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A New Method for Generating CIM Using Business and Requirement Models

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Abstract— The foundation of Model Driven Architecture (MDA) approach is creation of models. MDA life cycle begins from Computation Independent Model (CIM) and ends with code. Object Management Group (OMG) explains various models and their relations, but it does not specify clearly how to create these models and which models to use for representation them. In this paper, we focus on CIM level. CIM is the highest level of abstraction in MDA and it has high reusability in practice. In this paper, we present a method for generating CIM using artifacts and concepts of RUP methodology. Our proposed method presents a CIM that covers both aspects of CIM include business model and requirement model and it can transform into a complete Platform Independent Model (PIM). Proposed method is highly acceptable by experts.

Keywords- MDA; CIM; RUP; Business Model; Requirement Model; Use Case Model.

I. INTRODUCTION

The MDA is an approach for software development defined by the OMG. MDA is an approach to IT system specification that separates the specification of functionality from the specification of the implementation of that functionality on a specific technology platform [1].

MDA defines four models [1]:

- CIM, a model that describes a system from the computation independent viewpoint and does not show details of the structure of systems.
- PIM, a model of a subsystem that contains no information specific to the platform, or the technology that is used to realize it.
- Platform Specific Model (PSM), a model of a subsystem that includes information about the specific technology that is used in the realization of it on a specific platform, and hence possibly contains elements that are specific to the platform.
- Code, a specification of the system in the source code.

MDA life cycle is depicted in Fig. 1.

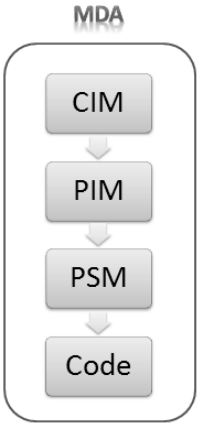

Figure 1. MDA life cycle.

Key to MDA is the importance of models in the software development process [2]. CIM is the highest level of abstraction in MDA, and it has high reusability in practice.

CIM plays an important role in passing the gap among specialists for domain (business analysts and domain expert) and specialists for design and development of an information system (software analysts). It has shown in Fig. 2.

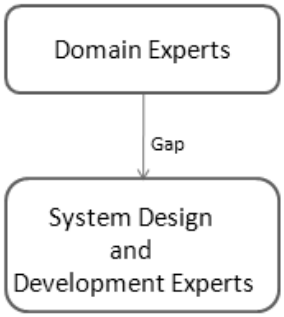

Figure 2. Role of CIM in software development.

OMG explains various models and their relations, but it does not specify clearly how to create these models and which models to use for representation them. In this paper, we present a method for generating CIM using artifacts and concepts of RUP [3] methodology. Overview of proposed method is described in Fig. 3.

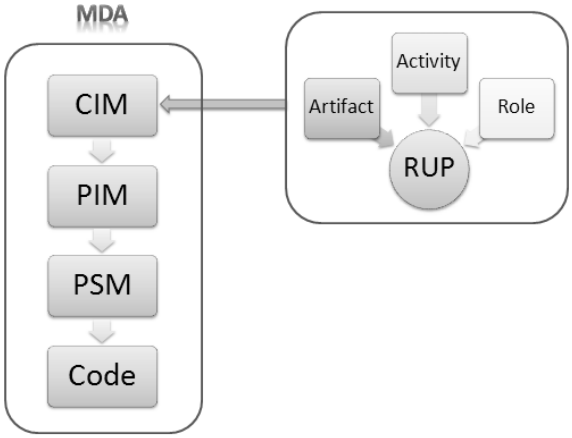

Figure 3. Overview of proposed approach.

This paper is organized as follows: section 2 discusses related work. Section 3 discusses our proposed method. Evaluation of proposed method is discussed in section 4. Section 5 discusses conclusion of the paper.

II. Related Work

CIM is the first model in MDA life cycle. In [9] is mentioned that Regarding CIM, there are two basic streams of suggestions of what is to be represented by CIM. One of the streams suggests that the business model is to be represented at this level [10]. Another stream points to CIM as a model, which represents system requirements [11]. Some researchers position both models representing business knowledge and system requirements at the CIM level [12].

