

## Applying MVC to Evolutionary Acquisition IRPM

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**Abstract.** This work presents a combination of the Model-View-Controller pattern with the Evolutionary Acquisition Interdisciplinary Research Project Management for web services development. It intends to promote an increase in productivity and to facilitate interdisciplinary web services evolution. It consists of an independent database for users' feedback that together with technological opportunities and evolving threats considerations may start a new release of the system allowing a dynamic evolution through acquiring new features or correcting errors, but the new release decision is not automatic. In other words, web service evolution is accomplished adding requirements analysis into the Model-View-Controller pattern, which is incorporated into Interdisciplinary Research Project Management.

**Keywords:** Evolutionary acquisition, IRPM, MVC, project management, software engineering, web services.

### 1. Introduction

Web services for scientific research are becoming more interdisciplinary. Naturally, a rising question would be how to develop interdisciplinary research web services? This paper offers an answer, to combine the MVC (Model-View-Controller) pattern [1]-[2] with Evolutionary Acquisition IRPM (Interdisciplinary Research Project Management) [3].

The MVC pattern has been widely adopted to develop web services, and some examples are: an integrated community web-based service platform [4]; a comparative analysis on MVC modelling and implementing [5]; and a University project management model [6]. Actually, the latter example may be integrated to the method proposed herein, because both are project management based.

The IRPM [7] is a methodology for developing interdisciplinary research based on project management that intends to maximize academic results. When it integrates Evolutionary Acquisition [8], it becomes a systems' development strategy, and it is called Evolutionary Acquisition IRPM, or EA-IRPM. One example that uses IRPM was presented in [9], which is a simulation of a software house in a classroom to develop a system for academic project management; and others examples that use Evolutionary Acquisition were presented in [10] and [11], respectively, a social network to provide free internet access for public schools' communities, and a medicine 2.0 architecture for managing transplantation patients.

Hence, this work proposes a modification of MVC that allows its combination to the systems' development methodology EA-IRPM. It consists of an independent database for users' feedback that together with technological opportunities and evolving threats considerations will start a new release of the system allowing a dynamic evolution. Also, it allows the system to acquire new features or correct errors using users' feedback, that is, the evolutionary acquisition requirement analysis becomes part of the system.

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The authors organized this paper in accordance to the IMRAD structure: introduction, methods, results and discussion; which is adopted as part of the Uniform Requirements for Manuscripts Submitted to Biomedical Journals of the International Committee of Medical Journals Editors, 2008 update. The authors believe that adopting this structure would help search engines in international databases to store and to retrieve information within research papers in order to facilitate meta-analyses and systematic reviews.

## 2. Methods

### 2.1. Evolutionary Acquisition IRPM

IRPM is an approach for interdisciplinary research of real problems using Project Management concepts [12] and problem-based learning [13], [14]. IRPM's schematic is present in Figure 1, but first let us briefly review the Project Management phases: (1) **Initiation**: to determine project goals, deliverables and process outputs, to document project constraints and assumptions, to define strategy, to identify performance criteria, to determine resource requirements, to define the budget and to produce a formal documentation; (2) **Planning**: to refine project, to create a work breakdown structure, to develop the resource management plan, to refine time and cost estimates, to establish project controls, to develop the project plan and to obtain the plan approval; (3) **Execution**: to commit resources, to implement resources, to manage progress, to communicate progress and to implement quality assurance procedures; (4) **Control**: to measure performance, to refine control limits, to take corrective action, to evaluate effectiveness of corrective action, to ensure plan compliance, to reassess control plans, to respond to risk event triggers and to monitor project activity; (5) **Closing**: to obtain acceptance of deliverables, to document lessons learned, to facilitate closure, to preserve product records and tools, and to release resources.

