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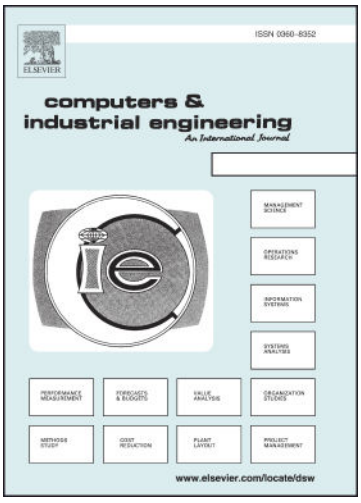

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Agile Model-Driven Methodology to Implement Corporate Social Responsibility

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An Agile Model-Driven Methodology to Implement Corporate Social Responsibility

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Address

Abstract

Corporate Social Responsibility (CSR) has become a key factor in the success of enterprises. There are well-defined case studies in the literature as well as standards that include recommendations about CSR, yet there are no specific methodologies that guide enterprises in integrating CSR within their information system. This paper describes an Agile Model-Driven Methodology especially focused on implementing CSR Computer Systems. This Methodology is included within a larger conceptual framework developed to define, model and manage CSR requirements in enterprises. It provides a set of Model-Driven processes that guide the implementation of a CSR Computer System following agile principles.

Keywords: Agile Methods, Model-Driven Engineering, Domain-Specific Modelling Language, Methodology, Corporate Social Responsibility, Case Study.

1. Introduction

The way enterprises do business and their success no longer depend on just the quality and price of their products. Large companies are aware that to carry out their business successfully and reach a critical market sector they must include Corporate Social Responsibility (CSR) in their business strategy [1].

In spite of the number of research papers and publications from international organisations that provide guidelines concerning CSR [2, 3, 4, 5, 6], enterprises still have difficulties to apply the general concepts and processes of CSR to their

businesses [7]. From the theoretical point of view, much research has evolved in recent years, providing frameworks to define strategic objectives on CSR and sustainability [8, 9] but little research has been conducted on how to align IT and strategic objectives on CSR [9, 10]. Although there are case studies that show how to apply sustainability from the strategic point of view [11] and the need to continuously align Information Systems and ICT with the CSR strategy is addressed in several studies [12, 13], one paramount problem when it comes to applying CSR in a practical way is the lack of specific methodologies to implement CSR Computer Systems [14].

The research work presented in this paper is part of a project focused on how to apply Model-Driven Engineering to generate CSR Computer Systems. The main goal of this project is to develop a Model-Driven CSR Framework [14]. This Framework includes: (1) a CSR Metamodel to provide a Domain-Specific Modelling Language based on a CSR UML Profile to represent CSR, which is called **DSML4CSR** [15]; and (2) an Agile Model-Driven Methodology to guide the implementation of CSR Computer Systems called **AMDM4CSR**, which is the objective of this paper. In the modelling context, the Model-Driven CSR Framework can be considered as a Modelling Technique [16] that provides a Modelling Language by the CSR Metamodel, and a Modelling Procedure by the Agile Model-Driven Methodology.

On the one hand, Model-Driven Engineering is a well-known software development paradigm which provides many benefits [17], sustainability and being model-oriented among others, and accordingly it can be adopted as a framework to develop suitable solutions [18, 19]. This paradigm is focused on models and their transformations in order to obtain more interoperable and sustainable computer systems. Several studies provide examples of how to apply it in web engineering [20], in small enterprises [19], or that even analyse the factors that lead to the success or failure of this kind of project [18]. However, the application of Model-Driven Engineering to generate CSR Computer Systems is a new challenge and there is a need for more practical case studies on how to apply it.

On the other hand, the development of CSR Computer Systems demands the full involvement of end-users, especially to perform the requirements engineering process. Therefore, Agile Methods are a good paradigm to gain a better understanding of requirements elicitation. The constant feedback from stakeholders, which is one of the main advantages of this kind of method, is a visible benefit from following agile principles [21].

The paper is organised as follows. Section 2 outlines the main concepts and standards related to CSR and the background within Agile Methods and Model-Driven Engineering. Section 3 includes a brief description of the Model-Driven CSR Framework in which the proposed Methodology is included and Section 4 details the processes, activities, tasks and results of this Methodology. Section 5 describes a proof of concept for testing the proposal in an actual company. And finally, Section 6 presents the conclusions from this research and suggestions for future work.

2. Background

The proposed Methodology is based on two trending topics in the Software Engineering domain, Agile Methods and Model-Driven Engineering. This is the reason why this section contains a review of CSR concepts and the two aforementioned subjects.

2.1. CSR Perspective

The concept of CSR has been extensively addressed, both from a business point of view and from the field of research. This has given rise to numerous definitions and proposals on how to establish the principles of CSR in companies and its increasing importance in enterprises as a competitive advantage.

CSR is not a new concept and one of the first authors to publish on social responsibility was Bowen [22]. He defined the social responsibility of businessmen as the need to apply policies, good decisions and lines of action to business in order to align them with the values of our society.

Many authors have provided definitions of CSR implying that enterprises

should follow not only economic and legal issues, but also need to answer to society and accept the consequences of their decision-making processes [23, 24, 1].

Other research work has proposed that CSR endeavours to align the three P's of a company, namely Profit, People and Planet, which Elkington called the Triple Bottom Line (TBL) [25]. CSR appears as a tool for enterprises to manage sustainable development, which was defined in [26] as development that achieves the needs of current generations without compromising the ability of future generations to achieve their own needs.

Regarding how to apply CSR, many international organisations have developed rules, recommendations and standards on CSR to provide support, validate how CSR is applied and establish some regulations. Some well-known proposals include: ISO 26000 [4], as guidance on how businesses and any kind of organisation can operate in a socially responsible way [27]; **The Global Reporting Initiative (GRI)** [5], as a framework for voluntary reporting [28]; **Global Compact** [6], as a Guide to Corporate Sustainability [29]; and **NORMAPME2011** [30], as a European recommendation for the application of ISO 26000 in SMEs.

In conclusion, CSR implementation includes improving, modifying or creating new business processes and producing adequate information from the outcomes of these policies. Consequently, information systems, business and industrial processes, and ICT must be aligned with this new strategy [12, 13], as well as being prepared to process the data and provide the required information in the way that regulations and international standards propose.

Finally, an important problem when it comes to applying CSR in a practical way is the lack of specially CSR-focused methodologies to implement not only the CSR strategic and business processes, but also accurate computer systems that allow the management and dissemination of CSR plans and provide measurable results [14]. Although some research work has been conducted in order to integrate CSR practices and management systems, a clear alignment with ICT is still lacking [8, 31, 32].