In Fig. 4, we are depicted taxonomy of CIM.

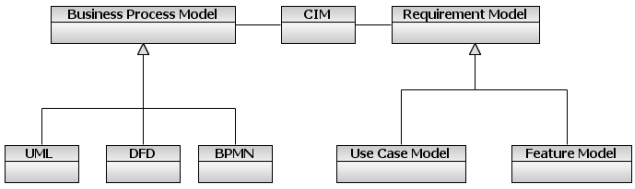

Figure 4. Taxonomy of CIM

As shown in Fig. 4, we classify the different representations of the business process model aspect used in the proposed approaches into three types: UML Diagram, Data Flow Diagram (DFD) and Business Process Modeling Notation (BPMN). The Requirement Model aspect is classified into two types: Use Case Model and Feature Model.

In [4] proposed a disciplined approach for transformation from CIM to PIM using feature-oriented and component-based approach. In this paper, feature model used for representing requirement in CIM and this model includes a set of features and relationship between them.

In [5] presented a possible solution for CIM modeling and then transform it to PIM using the analytic method of transformation. In this paper CIM level representing by DFD that it is used for business process modeling.

In [6] proposed a disciplined approach for transformation of CIM into PIM. In this paper, CIM includes Business Process Model and requirement model. First Business Process modeled using an activity diagram then activity diagram details for specifying a system requirement.

In [7] presented an approach for transforming CIM into PIM. In this paper, CIM is represented by a secure business process in BPMN [8].

III. Proposed Method

One of the challenges in MDA is that PIM model must be CIM-based. Also the main problem in order to more effectively generate an IT system from business requirements is how to generate a CIM so that it can be automatically transformed into PIM. For solving these challenges, we propose a method for generating CIM.

CIM should be transformed into a complete PIM that includes structural and behavioral aspects. For this for generating structural aspect of PIM we use the business model in CIM and for generating behavioral aspect, we use the requirement model in CIM.

According to above discussion, in this paper in order to represent a CIM, we use both aspects of CIM including business model and requirement model. In the following subsections, we explain each aspect of proposed CIM.

For our method, we use RUP methodology for the following reasons: The first one is availability of Guidelines for activities. The second one is the level of maturity of this methodology. And the third one is wide usage of RUP

methodology. For our purpose, we focus on business modeling and requirements disciplines of RUP.

3.1 Business Model

Business process model represents one part of CIM. For Business process modeling, there are three modeling techniques: DFD, UML [13] (activity diagram) (most used), and BPMN.

According to discussion in section 2, first stream about CIM representing the business process model in CIM. RUP uses the business model for modeling business process and provides a systematic approach for visual representation of the business model. In RUP, business model generates in business modeling discipline.

Furthermore, for business process model for representing one part of CIM, we use the business model that is the main artifact of business modeling discipline in RUP methodology.

Business model comprises a business use-case model and a business analysis model [3].

A business use-case model is a model of the business's intended functions consists of business actors and business use cases. The actors represent roles external to the business (for example, customers), and the business use cases are processes.

A business object model includes business use-case realizations, which show how the business use cases are "performed" in terms of interacting business workers and business entities.

3.2 Requirement Model

Requirements should be modeled in CIM. As regards RUP is the use case driven and represent software requirements using use case. For requirement modeling, we use use case model that is the main artifact of requirements discipline. In fact, use case model is another part of CIM.

According to above discussion, we use business modeling and requirements disciplines for generating CIM. We use business use case model and business analysis model in the business modeling discipline and use case model in requirements discipline.

Fig. 5 shows above discussions, in summary.

