

Diffusion of Model-driven Architecture in Academia

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Abstract

Model-driven architecture (MDA) is a relatively new software development paradigm that advocates the use of modeling throughout the software development lifecycle. This paradigm appears to be gaining validity in the industry as several large companies are investing resources to develop tools that support MDA. However, little is known about the diffusion of MDA in an academic setting. A survey of Information Systems and Computer Science faculty from around the world was conducted to understand the awareness, interest, evaluation, trial, and adoption of MDA in academia.

1. Introduction

Each year software development companies such as Microsoft, IBM, Oracle and others forego millions of dollars in licensing costs by allowing faculty, staff, and students of educational institutions to acquire free or low-cost licenses to their applications. One motivation for “giving away” these licenses is the hope that students who become familiar with the programs will continue to use them when they enter the workforce. The loss of short-term revenue is often recouped in the long run when these students become influential in purchasing decisions. These academic alliance programs increase the diffusion and adoption of new technologies in both academia and industry.

New technologies and standards emerge both in industry and academia. The diffusion of these technologies and standards in either industry or academia greatly influences their diffusion in the other. The diffusion of a new technology in academia might be viewed as a reflection of the demand for that technology in industry. Understanding the current state of diffusion and adoption of a new technology in an academic setting provides a number of benefits including:

- A better understanding of the awareness of a new technology in an emerging workforce
- A reflection of the perceived demand for the new technology in industry

- An understanding of the perceived benefits of the new technology and the importance of the benefits

In this paper I investigate the diffusion and adoption of Model-driven Architecture (MDA) in academia through the use of a survey distributed to both computer science and information systems educators. The results of the survey illustrate that the diffusion of MDA in academia is in its early stages.

2. Foundations

2.1 Model-driven Architecture

Model-driven architecture (MDA), published by the Object Management Group (OMG) in 2001, is a software development paradigm that advocates the use of models throughout the software development lifecycle. MDA advocates a distinct separation between the problem domain and the technology that is used to solve the problem. Initially, the semantics of the problem domain are captured in a model called the Platform-independent Model (PIM). The platform independent model does not contain any technology-specific information. At some point during the development cycle a specific platform/technology will be chosen and the PIM will be translated into a Platform-Specific Model (PSM). In other software development paradigms (where there is a separation between the problem domain and the technology used to solve the problem) the transformation from PIM to PSM is done by hand and is a laborious process. In MDA, however, transformation patterns are automated and can be reapplied when changes occur in the PIM. The PSM is eventually transformed into executable code and deployed in a specific environment.

MDA has several potential benefits, including reduced risk of project failure due to changing technology [1], improved productivity for developers and architects [1], business models and technologies that evolve at their own pace [1], enforcement of best practices, standards, guidelines [2], and application quality and reliability [2].

2.2 Diffusion of Innovation

The diffusion of innovation has been widely studied over the years. In 1953, Hagerstrand asserted that the adoption process is “primarily the outcome of a learning and communication process”[3]. In 1987, Kwon and Zmud describe a change agent that “creates a new technology and directs its diffusion within a particular social system”[3]. Rogers describes diffusion as a process in which an innovation is communicated through certain channels over time among members of a specific social system [4]. The diffusion of an innovation in most social systems is not a collective decision; rather, each individual makes her or his individual decision of adoption. Thus, adoption of an innovation can be viewed as an individual decision and diffusion of an innovation is a combined, snapshot view of the social systems adoption based on the adoption decision of each member.

Rogers breaks down the process of innovation adoption in 5 main progressive stages—awareness, interest, evaluation, trial, adoption [4]. Awareness simply refers to the idea of knowing that the innovation exists but not having a working knowledge of the innovation. During the interest stage an individual becomes interested in the innovation and seeks out information about it. During the evaluation stage an individual mentally applies the innovation to her situation and decides whether or not to try it. During the trial stage the individual uses the innovation, and during the adoption stage the individual decides whether to continue the full use of the innovation.

In addition to the stage of adoption, system members can be categorized by the time when they adopt a particular innovation (relative to the whole social system). Major groups ordered chronologically by adoption date include innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%), and laggards (16%) [4].

3. Survey

A survey of Information Systems and Computer Science faculty from around the world was conducted to understand the awareness, interest, evaluation, trial, and adoption of MDA in an academic setting. Additionally, it was hoped that the survey would help in understanding the reasons why certain individuals adopted earlier than others. Questions about the perceived benefits of MDA were also included to see if adoption rates correlated with perceived benefits.

Questions in the survey were grouped by their focus on awareness, interest, evaluation, trial, and adoption. Questions were also posed to gather demographic information. Below I briefly describe each section of the survey and include sample questions.

The demographic section contained questions that primarily dealt with the background of the individual and the organization where they work. Information was gathered about the type of academic appointment, the importance of teaching and research at the institution where they work, whether the department has a masters or doctoral program, what college the department belongs to, and what classes the individual has taught and is slated to teach.

Questions in the *awareness* section surveyed whether or not the individual had heard of MDA (prior to this survey) and their knowledge of MDA.