The research performed on (a) standards and regulations, (b) other research trends and best practices, as well as (c) a current practices survey we carried out are the inputs that allowed us to define the CSR Metamodel and the Domain-Specific Modelling

Language for CSR (**DSML4CSR**), which are explained at length in [15]. Jointly with these results, we address the CSR Computer System implementation by means of the specific AMDM4CSR defined in this paper, which includes as a specific contribution on how to use the DSML4CSR.

2.2. Agile Methods

There are many methodologies that should be suitable to guide the implementation of CSR Management Systems, such as Soft Systems Methodology, Strategic Options Development and Analysis, and Strategic Choice. These methodologies, grouped as Problem Structuring Methods, offer support on how to act to solve complex situations and reach agreements [33, 34]. This approach could be useful in our research on CSR, although we do not consider this proposal because our ultimate objective is to generate a computer system. In the context of Software Engineering, agile methods are considered flexible and suitable methods for problem-solving, since they involve the final user in the whole process [21, 35].

Agile Software Development establishes a set of principles to guide the development of systems by putting forth four main preference values [36]: individuals and interactions over processes and tools, obtaining software over comprehensive documentation, working with clients instead of the negotiation of a contract, and the response to change instead of following a plan [37]. These agile principles are followed in processes of software development called Agile Methods [36]. There are also some other features that these Agile Methods share, such as short development cycles, frequent deliveries, continuous face-to-face communication between the development team and the final customer, difficulty in defining requirements, shared learning, etc. [38]. Some popular Agile Methods have been proposed based on these principles, such as Scrum [39, 40], eXtreme Programming (XP) [41], Lean Software Development [42] or Crystal [43]. These methods are especially useful in environments where the definition of requirements is critical and is closely linked to end-users [44].

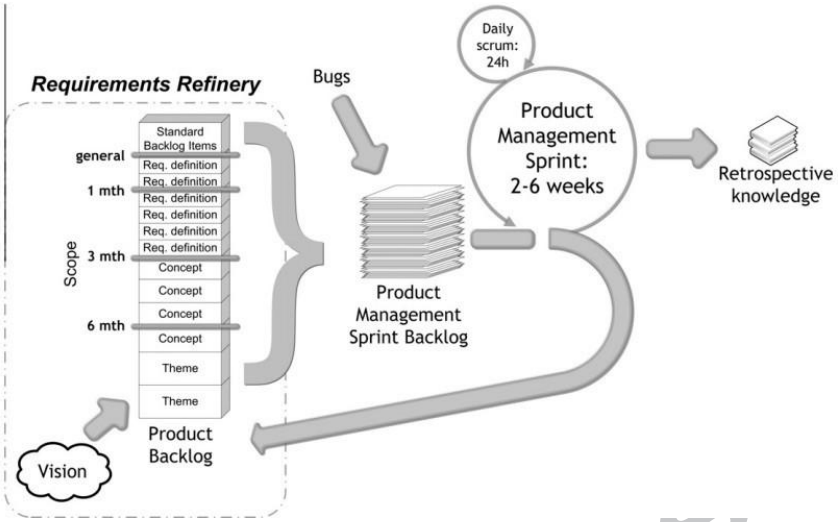

Figure 1: Scrum process [47].

Nowadays, according to existing research, two of the most widely adopted Agile Methods are Scrum and XP [35]. We selected Scrum as an Agile Method to apply in our proposal on the basis of several research studies in which this method has successfully been used in small companies [45] or even in large enterprises [46].

The main feature of Scrum [47] is the development of the product following short iterations called sprints, which last from one to four weeks. An increment of the final product is delivered to the final user at the end of each sprint. Then, all the team performs the Review Meeting to test the added value of this increment. Scrum defines a process which requires the participation of different kinds of roles, produces several artefacts at diverse moments in the process, and provides different types of meetings (see Figure 1 [47]).

The development of a CSR Computer System has all the features that make it suitable to apply agile principles, since the specification of CSR Requirements needs constant feedback from the participants and their total commitment, which are both common in Agile Methods. Furthermore, the implementation of a CSR Computer System is an evolving context where new requirements arise while the project is being carried out. This affects the need to establish mechanisms and methodologies that facilitate the incorporation of requirements because the product and versions need agile evolution.

Therefore, adopting this kind of principle to draw up our methodology follows two

aims. On the one hand, it seeks to encourage customer collaboration, since CSR is a broad concept and it should be implemented depending on the specific objectives of each enterprise. On the other hand, it is intended as a way to change management, because CSR needs to be adapted quickly to the changing environment and the new requirements of society.

2.3. Model-Driven Engineering

Model-Driven Engineering promotes the use of models and their transformations in order to obtain computer systems from conceptual models [17, 48, 49]. In this context, the Object Management Group (OMG) provides Model-Driven Architecture (MDA) as a proposal in which models are defined at three levels of detail: Computer Independent Model (CIM), Platform Independent Model (PIM) and Platform Specific Model (PSM), with the aim of reducing the level of abstraction from conceptual models to code [50].

The application of this paradigm to develop enterprise models to be transformed into computer systems is proposed in several research studies with the aim of obtaining more interoperable computer systems [51, 52]. In this work, the authors propose a method to transform enterprise models from the CIM level to the PIM level, although there is a lack of examples showing how to perform this kind of transformation [51] and, in particular, how to model the CSR dimension in enterprises like other dimensions of an enterprise, such as organisation, processes, decisions, etc. [53, 54]. There are, however, many studies dealing with transformations between PIM and PSM models [55, 56, 57].

The benefits of this paradigm in terms of reducing software development costs are also stated [58]. In [19] the application of Model-Driven Engineering is analysed in two cases of small software enterprises. The research concludes that on a practical level it is possible for small companies to gain competitive advantages using this paradigm, since its benefits in large enterprises are widely reported [18, 59, 60, 61]. In fact, successful adoption of model-driven practices depends on the management of change, since these practices involve an organisational, technological and cultural change for the enterprise [18].

However, there is a lack of specific formal methodologies that guide enterprises in the process of obtaining computer systems from enterprise models or CIM models [14]. As an example, in [20] the authors explain how to apply the model-driven approach to a Web Engineering process through mock-ups. This research is focused on incorporating constant feedback from final users, which is usual in agile practices, into

the Model-Driven Web Engineering process. Thus, this work is an attempt to combine Agile Methods with Model-Driven Engineering, although it does not consider how to apply it in a specific domain such as CSR [44].

In this context it is worth mentioning the work conducted by [44], where the author proposed a user objectives-driven methodology. The main goal of this work is to integrate the two above-mentioned approaches, Agile Methods and Model-Driven Engineering, with a third one, User-Centred Design, since the authors argue that none of them on their own are successful. They analyse how other approaches that integrate Agile Methods and Model-Driven Engineering [62, 63, 64] have not been satisfactory, since they were focused on software architecture, and therefore they propose an approach that takes into account the user's objectives to guide software development.