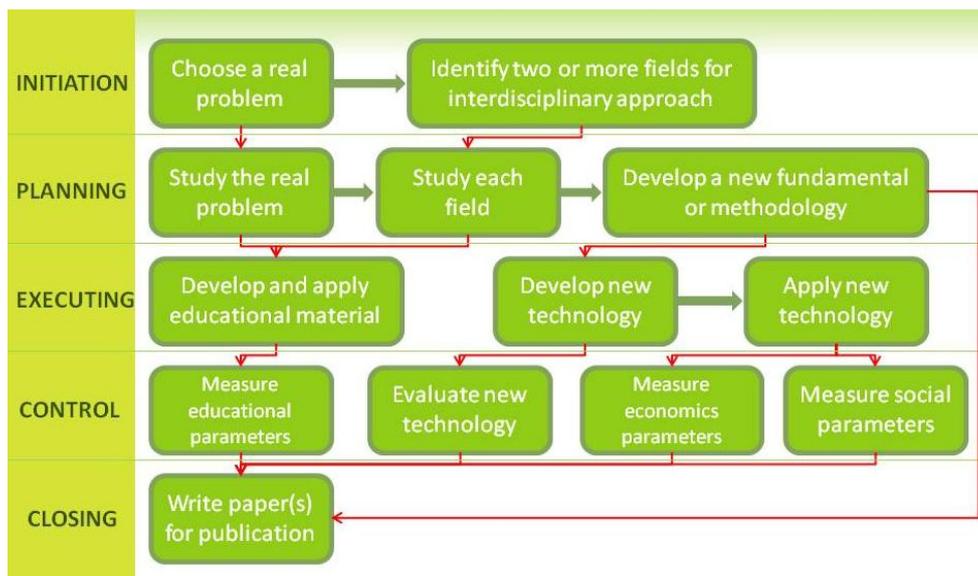


Fig. 1: The Interdisciplinary Research Project Management model.

In IRPM, Initiation phase begins with choosing the real problem to solve and identifying at least two fields for an interdisciplinary approach. These fields are necessary to: document the real problem constraints and assumptions; define strategy; identify performance criteria; determine resource requirements; define budget; and produce formal documentation. Planning phase consists of refining project and analyzing the real problem through studying the chose fields. These studies may produce a new fundamental or methodology. Then in Execution phase, even if new concepts are not obtained, an educational material may be prepared and used in class for a problem-based learning approach, or else the new technology may be implemented and applied. Moreover, if in Planning phase controls were established then educational, technological, economics and social parameters may be available for measurement, allowing Control phase to be performed. Finally, after analyzing measurements, papers should be written as part of Closing phase.

Evolutionary Acquisition (EA) starts with the requirements analysis [2], Figure 2. After defining the “general” requirements for the system and the “specific” requirements for the core, the concept of operations is elaborated. Then together with a requirements analysis of user feedback, technological opportunities and

threats evaluation, the preliminary system architecture is developed. From the system architecture a core is produced. New definitions and developments with an operational test may result in a new version of the core. Then with experience and use, new requirements refinements and updates may be identified and used to develop a new core, or improve it.