The *interest* section contained questions that included a self ranking of the individual’s interest in MDA and the time spent reading about or researching MDA.

To assess the *evaluation* stage, the amount of time that the individual has spent reading or researching MDA was used. This section also contained the perceived impact of MDA on various aspects of software development and the importance of those aspects.

The *trial* section of the survey had questions asking about the amount of time spent evaluating MDA products, awareness of specific MDA products, and whether the individual had used any MDA products and which ones.

The *adoption* section had questions that focused on the use of MDA or planned use of MDA in an educational setting. Sample questions included whether MDA had been taught or was planned to be used in a classroom setting and which products were used. There were additional questions about the classes where MDA would be taught, including the type of class, how much time would be devoted to MDA, and the amount of emphasis that would be placed on various development concepts.

The conclusion section included questions to allow the survey participant to include additional narrative information about the reasons for adoption, the reaction of students, resources used, and contact information.

4. Results

Of the 39 respondents that participated in the survey, 21 were recruited from the CS educators

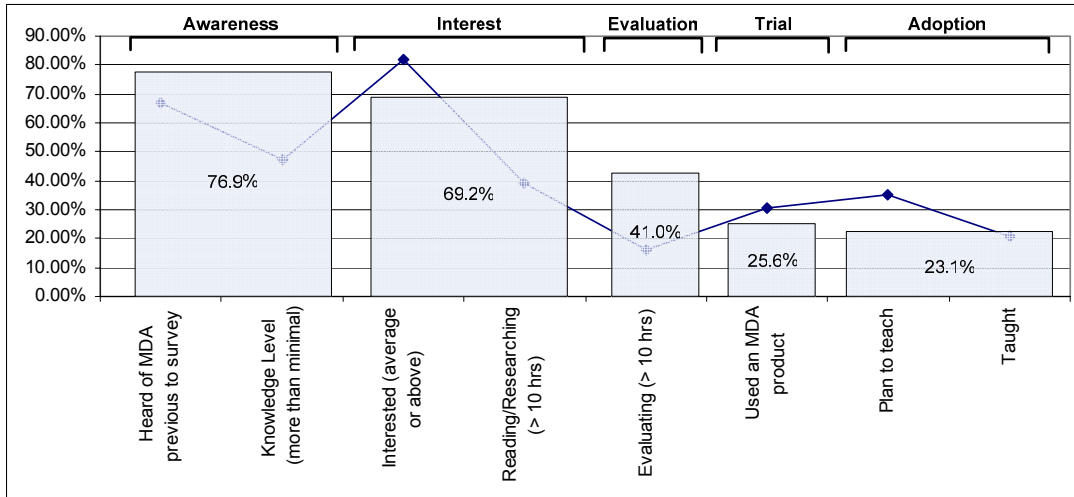


Figure 1 Responses to survey questions broken down by adoption stage

mailing list and 18 were from the Association for Information Systems IS World list. 41% were tenured, 35.9% were tenure-track but not tenured, and the remaining were either non-tenure track or graduate students. 61.5% indicated that teaching was very important at their institution and 46.2% marked that research was very important at their institution.

As indicated previously, questions in the survey were written to assess the individual's current stage in the adoption process. The line chart in Figure 1 illustrates the percent of people who responded positively to each of the questions listed. For example, 66.7% of individuals had heard of MDA previous to the study.

Since multiple questions were used to assess what stage of adoption an individual was in, the answers to multiple questions were combined to create a single percentage of individuals that were currently in that stage or that had previously been in that stage. To determine awareness, an individual had to have heard of MDA prior to the survey and had no knowledge or minimal knowledge of it (76.9%). Those that responded as having interest in MDA and reported reading or researching MDA at least a little were categorized as being in the interest stage (69.2%). If they had read or researched more than 20 hours they were considered to be in the evaluation stage since they had likely tried to understand how they might use or teach it (41.0%). If an individual reported time evaluating MDA and had used an MDA product (e.g. OptimalJ, AndroMDA, other) then they were classified as being in the trial stage (25.6%). If the individual had either used MDA in her teaching in the past, or if she planned to teach it and knew which product she was going to use, she were considered to be in the

adoption stage (23.1%). Figure 1 maps these percentages of adoption onto each stage.

From these results (23.1% adoption rate) we assert that any academics who adopt MDA in the near future can be categorized as part of the early majority (16.1%-54%), but not as early adopters (2.51%-16%). These results hint at the training of the emerging workforce and perhaps to a degree reflect the current demands for MDA in industry.

Some shortcomings of this survey approach include 1) the classification rules for determining stages were arbitrary, and 2) some questions that seek to understand the stage of adoption may not be an accurate reflection of the intent to use MDA in an educational setting.

While we may not have a perfect understanding of the diffusion of MDA in academia, this survey is the first of its kind in assessing the current state. Planned future steps of this research include 1) correlating the benefits of adoption with the stage of adoption the individuals are in and 2) a follow up survey to track the MDA adoption process over time.

5. References

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- [4] E. M. Rogers, *Diffusion of Innovations*. New York: Free Press, 1995.