We can find some other proposals, such as [65], that are more focused on the CSR domain, in order to integrate sustainability within both the planning and the management tasks of companies, which can be a basis on which to implement information systems aligned with strategic objectives. This methodology is not, however, Agile or Model-Driven oriented.

A methodological approach and a Computer-Aided Method Engineering (CAME) tool that supports the in-house design of software development methods, in particular the process part, is described in [66]. The specification of the process and the product are defined by engineers in the tool kit provided, which is Model-Driven oriented.

Regarding these proposals, we present a methodology to support the development of CSR Computer Systems from a strategic point of view that integrates Agile Methods and Model-Driven Engineering, since they are currently two of the most popular approaches in the software development process. Moreover, according to our own previous research work, CSR can be considered as an enterprise dimension to be modelled in order to obtain modelling benefits, in the same way as other dimensions like organisation, processes or decisions are [14].

3. The Model-Driven CSR Framework

The Agile Model-Driven Methodology for CSR presented in this paper, called **AMDM4CSR** for short, is part of a larger research project mentioned in Section 1. The main objective of this project is to provide a **Model-Driven CSR Framework** to

define, model and manage CSR Requirements and thus, ultimately, to implement CSR Computer Systems. A first vision of this research was presented in [14] and the resulting Framework (see Figure 2) currently includes:

- A **CSR Metamodel** [15] to characterise CSR as yet another enterprise dimension. The main inputs taken into account to develop this Metamodel are: (1) the review of several standards, such as the ISO 26000, which, in its Clause 6, outlines the Social Responsibility Core Subjects that an enterprise should take into account in order to operate in a socially responsible way, or the GRI recommendations for information disclosure; (2) the analysis of research trends and best practices on CSR; and (3) a survey we developed about how some representative companies performed CSR management and disclosure.

  This Metamodel (see Figure 3) provides a Domain-Specific Modelling Language for CSR, called **DSML4CSR**, which is defined as a UML Profile and can also be used as a Reference Model [67] to define the CSR Requirements of an enterprise. This DSML4CSR can be used as an

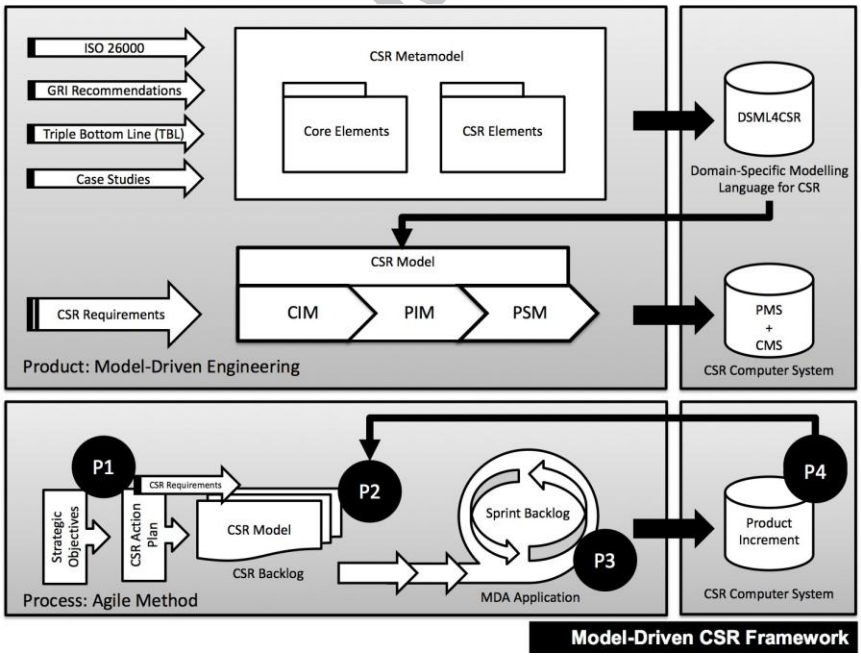

Figure 2: Model-Driven CSR Framework to implement CSR following the AMDM4CSR.

Enterprise Modelling Language in order to obtain enterprise models

focused on the CSR dimension at the CIM level that are used as the input in the Model-Driven Development Process.

- An **Agile Model-Driven Methodology for CSR** described in this paper, called **AMDM4CSR**, which is based on the following two approaches:
  - **Model-Driven Engineering**: regarding product development, this Methodology takes into account the strategic objectives to define the CSR Requirements and then the application of Model-Driven principles to obtain the CSR Computer Systems after successive transformations.
  - **Agile Methods**: regarding process organisation, this Methodology follows the agile principles, in particular Scrum Manager, in order to develop a CSR Computer System in a more flexible way. This approach provides a better integration of users into the requirement engineering process, and a faster response to quickly changing requirements.

