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# Applying model-driven engineering in small software enterprises

Jesús Sánchez Cuadrado [a,*], Javier Luis Cánovas Izquierdo [b], Jesús García Molina [c]

[a] Universidad Autónoma de Madrid, Spain
[b] AtlanMod, Ecole des Mines de Nantes INRIA, Nantes, France
[c] Universidad de Murcia, Spain

## HIGHLIGHTS

- Description of two MDE projects carried out in two small companies.
- Metrics show productivity gains.
- The selection of the pilot project is a key issue.
- To foster adoption the research team must advice the company about new developments.

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## ABSTRACT

Model-Driven Engineering (MDE) is increasingly gaining acceptance in the software engineering community, however its adoption by the industry is far from successful. The number of companies applying MDE is still very limited. Although several case studies and reports have been published on MDE adoption in large companies, experience reports on small enterprises are still rare, despite the fact that they represent a large part of the software companies ecosystem.

In this paper we report on our practical experience in two transfer of technology projects on two small companies. In order to determine the degree of success of these projects we present some factors that have to be taken into account in transfer of technology projects. Then, we assess both projects analyzing these factors and applying some metrics to give hints about the potential productivity gains that MDE could bring. We also comment on some lessons learned. These experiences suggest that MDE has the potential to make small companies more competitive, because it enables them to build powerful automation tools at modest cost. We will also present the approach followed to train these companies in MDE, and we contribute the teaching material so that it can be used or adapted by others projects of this nature.



## 1. Introduction

Model Driven Engineering (MDE) has emerged as a new software engineering discipline which emphasizes the use of models to improve the software productivity and some aspects of the software quality such as maintainability or interoperability. MDE techniques have proven useful not only for developing new software applications but for reengineering

* Corresponding author.
*E-mail addresses:* jesus.sanchez.cuadrado@uam.es (J.S. Cuadrado), javier.canovas@inria.fr (J.L. Cánovas Izquierdo), jmolina@um.es (J.G. Molina).
*URLs:* http://sanchezcuadrado.es (J.S. Cuadrado), http://jlcanovas.es (J.L. Cánovas Izquierdo).

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legacy systems and dynamically configuring running systems. Several software development paradigms are included in MDE, among which Model-Driven Architecture (MDA) [1], domain-specific development [2], language-oriented programming [3] and model-driven modernization [4] have received more attention. As noted by [5], the different MDE paradigms can be reduced to two main ideas: raising the level of abstraction and raising the degree of computer automation.

Although MDE is increasingly gaining acceptance in the software engineering community, its adoption by the industry is very limited. There are a growing number of companies which have successfully applied MDE [6], but "its use by the industry is still an exception rather the norm" [5]. Indeed, the industrial adoption of a software innovation is not immediate, but a period of time (more than two decades in the case of object technology) is required to reach the needed conditions: a stable and mature foundation, usable and robust tools, skilled professionals and companies aware of the benefits of the new technology. Therefore, three main actions must be carried out for MDE to be successful: more research and development effort to overcome the technical challenges; including MDE in the University curricula; and projects of Transfer of Technology (ToT) intended to increase the awareness of industry, as well as training software developers in the model-based style of thinking [7].

Most experience reports about MDE adoption are focused on large companies, however as noted in [8], "small companies are different" as they have some particularities that cannot be overlooked. Both large and small companies face similar software engineering challenges, but the solutions have to be adapted to the size and nature of the company. For instance, small companies are more responsive and flexible, but they do not typically have enough resources to build custom, in-house solutions. In this way, the adoption of MDE in a small company has to be different from a large one. It is particularly important to scale well the initial MDE projects. For instance, it is not reasonable to convert the code-centric development style of a small company into a model-centric style, since the cost is high, and the benefits have not been clearly assessed yet [9]. Instead, a better alternative is to use MDE techniques to automate certain development problems as a means to enhance the company productivity.

In this work we report on our practical experience in two ToT projects. Unlike most experience reports, we have dealt with two small software companies: Sinergia with around 100 employees, with which we carried out a modernization project, and Visualtis with 12 employees (at the time of the project) which built a generative architecture. The analysis of these experiences suggest that MDE has the potential to make small companies more competitive, because it enables them to build powerful automation tools at modest cost. By reporting on these projects, our hope is to give insights that may help other ToT projects aiming at introducing MDE to small software companies. To this end, we introduce some factors that affect the success of this kind of projects, and provide an assessment of both projects on the light of these factors. The assessment is based on qualitative data about the projects, and quantitative data in the form of metrics. We also present some lessons learned. In addition, the description of each pilot project may serve as an inspiration for small companies that want to begin with MDE on their own, since they are prototypical small–medium projects that can be addressed without spending much resources and pay off rapidly. We will also present our approach for training companies in MDE, and we contribute the teaching material so that it can be used or adapted by other ToT projects.

*Paper organization*. Section 2 introduces the factors considered in assessing the success of our ToT projects. Sections 3 and 4 describe in detail the two projects: generating Java wrappers and building of a generative architecture. Section 5 gives an assessment of the projects by analyzing the factors previously introduced, while Section 6 discusses some lessons learned from these experiences.

## 2. Success factors in ToT projects

Our research team has always been conscious of the need of collaborating with software companies in order to apply the research results obtained. Since we started to work in MDE in 2005, we have participated in several ToT projects which have been funded by the national or regional government with the aim of promoting the innovation and research in regional industries. Based on this experience we have identified several factors that affect the development of ToT projects, particularly in small companies. We introduce them in the rest of this section, but first we discuss our view about success in this kind of projects.

### 2.1. Success in ToT projects

A ToT project is aimed at transferring research results (normally knowledge, technologies, skills or methods) from research institutions (e.g., universities) to companies. Determining the degree of success in this kind of projects must be done according to the objective of the transfer. In our case, both projects shared a common objective: to show the benefits of MDE technology by building a tool able to automate some software development tasks in the companies. Therefore, the experience would serve to the company's staff to realize the potential of MDE to improve their productivity by automating certain tasks. From this perspective, the success of our projects should be assessed from three main dimensions: (1) at the knowledge dimension (i.e., to what extent the company has acquired an accurate judgment on the potential and current state of the technology), (2) at the product dimension (i.e., the application of MDE techniques for building the desired tool has proved useful) and (3) at the adoption dimension (i.e., is the company committed, somehow, to adopt MDE in some form in the future?). It is important to note that the fulfilment degree of each dimension may vary according to the goals