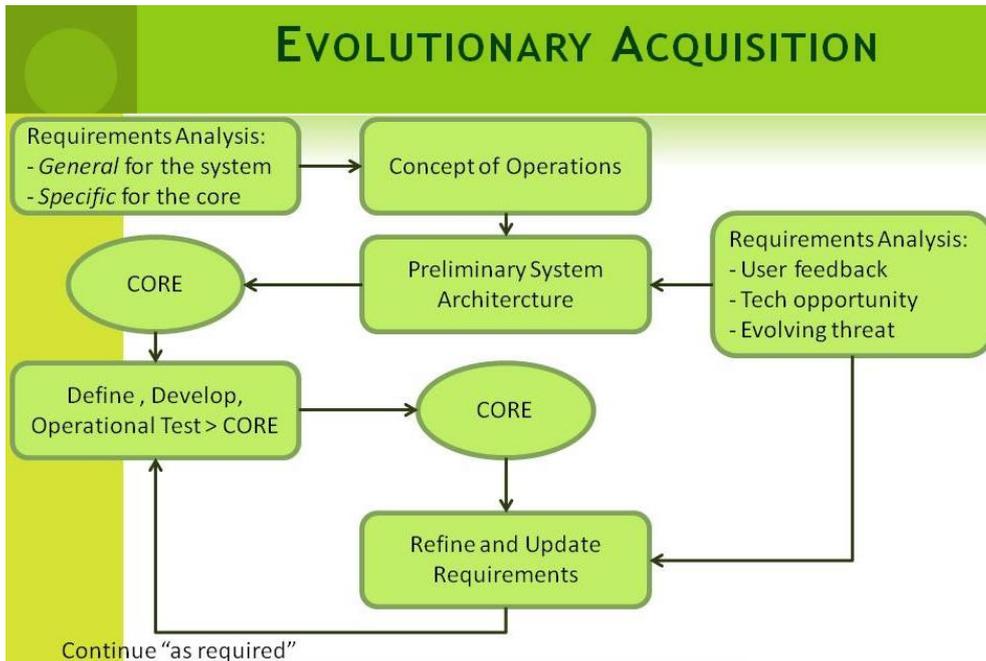


Fig. 2: The Evolutionary Acquisition diagram.

Additionally, Evolutionary Acquisition separates the core of the system into blocks as in Figure 3. A particular block can have several releases, including a final one. If the system is a software, then software engineering techniques may be applied. This paper proposes the use of MVC as the software architecture for the Interdisciplinary Research web service system.

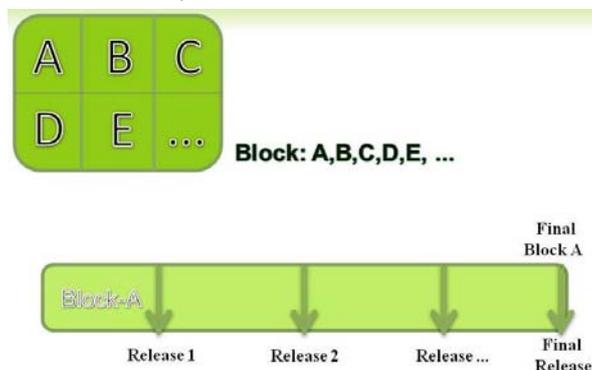


Fig. 3: Core division in Evolutionary Acquisition.

The incorporation of EA into IRPM is presented in Figure 4. It shows that it is inserted into phases Planning, Executing and Control. In Figure 4, RA means Requirements Analysis of: (1) general for the system and specific for the core; and (2) user feedback, technological opportunities and evolving threat. Hence, in Planning phase the attempt to develop a new fundamental or methodology consists of generating a preliminary system architecture beginning with RA 1, and then elaborating the concept of operations, and when available, also considering RA 2. Executing phase consists of implementing the core from the preliminary system architecture followed by new definitions and developments of operational tests. Afterwards, the system is applied in a real life situation. Control phase is about refining and updating requirements, which implies in evaluating technology, measuring economic and social parameters, and verifying users' feedback, technological opportunities and evolving threats, that is, RA 2.

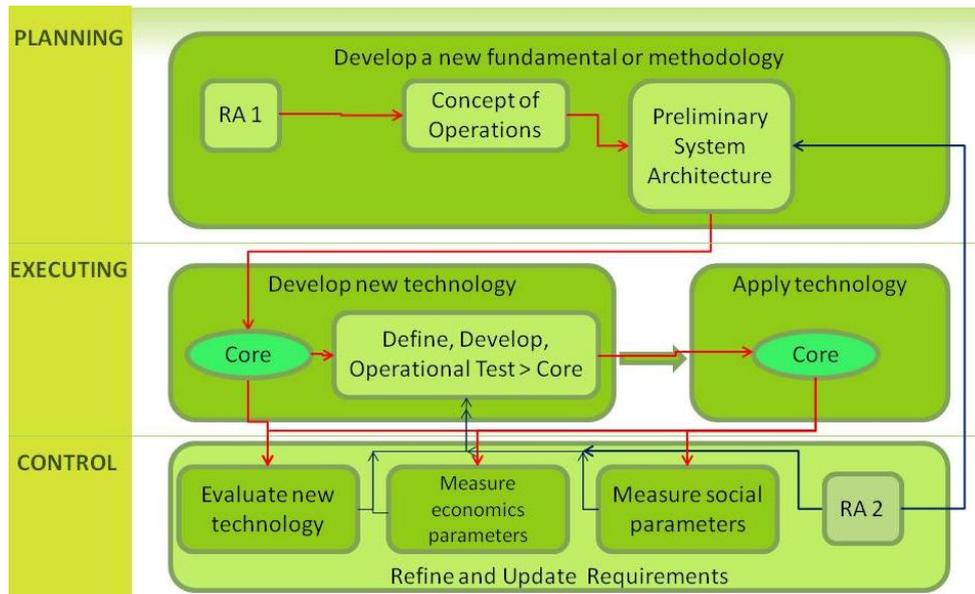


Fig. 4: The insertion of the Evolutionary Acquisition into the Interdisciplinary Research Project Management model.