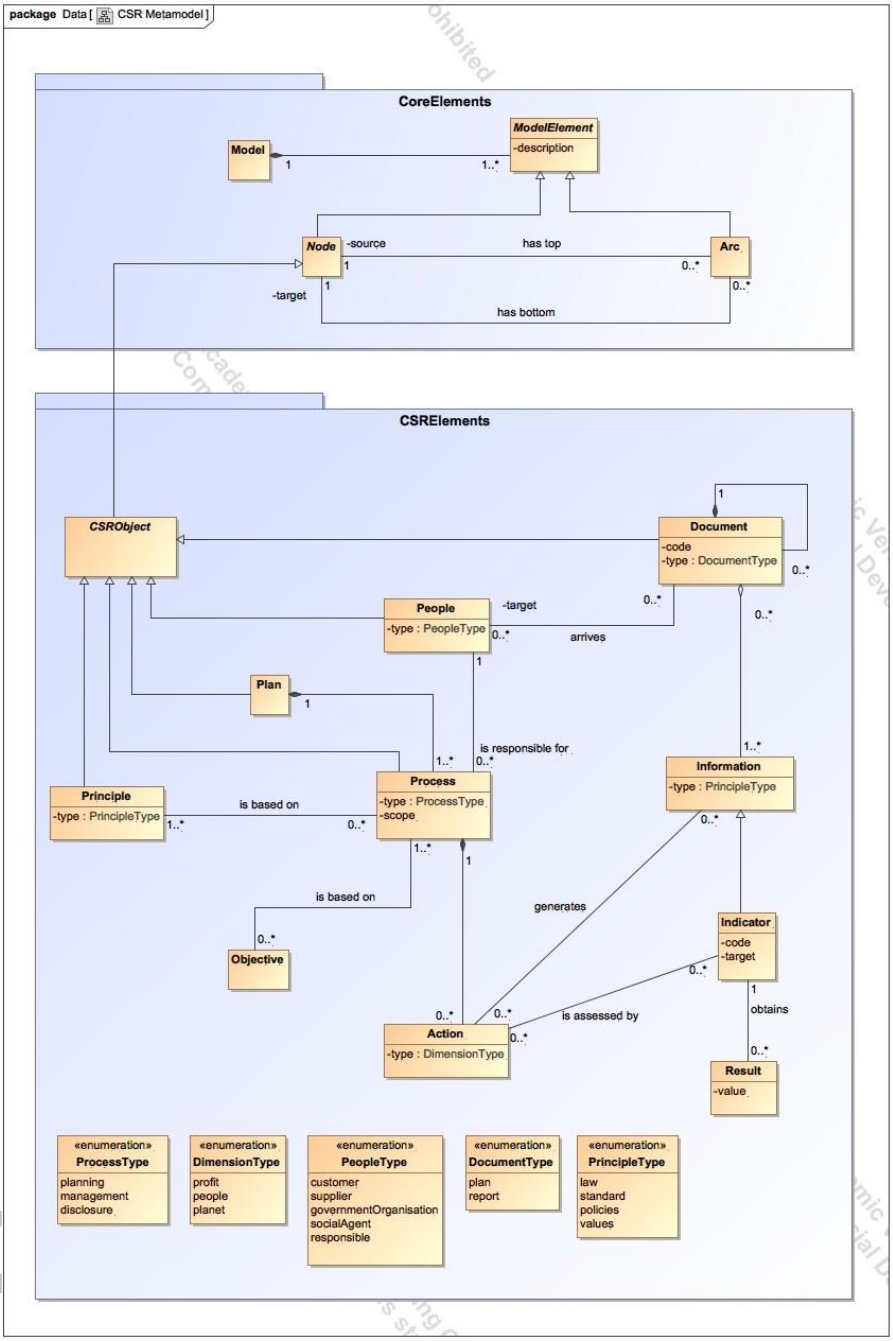

Figure 3: CSR Metamodel [15].

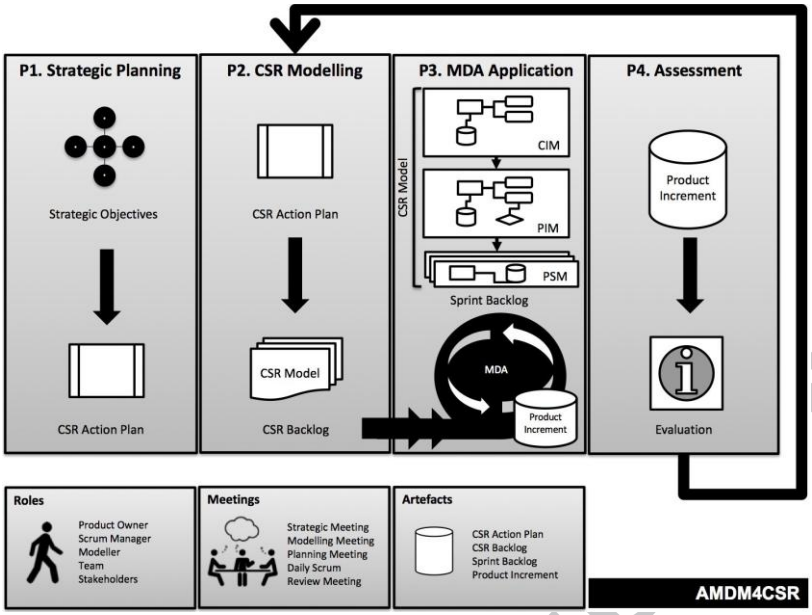

Figure 4: AMDM4CSR: Agile Model-Driven Methodology for CSR.

Not only the proposed Methodology adopts and combines these two approaches, but each process, task and technique is defined having in mind the specific casuistry of CSR management.

4. Agile Model-Driven Methodology for CSR

The proposed Methodology is agile-oriented in its conception, although we have distinguished four processes that have been integrated in order to follow Scrum Manager [39, 40] (see Figure 4). These four processes are as follows:

- **P1 Strategic Planning**. The main goal of this process is to analyse the Strategic Objectives of an enterprise in order to find out what the CSR Requirements for the specific enterprise are so as to be able to define the CSR Action Plan.
- **P2 CSR Modelling**. The CSR Requirements included in the CSR Action Plan are transformed into a CSR Model which constitutes the CSR Backlog. Then, the diagrams that make up this model are organised and prioritised to define the sprints.
- **P3 MDA Application**. Each sprint is carried out following a Model- Driven Development based on MDA. Therefore, the CSR Model at the CIM level is successively transformed until the CSR Computer System has been generated.

- **P4 Assessment**. Each Product Increment that is generated is evaluated by all the team at the end of each sprint.

Processes 2 to 4 are executed iteratively in different sprints, as can be observed in Figure 4. In the following, the processes of the Methodology are detailed.

4.1. P1 Strategic Planning

The goal of this first process is to align the strategic objectives and the CSR Requirements of the enterprise. The input of this process is made up of the Strategic Objectives of the enterprise. The result will be the CSR Action Plan, which will show the specific CSR Requirements for this enterprise taking into account its strategy.

4.1.1. P1.1 Set up the context

The first task to be carried out consists in defining the main objectives of the CSR Computer System that we want to implement, accurately describing its scope at the functional, organisational and technological levels, and setting up the human resources of the project.

The scope, especially functional, must identify what the CSR Computer System will provide with a high level of detail, and what it will not include. For instance, it must determine the specific regulations on CSR the company wishes to consider or whether any of the three P's (Profit, People and Planet) have not been included. The team is set up by members that play different roles. These roles, which must be defined taking into account the functional CSR scope and the principles of the Scrum Manager, are:

- **Product Owner**, who has comprehensive knowledge about how the enterprise wants to manage CSR and what the enterprise needs to take into account in its strategic objectives.
- **Scrum Manager**, who has a good knowledge of Scrum processes and also has a technological profile. The Scrum Manager should have certain qualities such as good communication skills and be able to lead the team, solve problems, evaluate risks and remove impediments, etc.
- **Modellers**, who develop the models. They must have modelling skills and must also have expertise in MDA techniques.

- **Development Team**, who carry out technical tasks required by the Methodology. They should be defined taking into account different technological profiles.
- **Stakeholders**, people with an interest in the final outcome of the project should participate in order to evaluate the final results and offer their feedback.

The main techniques that can be useful during this task are information collection techniques, such as face-to-face interviews or inspection of the enterprise documentation on strategic plans.