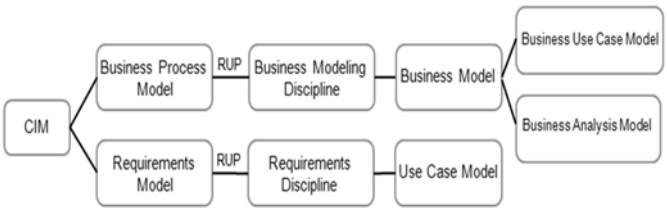

Figure 5. Overview of selection of RUP's disciplines.

So far, we select three models (Business Use Case Model, Business Analysis Model, and Use Case Model) from Business Modeling and Requirements disciplines for proposed CIM.

Proposed CIM is depicted in Fig. 6.

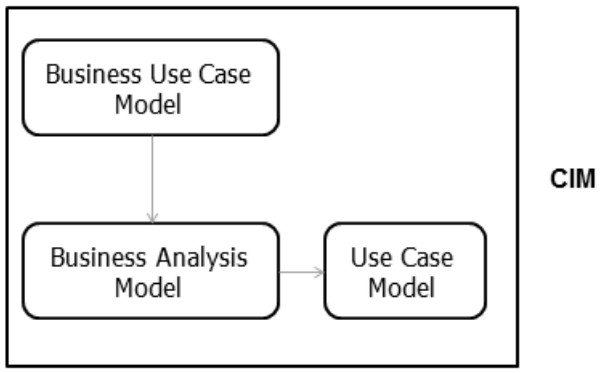

Figure 6. Proposed CIM.

3.3 Activity, Artifact, and Role Selection

Now we propose a method for generating CIM according to above discussions using artifacts and activities of Business Modeling and Requirements disciplines of RUP.

We are studied all the activities, artifacts, and roles in both disciplines and selected main artifacts and activities that have important roles in producing the business model and use case model and then organized them.

In previous subsections, we are selected required artifacts for generating CIM from RUP. Now we select activities and roles that produce these artifacts. In fact, we do not want to use all the activities and roles, but we want to only use the most important activities and roles.

As regards Business Use Cases support business Goals. We start from defining Business Goals and according to this, we select "Identify Business Goal" activity from Business Modeling discipline. The next activity is, "Find Business Actors and Use cases"**.** Desired outputs in this activity for us are Business Actor, Business Use Case and Business Use Case Model.

So far, first artifact of CIM is generated. Now we need to realize Business Use Case Model. For this reason, we select "Find Business Workers and Entities" activity. Desired outputs are Business Worker, Business Entity, and Business Analysis Model.

Now second artifact of CIM is generated, and we need to derive Use Case Model. Finally, with the help of "Define Automation Requirement" activity, we derive Use Case Model from Business Analysis Model.

Fig. 7 illustrates our proposed method visually.

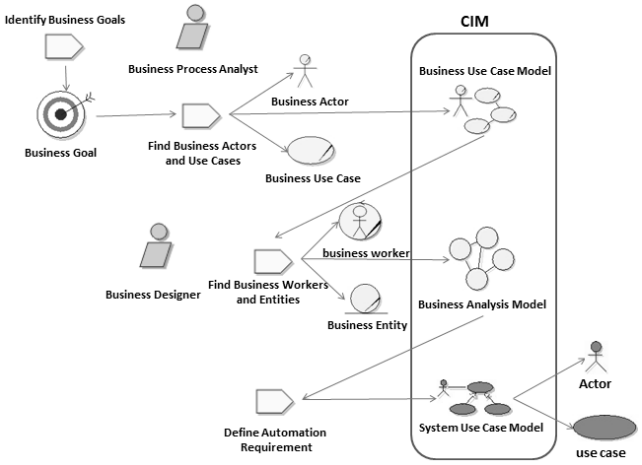

Figure 7. Proposed method for generating CIM.

IV. EVALUATION

We used two methods for evaluating our proposed approach. The first one is the case study and the second one is criteria-based evaluation. In fact, we use criteria-based evaluation for considering and covering all aspects related to our work.

4.1 Case Study

One case study has been performed to evaluate our approach. The illustration of proposed approach can be explained with the help of an example of physician's activity system (PAS) [14].

