or Eclipse Modeling Framework (EMF) [30] are based on the same MDE principles, but they provide different standards and technical spaces to generate software from models [31]. Despite, all these proposals, in [32] it is stated that MDE is not well applied in industry since there is no general purpose tools.

MDA suggests a framework that defines models at three levels of abstraction: Computation Independent Model (CIM), Platform Independent Model (PIM), and Platform Specific Model (PSM). These models are obtained by successive transformations from CIM to PIM and, from PIM to PSM. As it is demonstrated, this approach improves portability, interoperability and reusability through architectural separation of concerns [12]. Particularly, these advantages are more interesting when we want to generate software from enterprise CIM models [33].

Therefore, the task of developing enterprise models has more benefits than just those derived from the definition of Vernadat [18], that defines Enterprise Modelling (EM) as the art of externalising enterprise knowledge with several purposes. Examples of these benefits are supporting computer systems development, providing understanding to apply business processes reengineering, and enabling better analysis of information and workflows among others.

Enterprise Modelling Languages (EML) allow engineers to develop models to represent the enterprise from different points of view such as organisational perspective, processes, decisions, product, information, etc. In this context, some initiatives, as for example GRAI [34] or CIMOSA [35], were carried out around the 80s in order to provide suitable EMLs to model enterprises at conceptual level, which could be considered as CIM models into the MDA domain [36].

Other research works based on the aforementioned EMLs, such as UEML [19,37] or POP* [38,39], have performed an effort to make EMLs more interoperable, when it is needed to exchange or integrate enterprise models represented with different EMLs.

On the other hand, the Engelsman's proposal [40], based on the existing standard for enterprise modelling: the ArchiMate [41], provides a modelling language focused on a specific field. Its objective is to model high-level goals from the stakeholders' perspective. Although this proposal can fit some of the CSR needs regarding goals and allows to represent stakeholders concerns and assessments, there are CSR aspects that cannot be explicitly represented. The objective of the work included in this paper is to provide a specific representation tool, closer to the business people that manage CSR, focused not only on goals, but also on processes, information, stakeholders, policies and all the key issues that CSR management requires.

Although the business research community defines theoretical and business CSR Models [42] and frameworks that are useful to suggest ways or patterns to perform CSR management, there are no proposals in the context of EMLs that allow to represent CSR conceptual models as they are needed for MDA application [20].

A specific EML for CSR should provide artifacts and an adequate semantic and a syntax to represent the components and behaviour of this new asset. Therefore, it would be useful to define a Domain-Specific Modelling Language (DSML) [32] for CSR modelling and, taking into account the fundamentals of the modelling languages, the first step would be to define a metamodel which could identify relevant concepts and their relationships regarding the CSR domain and management [25].

2.2. Metamodelling for specific domains

Models need to be expressed in a modelling language, (for example UML for design models or programming languages for source code models) if we aim to transform models following MDA. Metamodels are the way which the syntax and semantics of these modelling languages are expressed [43,44].

In this context, a metamodel can make statements (some expression about the system under study that can be considered true or false) about what can be expressed in the valid models of a certain modelling language [45]; or a metamodel can also be defined as a model of a language of models [14]. Therefore, a metamodel defines a modelling language, and the instances of a metamodel are models of that modelling language.