4.1.2. P1.2 Establish the CSR Action Plan

Once the context has been established, the Product Owner analyses the Strategic Objectives in order to define the needs of the enterprise in terms of CSR. Therefore, he needs to tackle the Strategic Objectives related to CSR taking into account sustainability and the TBL, and then define accurate plans to accomplish these objectives, which together make up the CSR Action Plan.

CSR is a huge concept which includes many issues that could be implemented in a CSR Computer System. Therefore, enterprises need to carry out a first step in order to align the CSR needs expressed in the CSR Action Plan with the enterprise strategy. Enterprises need to identify the requirements in terms of CSR taking into account their strategy as a final result of this task and express them in the CSR Action Plan.

This CSR Action Plan states what the proposed actions are, who will carry them out, when they will take place, what resources are available and what set of indicators is proposed to measure performance. The CSR Action Plan must also be a responsibility assigned to the Product Owner, who should organise a Strategic Meeting in order to explain the results of tasks P1.1 and P1.2 to the whole team.

Therefore, the CSR Action Plan displays the high level CSR Requirements for the CSR Computer System, since the system must allow management and disclosure of information about these objectives, actions, plans and indicators.

4.2. P2 CSR Modelling

The second process is focused on the modelling of the CSR Action Plan with the ultimate objective of defining the CSR Backlog, which includes the CSR Model made up of diagrams. Then, the team prioritises the diagrams of this model in order to select which ones will be implemented in each sprint. The input for this process is the previous

CSR Action Plan and the output is the diagrams selected for the next process, where the sprints will be executed.

4.2.1. P2.1 Define the CSR Backlog

The first task to be performed in this process is to analyse the CSR Requirements from the CSR Action Plan with the aim of developing the CSR Model. Therefore, at this stage, the CSR Requirements will be specified as models in order to obtain the CSR Backlog. The process implemented to define the CSR Model is driven in this Methodology by the CSR Metamodel provided as a UML Profile [68, 69].

Enterprise Modelling [53] is the technique proposed to define the CSR Requirements that will make up the CSR Backlog. The Modeller is responsible for performing this CSR Backlog. The CSR Model is developed using the DSML4CSR, which is presented in Section 3 and detailed extensively in [15]. This is a complicated task led by the Modeller, in which the whole team needs to be involved with the final aim of obtaining an enterprise model that represents the CSR Requirements at the CIM level.

A Modelling Meeting needs to be arranged in order to analyse this kind of model and the aim of this task is to ensure that the whole team knows and understands the CSR Requirements that must be implemented.

As a result the CSR Requirements are represented at the end of the second process as the CSR Model that constitutes the CSR Backlog.

4.2.2. P2.2 Define the Sprint Backlog

The CSR Backlog must be prioritised taking into account the enterprise strategy to decide which diagrams of the CSR Model will be implemented in each sprint. Subsequently, at the beginning of each sprint, the new requirements or the results obtained in the previous sprints could bring about a new prioritisation. A meeting, called the Planning Meeting, is held so that all the team members are able to understand which diagrams are included in the Sprint Backlog. This meeting must be re-arranged in order to perform this task at the end of each sprint. The nature of these meetings will differ along the successive sprints as the amount of time needed will vary.

4.3. P3 MDA Application

The third process is focused on transforming the models developed in the previous process to obtain several models at different levels of abstraction until the software is completely developed. The transformation process is carried

out following MDA principles. Therefore, the input of this process consists of the diagrams selected from the CSR Model in each sprint and the output is made up of the Product Increment that is obtained, i.e. one part of the CSR Computer System that executes the requirements represented in the diagrams of the CSR Model selected for the sprint.

4.3.1. P3.1 Transform using ATL

Different types of transformations must be performed during the execution of each sprint. The starting point consists of the diagrams of the CSR Model developed at CIM level. These diagrams are transformed into PIM models, then the PIM models into PSM models and finally these into code as the Product Increment. These transformations are performed using ATL [70].

This task is carried out by all the team except the Product Owner and the Stakeholders. Following Scrum Manager, the team performs a Daily Scrum, which is a meeting held in order to state the progress of the sprint and the difficulties that arise during the transformation process. These tasks are performed while the sprint is executing.

4.4. P4 Assessment

Finally, the fourth process is the evaluation of the Product Increment obtained and the process itself. The main input to perform the assessment is the software obtained as a Product Increment and the output is its evaluation.

4.4.1. P4.1 Evaluate Product

The final task of each sprint is the Review Meeting. During this meeting, the whole team, including the Stakeholders, evaluates the software obtained and provides feedback about its functionality and how accurate it is. The above-mentioned meeting can be useful to validate the Product Increment and also to consider new CSR Requirements and to review the company's CSR strategy, as well as to announce the next sprint.

The most suitable technique for validating and verifying the Product Increment is the acceptance test.

4.4.2. P4.2 Evaluate Process

Another important result of this meeting is the assessment of the methodology itself from the process point of view. All the team must analyse

Table 1: Processes of AMDM4CSR: tasks, roles and meetings.

Process	Task	Role	Meeting
P1	P1.1 Set up the context	Product Owner	Strategic
	P1.2 Establish the CSR Action Plan	Product Owner	Strategic
P2	P2.1 Define the CSR Backlog	Modeller	Modelling
	P2.2 Define the Sprint Backlog	Modeller	Planning
P3	P3.1 Transform using ATL	Modeller	Daily Scrum
P4	P4.1 Evaluate Product	Development Team	Review
	P4.2 Evaluate Process	Development Team	Review

Table 2: Processes of AMDM4CSR: techniques, inputs and outputs.

Process	Technique	Input	Output
P1	Interview/Inspection	Strategic Objectives	CSR Action Plan
P2	DSML4CSR	CSR Action Plan	CSR Model
P3	MDA Techniques (ATL)	Sprint Backlog	Product Increment
P4	Acceptance tests	Product Increment	Evaluation

the main problems detected during the execution of the Methodology and can define work methods and strategies to avoid problems or to improve the activities and results. These tasks can also be carried out during the Review Meeting.

Finally, a summary of the tasks, roles, meetings, techniques, inputs and outputs that can be used in each process can be seen in Tables 1 and 2.

5. Proof of Concept of AMDM4CSR: Pamesa

In this section we describe how to apply the AMDM4CSR in an actual company in order to evaluate its applicability and correctness by means of a case study [71]. The objectives are to apply the processes defined in the Methodology in order to [72]: (1) test their adequacy; (2) assess their feasibility; (3) obtain feedback to improve the Methodology; and (4) develop an example of use that can guide other companies in applying AMDM4CSR.

The project was carried out considering the case study of Pamesa Cerámica, an enterprise in the ceramic tile industry. This kind of enterprises are suppliers of ceramic

tiles and services for the construction industry. The

Methodology was applied taking into account the information published on Pamesa's Corporate Website [73].