The PAS is software used to manage activities related to the checkup of patients, the treatment of patients and management of financial transactions involved.

After interviewing the primary stakeholders of PAS and understanding its business needs, the following activities may occur in the due course of working of PAS:

- The assistant either creates a new patient file (for new patients) or opens up an already existing file (for patients already registered with PAS) to note the detailed information of the incoming patient and sends the patient to doctor for initial checkup.
- The Physician or doctor prepares the prescription mentioning tests and medicines, if any, and; procedure of treatment.
- If some tests are prescribed the assistant sends the patient to the lab technician for these tests.
- The lab technician performs the prescribed tests on the patient and after recording the information of all these tests sends the patient to the doctor again.
- Doctor examines the findings of all the tests and prescribes the treatment to the patient.
- The assistant generates the bill for the patient that includes consultation fees, and tests and medicine charges, if any.
- The patient clears the bill by making the payment and walks away.

The users or actors of the system and their characteristics are as follows:

- Doctor is a person who examines the patient, prescribes test and medicine for patients; and prepares the diagnosis.
- Lab technician is a person who is responsible for: a) performing medical tests on patients, and b) preparing the tests reports.
- Assistant is a person who is responsible for: a) entering the details of patient, b) generating bills for the consultation fee, test charges and medicine charges, and c) Accepting payments from patients.
- Patient is a person who visits the doctor for the medical treatment of an ailment.

Now we follow our proposed method. In this case study for simplicity, we suppose one Business Goal. Business Goal of PAS according to PAS definitions and "Identify Business Goals" activity in RUP can be considered "Treatment".

The following table shows generated Business Use Case and Business Analysis Model for PAS based on proposed approach.

TABLE I. Business Use Case Model and Business Analysis Model Artifacts

Activity	**Artifact**	
Find business Actors and Use Cases	Business Actor	Patient
	Business Use Case	Treatment
Find Business Workers and Entities	Business Entity	Medicine
		Bill
		Patient File
		Test
		Sample
	Business Worker	Doctor
		Assistant
		Lab Technician

Fig. 8 shows resulting output.

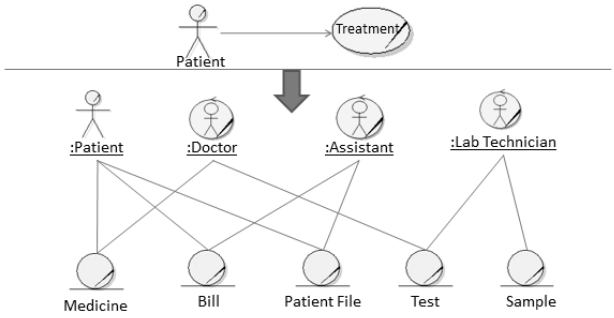

Figure 8. Business Use Case Model and Business Analysis Model.

Now according to "Define Automation Requirement" activity, we derived Use Case Model from above artifacts. Fig. 9 shows Use Case model of PAS.

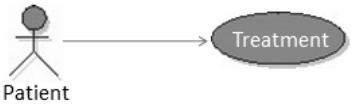

Figure 9. Use Case Model of PAS.

Results show that complete CIM can be generated by the proposed approach.

4.2 Criteria-Based

In this sub section first we are derived evaluation criteria from taxonomy of CIM in section 3 and then compare our proposed CIM with other approaches.

4.2.1 Evaluation criterion for CIM Based

We evaluate the CIM with respect to two evaluation criteria. The first one is "CIM creation" and the second one is "Coverage of CIM". The evaluation criterion "Coverage of CIM" is derived from the Taxonomy of CIM.

If an approach explicitly describes steps and techniques for creating the CIM model then the approach support "CIM creation". "Coverage of CIM" indicates which aspects of CIM covers by proposed approaches.

4.2.2 Evaluation

The evaluation criteria are used to evaluate each proposed approach in terms of CIM creation, Coverage of CIM. In table 2, we compare our method and other approaches in terms of evaluation criteria.