## 2.2. MVC

The Model-View-Controller (MVC) pattern is a software architecture. It intends to separate the business logic – model, the user interface – view, and the user input – controller. As a consequence, it provides a way to split functionalities to independent development, testing and maintenance. Basically, the model represents the application data and the business rules that command data access and its modification. It also keeps business state and provides to the controller the ability to access encapsulated functionalities. The view displays the system’s state and the controller sets the application behaviour. Figure 5 presents the MVC.

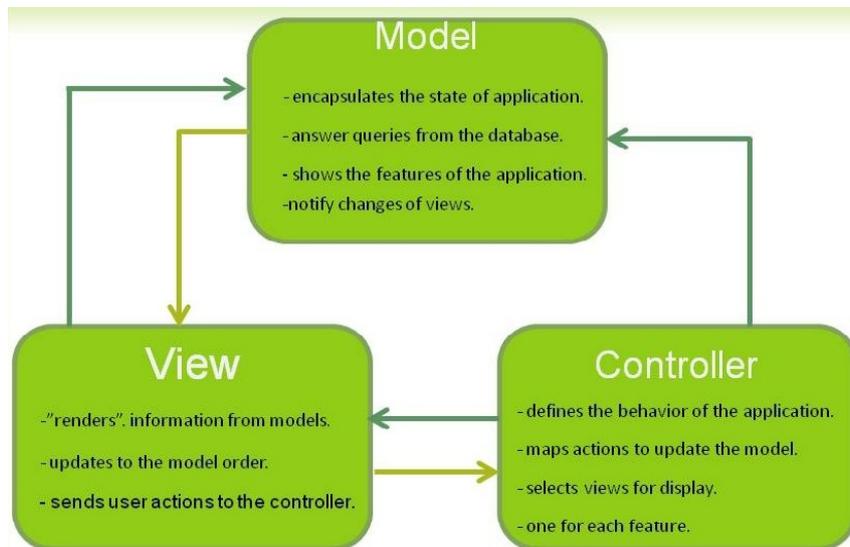


Fig. 5: Model-View-Controller pattern.

## 3. Results

The idea of incorporating MVC into Evolutionary Acquisition is presented in Figure 6. The core architecture of the web service is a modified MVC pattern that is connected to the Requirement Analysis – RA2 of Figure 3, through the user feedback, which should be an independent database system. The letter links means: *A* – to query the model state; *B* – to notify view of change in model state; *C* – state view; *D* – user actions/commands; *E* – invoke methods in the models public APIs; *F* – output to user; *G* – input from user; *H* – to report problem/suggestion/requirement (psr). Connection between web services’ core and Requirement Analysis occurs in the following way: (1) user identifies a system’s psr; (2) then user access the view to report psr, for instance, by pressing a specific button available in the user interface; (3) View queries Controller state about psr; (4) Controller notifies View of change to psr state; (5) View displays psr state to

user; (6) user reports psr through View; (7) View transmits user's report to Controller; (8) Controller accesses users' feedback database system to report psr; (9) refinements and update requirements are defined using users' feedback, technological opportunities and evolving threats considerations; (10) a decision to start a new release may be taken. Hence, MVC is also incorporated to the Evolutionary Acquisition IRPM, which is presented in Figure 7. It is worth noticing that a new release may imply in a change in the system's architecture or a new block release.