Pamesa is a company with over 40 years' business experience. Its mission is defined as 'the design, manufacture, distribution and marketing of ceramic products that meet its customers' needs, ensuring excellent quality, design and price'. Pamesa's vision includes consolidating the firm as a leader in the specific national and international market and generating value for all the company's stakeholders. Finally, the group is developing specific policies on CSR that are summarised in its corporate values as: design and innovation, commitment to the customer, teamwork, ethics and sustainability, work with transparency and commitment to economic, social and environmental progress.

Pamesa's corporate website provides information about how CSR and sustainability actions are performed. In particular, two main issues are included:

- **Environment**: this considers policies and actions to promote recycling and optimisation (reduction in waste, optimisation of water, recycling of raw materials and reduction in energy consumption); energy saving (gas consumption, investment in new technologies); and reduction of emissions.
- **Equality**: where a plan for equal opportunities between women and men is defined.

In the following sections, we show how to apply the AMDM4CSR to this company taking into account its specific public CSR policies on environmental and equality issues. For each process of the Methodology we describe the tasks and steps that should be carried out, as well as the inputs needed and what results should be obtained.

5.1. P1 Strategic Planning

The goal of the process is to define Pamesa's CSR Action Plan. Pamesa has already defined some plans and actions on its corporate website. We reviewed these previous results and we added new plans, actions and indicators to complete and organise the CSR Action Plan, which is the result of this first process. The research team hold a Strategic Meeting to assign the roles, to establish the scope and to define the CSR Action Plan. However, this meeting

should be organised by the Product Owner, who is in charge of engaging the CSR implementation.

5.1.1. P1.1 Set up the context

We considered two areas of interest in Pamesa's CSR policies: environmental and equality issues, as part of the three axes in the TBL: planet, people and profit. These two areas are enough for our proof of concept, although enterprises need to analyse and determine the required areas of interest and their boundaries in order to establish the scope of the CSR Computer Systems at this stage.

In this case study, the scope of the CSR Computer System includes all the needs regarding how to manage the measures, actions, plans and information concerning these two lines of interest.

In this first task, the team project is also organised. Regarding the roles in the teamwork and according to the company structure we defined:

- **Product Owner**, who is responsible for making the main decisions about the CSR Computer System and is in charge of launching the CSR process. Two people could play this role according to the subject of interest: the Quality Assurance Manager, when the tasks concern environmental issues, and the Human Resources Manager, when we consider aspects regarding the Equality Plan.
- **Scrum Manager**, in this case the **Modellers** and the **Development Team** are members from the research project.
- **Stakeholders** are the participants in the project that obtain direct or indirect benefits from the final product. In this case, they should be the Social Manager, the Financial Manager, etc.

Table 3: Pamesa's sustainability commitments [73].

Lines of interest	Strategic Objective
Environment	**(SO1)** Reduce waste production in terms of both quantity and hazard level
	(SO2) Reduce deforestation
	(SO3) Reuse waste water
Equality	**(SO4)** Provide equal opportunities between women and men
	(SO5) Raise staff awareness on equality issues

5.1.2. P1.2 Establish CSR Action Plan

The second task performed in this process was to analyse Pamesa's strategic objectives with the aim of defining the CSR Action Plan and determining the high-level CSR Requirements. We examined the information about the CSR strategy on Pamesa's website and we identified a subset of strategic objectives (see Table 3) related to the subjects of interest within the scope: environment and equality issues.

Pamesa has already defined some plans, actions and indicators, but we identified others to complete the definition of the CSR Action Plan in order to follow the proposal of the AMDM4CSR. Thus, we defined Pamesa's CSR Action Plan, which includes the strategic objectives, actions and different indicators to measure the performance for each action (see Tables 4 and 5). Additionally, we defined who can be the person in charge of each action. A more complete CSR Action Plan would include the milestones and targets for each indicator in order to establish what values must be achieved and when.

5.2. P2 CSR Modelling

In this process the CSR Action Plan defined for Pamesa was reviewed and modelled in order to prepare the CSR Backlog, which was the input to develop the transformations in the third process.

5.2.1. P2.1 Define the CSR Backlog

Taking into account the scope of the project, the team reviewed Pamesa's CSR Action Plan and analysed the requirements to develop the CSR Model.

Table 4: Pamesa's CSR Action Plan for Environment.

Strategic Obj.	Action	Responsible	Indicator
(SO1) Reduce waste production in terms of both quantity and hazard level	(A1.1) Use of co-generation turbines to produce electricity and to reuse gas	Quality Assurance Manager and Production Manager	(I1.1.1) CO^2 emissions/m^2 production
			(I1.1.2) Fuel consumption/m^2 production
(SO2) Reduce deforestation	(A2.1) Use of euro pallets	Quality Assurance Manager and Production Manager	(I2.1.1) Number of euro pallets distributed monthly
	(A2.2) Recycle cardboard paper, plastic and other materials	Quality Assurance Manager	(I2.2.1) Cardboard containers recycled
			(I2.2.2) Plastic containers recycled
			(I2.2.3) Containers of other materials recycled
(SO3) Reuse waste water	(A3.1) Recover waste water for both the group and its customers	Quality Assurance Manager and Production Manager	(I3.1.1) Water recovery considering production in m^2
	(A3.2) Create the infrastructure to recover the waste water	Quality Assurance Manager	(I3.2.1) Annual investment in infrastructures
	(A3.3) Obtain management commitment to water saving activities		

Table 5: Pamesa's CSR Action Plan for Equality.

Strategic Obj.	Action	Responsible	Indicator
(SO4) Provide equal opportunities between women and men	(A4.1) Equality of opportunities in selection processes	Human Resources Manager	(I4.1.1) Increment in % Male/Female hired
	(A4.2) Create a protocol to prevent harassment in the workplace	Human Resources Manager	(I4.2.1) Number of hours in training on equal opportunities issues
			(I4.2.2) Number of harassment situations identified and solved satisfactorily
(SO5) Raise staff awareness on equality issues	(A5.1) Promote use of non-sexist language	Quality Assurance Manager	(I5.1.1) % of internal documents using non-sexist language
	(A5.2) Anonymous assessment survey on equality plan	Human Resources Manager	(I5.2.1) Number of employees participating in the survey
			(I5.2.2) Level of awareness about equality issues
	(A5.3) Create a protocol to prevent harassment in the workplace	Human Resources Manager	(I5.3.1) Number of hours' training on equal opportunities issues
			(I5.3.2) Number of harassment situations identified and solved satisfactorily