TABLE II. Criteria Based Evaluation

Primary Study	**CIM Creation**	**CIM Representation**	**CIM Coverage**	
			Business Model	***Requirement Model***
Wei et al. [4]	No	Feature Model		Yes
Kardoš et al. [5]	No	DFD	Yes	
Kherraf et al. [6]	No	Activity Diagram Use Case Diagram	Yes	Yes
Rodríguez et al. [7]	No	BPMN	Yes	
Our Proposed Approach	Yes	Business Use-Case Model Business Analysis Model Use Case Model	Yes	Yes

4.2.3 Discussion

We can see from Table II, that our proposed method can create CIM. The other approaches do not propose any steps and techniques for creating CIM. Two out of 5 approaches can cover business model (e.g., DFD). One approach can cover requirement model (e.g., Feature model). Two approaches (including our approach) are capable of covering CIM, including both aspects.

V. CONCLUSION

CIM is highest level of abstraction and is the first model in MDA life cycle. In this paper, we are focused on generating CIM and present a method for generating CIM using models and concepts of RUP methodology.

Regarding CIM, there are two aspects, and this paper according to its purpose covers both. For this purpose, we use Business Modeling and Requirements disciplines of RUP. Proposed method is confirmed by domain and technical experts. Companies familiar with RUP can use this method and apply benefits of MDA.

In the future work we want to propose an approach for CIM to PIM transformation based on proposed CIM.

REFERENCES

[1] J. Miller, J. Mukerji, "MDA guide version 1.0.1," OMG, 2003.

[2] A. Kleppe, J. Warmer, and W. Bast, MDA explained: the model driven architecture: practice and promise.: Addison Wesley, 2003.

[3] P. Kruchten, The rational unified process: an introduction, 3rd ed.: Addison Wesley, 2003.

[4] Wei. Zhang, Hong. Mei, Haiyan. Zhao, and Jie. Yang, "Transformation from CIM to PIM: A Feature-Oriented Component-Based approach," in MoDELS, Montego Bay, Jamaica, 2005.

[5] Martin. Kardoš, Matilda. Drozdová , "Analytical method of CIM to PIM transformation in Model Driven Architecture (MDA)," JOURNAL OF INFORMATION AND ORGANIZATIONAL SCIENCES, vol. 34, pp. 89-99, 2010.

[6] Samir. Kherraf, Éric. Lefebvre, and Witold. Suryn , "Transformation from CIM to PIM using patterns and Archetypes," , 2008, pp. 338-346.

[7] Alfonso. Rodríguez, Eduardo. Fernández-Medina, and Mario. Piattini, "Towards CIM to PIM transformation: from Secure Business Processes defined in BPMN to Use-Cases," Business Process Management, vol. 4714, pp. 408-415, 2007.

[8] "BPMN: Business Process Modeling Notation specification," OMG, 2006.

[9] Marite. Kirikova, Anita. Finke, and Janis. Grundspenki, "What is CIM: an information system perspective," Advances in Databases and Information Systems, vol. 5968, pp. 169-176, 2010.

[10] Steffen. Becker, "Coupled model transformations," in Proceedings of the 7th international workshop on Software and performance. Princeton, New Jersey, USA: ACM, 2008, pp. 103-114.

[11] Stefan. Biffl, Richard. Mordinyi, and Alexander. Schatten, "A Model-Driven Architecture approach using explicit stakeholder quality requirement models for building dependable information systems," in Proceedings of the 5th International Workshop on Software Quality. Washington, DC, USA: IEEE Computer Society, 2007, pp. 6-.

[12] Janis. Osis, Erika. Asnina, and Andrejs. Grave, "Computation Independent Modeling within the MDA," in IEEE International Conference on Software-Science, Technology & Engineering, Los Alamitos, 2007, pp. 22-34.

[13] OMG, "UML 2.1.1 superstructure specification," 2007.

[14] Yashwant, Singh and Manu, Sood, "Model Driven Architecture: a perspective," in IEEE International Advance Computing Conference (IACC), Patiala, India, 2009.