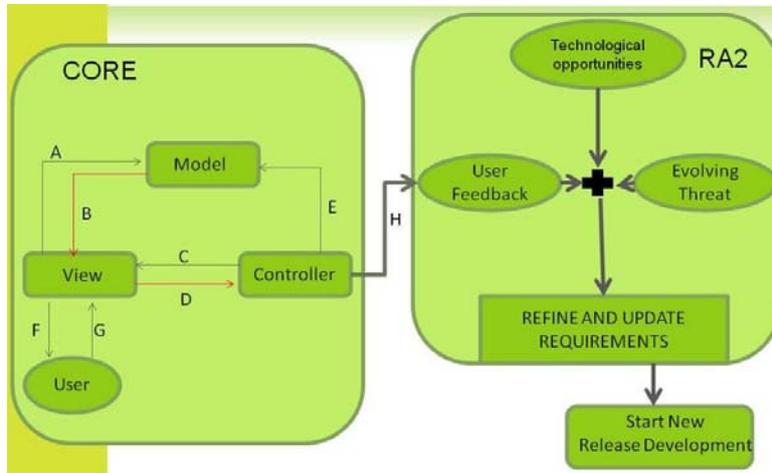


Fig. 6: The MVC Evolutionary Acquisition.

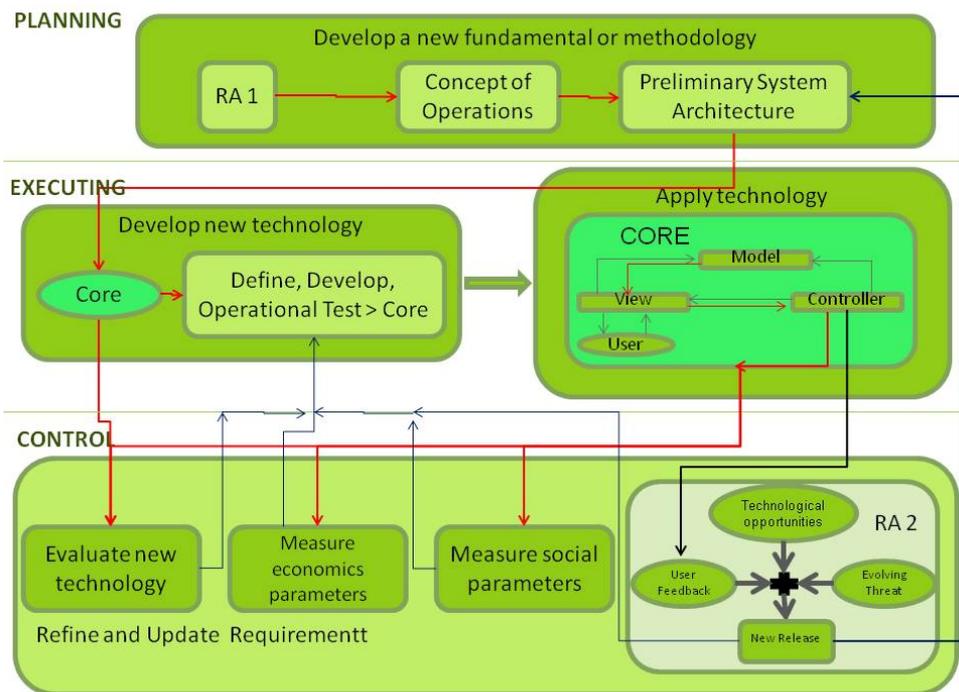


Fig. 7: The MVC Evolutionary Acquisition IRPM.

#### 4. Discussion

This work presented the MVC Evolutionary Acquisition IRPM, or MVC EA-IRPM. In order to incorporate the MVC pattern into EA-IRPM, it was proposed a modification of MVC that allowed it to connect to the Evolutionary Acquisition model. Basically, a users' feedback database system is proposed, that is, the Controller is linked to the users' feedback part of requirement analysis. Consequently, it becomes an evolving development strategy triggered by users' feedback and considerations of technological opportunities and evolving threats.

The decision of releasing a new version of the core or a block is not automatic, and considerations of technological opportunities and evolving threats are still independent parts, that is, they are not part of the

users' feedback database system, though they might be. Moreover, they are not automatic too. Consequently, error and fault detection mechanisms are important features to be considered for future developments, some works that may be applied are in [15]-[17].

Finally, the software development method proposed here presents evolution as an important factor in interdisciplinary web services systems. Actually, according to Breivold *et al.* in [18] "the ever-changing world makes evolvability a strong quality requirement for the majority of software architectures", that is, MVC EA-IRPM increases productivity and facilitates software evolution.

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