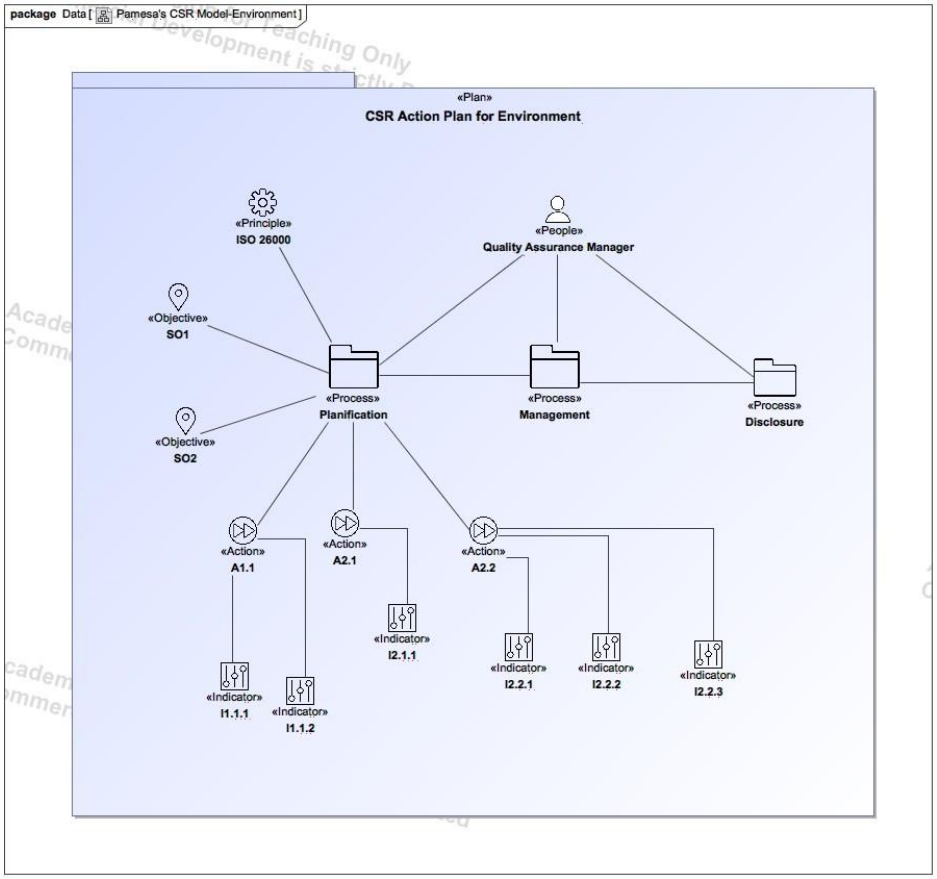

Figure 5: Pamesa's CSR Model for Environment.

495

500

The Modeller developed the first version of the CSR Model using the Domain- Specific Modelling Language for CSR (DSML4CSR) created for the AMDM4CSR in order to represent Pamesa's CSR Computer System at the CIM level of abstraction (see Figure 5 and Figure 6). Then, during the Modelling Meeting, the participants put together the information they had in order to understand the modelled requirements.

In this company a CSR Action Plan is composed of many Strategic Objectives; the diagram shows that actions can be performed to achieve one or more Strategic Objectives, and also that a Strategic Objective can have one

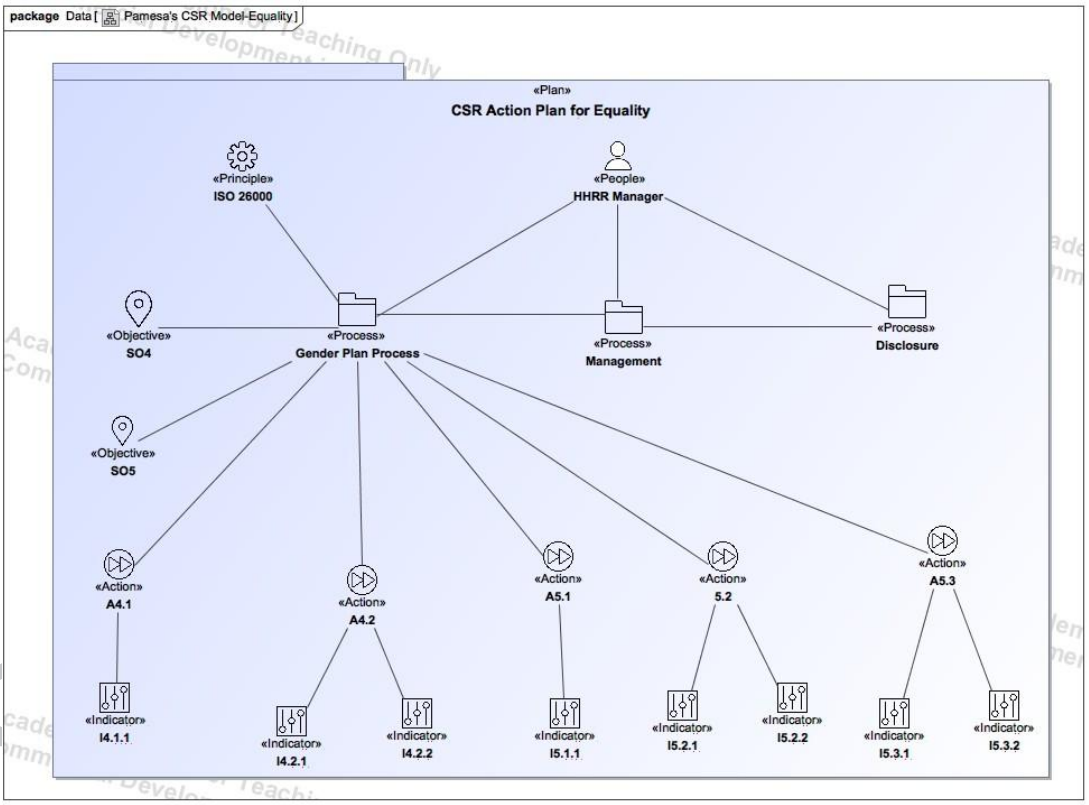

Figure 6: Pamesa's CSR Model for Equality.

or more actions; finally, it represents the fact that an Action can have one or more Indicators to measure its execution.

5.2.2. P2.2 Define the CSR Sprint Backlog

A first Planning Meeting would be needed to prioritise the CSR Backlog in order to consider the diagrams of the CSR Model that would be included in each sprint.

After the first sprint, a second and shorter Planning Meeting should be held to incorporate the new needs identified in the first assessment and to consider the next sprint. Thus, the CSR Backlog should be reviewed and increased with these needs. The Scrum Process is iterative and so new sprints had to be executed until the final product, the CSR Computer System, was obtained and this was accepted by all the participants in the process.

In a first sprint we can take, for example, Pamesa's CSR Model for Environment as one of the diagrams that make up Pamesa's CSR Model.

5.3. P3 MDA Application

Pamesa's CSR Model for Environment is performed at the CIM level and therefore the first objective during this process was to apply transformations in order to obtain the PIM model and then the PSM model, which is transformed into code in the last step. These transformations may be performed using ATL techniques in the same way as other work carried out by the authors with other modelling languages [51, 52].

By transforming Pamesa's CSR Model for Environment our aim is to obtain PIM models in UML. On the one hand, a class diagram is used to model the Performance Measurement System in order to measure the indicators defined for each action associated with each strategic objective. And on the other hand, an activity diagram is required to implement the computer system that could guide the planning process of CSR taking into account the Environmental issue.

During this third process it is important to perform the Daily Scrum. Following the Scrum principles, this meeting must be held standing and be a

> quick exchange of feelings in which the team discuss the work done the previous day, what is expected to take place during the day and the problems that may have arisen during planning.

5.4. P4 Assessment

Finally, once the product increment had been obtained, i.e. the CSR Computer System to measure and to plan the CSR regarding the Environmental issue, two meetings were held.

The first one was the Review Meeting in order to review the CSR Computer System obtained in the first sprint. This meeting was led by the Product Owner and all the team had to participate, including the stakeholders. The result of the evaluation should

be incorporated into process P2.2. Moreover, during the meeting the objective of the new sprint could be announced and the process will continue by starting a new Planning Meeting for the second sprint in which a new excerpt of the CSR Model will be selected and so on.

Finally, a second meeting was performed to review not only the final product but also the development process. The main idea is to provide feedback to the development team in order to continue to improve the development process and therefore to obtain a better product.

6. Conclusions

6.1. Results obtained

The Agile Model-Driven Methodology for CSR (AMDM4CSR) described in this paper is one of the results obtained in a large project performed by the research group, the final objective of which is to provide a Model-Driven CSR Framework.

Firstly, this Framework offers a Domain-Specific Modelling Language implemented by means of a CSR UML Profile, called DSML4CSR. This language allows enterprises to define both their needs and their goals when implementing a CSR Computer System. It is therefore a good mechanism to represent CSR requirements at a high level and it is a step forward towards modelling the CSR dimension within the context of Enterprise Modelling.

Secondly, the Model-Driven CSR Framework provides a methodology which proposes the combination of Agile Methods and Model-Driven Engineering in order to take advantage of the benefits of both paradigms. This methodology proposes a proactive and practical way to focus on the management and disclosure of CSR information and strategies through a CSR Computer System.

Companies usually develop their own ad-hoc methods and computer systems to manage CSR. The application of this Methodology aims to help enterprises to define their goals and CSR Requirements taking into account their Strategic Objectives. The steps of the Methodology then guide enterprises to model these CSR Requirements at a high level using the DSML4CSR proposed inside the Model-Driven CSR Framework. Finally, by applying MDA methods, this model can be transformed into a CSR Computer System.

To sum up, the Methodology provides three main processes that allow the user to: (1) define the CSR Action Plan, (2) obtain the CSR Model, and (3) apply MDA to obtain the Product Increment. A fourth process is needed for the evaluation of both the product obtained and the process itself. The Methodology is a guide to lead enterprises

from the conceptual level to the software level within the context of CSR management.

The final objective of this Methodology is to obtain a CSR Computer System starting from CSR Requirements defined at the strategic level. These CSR Requirements are defined as models, since the Methodology is model-driven. This fact has two advantages: on the one hand, CSR Requirements are more understandable than large specifications of functional requirements; and, on the other, we also obtain the advantages of the Model-Driven Paradigm in the context of the sustainable development of computer systems.

The other paradigm used (the Agile Method and particularly Scrum Manager) offers important benefits, such as the continuous feedback provided by the Product Owner and the Stakeholders to improve the product iteration after iteration. CSR management fits into this paradigm, because it is a large issue that usually involves many stakeholders from different areas and their continuous contact is a key factor of success.

Moreover, agile principles fit projects with evolving requirements very well and this is why CSR is an ideal context because new concerns appear every day. Hence, new CSR Requirements can be added to the CSR Backlog and they can be taken into consideration in subsequent sprints applying MDA transformations.

6.2. Lessons Learned

The case study provided in Section 5 outlines how to apply the Methodology. We learned the following lessons from this application:

- Collaboration among modellers, stakeholders and product owners is a critical aspect for success. Taking into account that the Methodology is based on agile principles, their collaboration is paramount. The participants must be not only involved but also committed.

- The definition of requirements is an essential part in the development of the CSR Computer System and this is the reason why the definition of CSR Requirements as a CSR Model is also such a crucial step in our methodology. At the same time it also makes DSML4CSR a fundamental mechanism that provides support and important benefits.

- The defined models are not only the input for the transformation to obtain the CSR Computer System, but also help us to: (1) understand the actual strategies on CSR that the enterprise wants to follow, (2) define graphically the CSR Action Plan, and (3) assess what is functioning correctly and what can be improved regarding CSR.

- Taking into account that the DSML4CSR is based on existing standards, its use provides an initial framework in which to consider what information is needed to accomplish regulations and standards about CSR and its disclosure.

6.3. Limitations of the work and future research

Finally, the case study provided us with valuable input in order to assess and improve the Methodology and the metamodel. By applying the Methodology we have been able to test its feasibility and we have obtained valuable feedback. The case study only describes how to apply the processes of our methodology regarding the way to combine Agile Methods and Model Driven Engineering but it does not detail how to apply MDA in each sprint. The main objective of our research is focused on providing a holistic approach about how to work from CSR strategic objectives to the CSR Computer System. There are many proposals about how to transform models by applying MDA but we consider this subject beyond the scope of this paper. Nevertheless, it is an interesting topic that we are working on in our research. As further work, we are focused on improving the CSR Metamodel and the Methodology by incorporating results from other case studies and also applying other transformation techniques. For instance, we can consider methodologies in the field of the Problem Structuring Method [33, 34] (i.e. Soft Systems Methodology, Strategic Options Development and Analysis, and Strategic Choice) that can support how to act in order to solve complex situations and reach agreements, for instance in the CSR requirements definition process. Finally, the method and the results obtained encourage us to adapt this Methodology to other sectors such as the field of healthcare.

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Highlights

- Analysis of Corporate Social Responsibility (CSR) standards and regulations.
- Identification of CSR management requirements.
- Definition of a CSR Methodology to implement CSR Computer Systems.
- CSR Methodology based on Agile principles and Model-Driven approaches.
- Proof of concept to show how to apply the CSR Methodology in an actual company.