

CoH-Agile: Proposal of methodology for development HW/SW embedded

Integrating Co-Design to Scrum

Glaydson Luiz Bertoze Lima¹, Osamu Saotome²

¹Department of Electrical Engineering and Computing, Aeronautics Institute of Technology, ITA, Sao Jose dos Campos, Sao Paulo, Brazil

Abstract: The development of devices that combine hardware and software has created new challenges. The new built devices have a short life cycle and frequently require upgrading.

The software industry attends to these requests with agile methods, such as Scrum. Agile methods apply quick iterations and continuous preplanning based on feedback and past iterations, enabling a quick and continuous delivery for those requests. Linking hardware and software development in an agile and co-designing environment makes the hardware development to be divided in more phases than in the traditional methods. This enables the whole development team to apply agile principles such as constantly working deliverables, testability applied to partial deliverables, simplicity, self-organizing teams, daily cooperation between business people and developers, among other principles.

This scenario is being analyzed when applied to hardware or software development and used along with agile methodologies.

Keywords: Scrum, Co-Design, Agile Methods, Hardware Agile.

INTRODUCTION

The embedded software development has been driven by new market trends. As it is in the case of IoT - Internet of Things[5], where a specific hardware is used, usually a single-board, which demands the dedicated boarding of a software for its correct operation.

The software to be embedded in the hardware must combine multiple perspectives from conception to development of the software and hardware. These are the combinations of software, electrical / electronics, mechanical design with other layers. The combination of these layers is called Co-Design. The objective of the co-design is to meet the changes requirements in order to optimize the product aligned to the customer's needs, allowing that software and hardware be produced together, resulting in value in each project phase[4].

The embedded software development, according to recent literature, has used methods of agile software development. The application of agile methods in embedded software has been justified because it enables the delivery of value, functional parts of software in short development cycles, customer involvement throughout the process and a rapid response to changing requests.

This approach to embedded software development on the management of agile methodologies has created new challenges for projects that need to develop the software and hardware together.

As the embedded software is developed in short development cycles, it is necessary to develop the embedded software in the hardware in sync to enable the value delivery in software and hardware at each stage of development, based on agile methodologies. [7]

This paper proposes adaptations to the Scrum practices to integrate the development of Co-based hardware design, make the hardware development cycles more dynamic and integrated with the software, enable rapid responses to requests for changing and delivering value, aligned between projects of hardware and software.

The paper is organized as follows: The next chapter presents the context for the development of this article, explaining the agile methodology based on Scrum. The third chapter presents the proposed solution. The fourth chapter presents factors that enable agile development and co-design hardware development. The fifth chapter presents the conclusions.

CONTEXT

Hardware development stages have procedural process, like traditional development, based on waterfall, where phases are directly interconnected and dependent. This model presents many risks, because if there are errors in the project, it is necessary to refactor the previous phases, to detect and correct non-conformities.

Unlike the traditional software development, agile methods have smaller phases. If there is any error, the developing process will go on, and the errors are handled in the next phase. This practice enables the development process to keep focus on smaller deliveries, which can be demonstrated at every phase of the project by adding value to every project stage, and not only at the final integration of the hardware and software project.

In this context, a proposal for the development of the integrated hardware and software will be presented in subsequent chapters.

AGILE METHODS

Agile methods were developed in 2001 by a group of professionals that worked together creating a framework to guide software development. This framework, named Agile Manifesto.

All agile software-developing projects have to follow these values and principles. During this process the team project is able to apply it in way that appropriately meets the project objectives. Frameworks were created to make the Software Project Management processes easier.

Scrum is applied in this project as a framework to integrate the management of both software and hardware projects.

“Scrum is not a process or a technique for building products; rather, it is a framework within which you can employ various processes and techniques. Scrum makes clear the relative efficacy of your product management and development practices so that you can improve.” [3]

In a Scrum environment projects are started based on customer’s expectations, which are mapped as the Product Backlog project, in form of stories that describe parts of the work to be done. After the product backlog is created, the product owner prioritizes the objectives focusing on the customer/business needs. The Scrum Master has the role to build a team aligned with these objectives and to remove any barrier that may come up during the developing phase.

The developing process is focused on delivering value in each iteration. Scrum names iterations as Sprint. During the development of a sprint, the customer interacts with the project team and is free to suggest changes in the scope. Being very adaptive, Scrum allows teams to quickly respond to requests of changes during the project development. [3]

To integrate the development of software and hardware projects, adaptations were made in the development cycle of both hardware and software.

In this study, Scrum was adopted with adjustments to be linked with the Co-Design for the development of software and hardware. As the Scrum method is focused on software, adaptations were proposed to support the development of the hardware.

Figure 1 presents the relationship between the development of hardware and software of a product in the traditional development method.

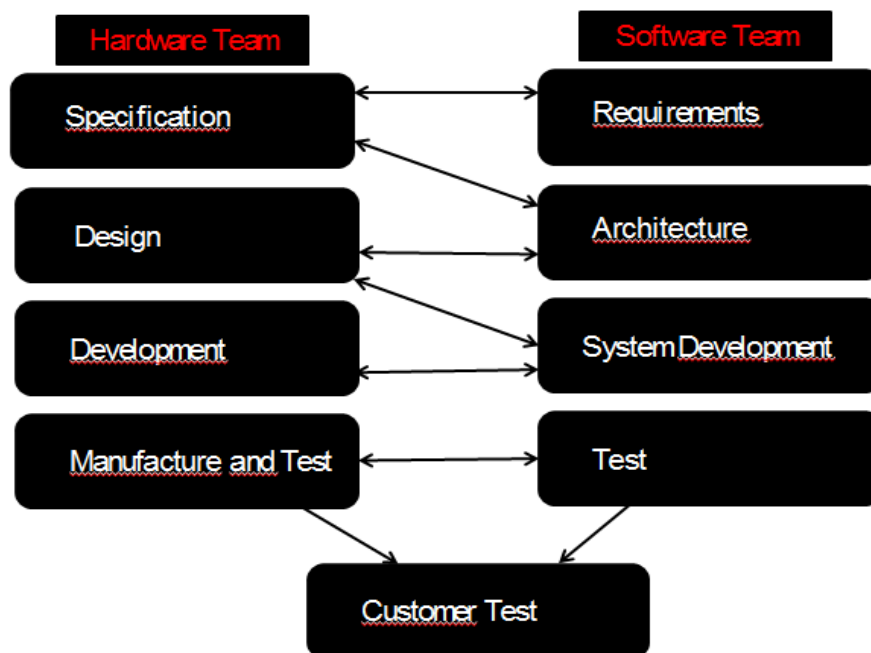


Figure 1. Intersection between hardware and software teams

In this proposed model, each phase of hardware development is linked to a software development phase. The hardware development phases become smaller as in software, delivering value in each phase. By reducing the developing cycles and integrating teams, it is possible to quickly respond for changes, as proposed by the agile development.

Figure 2 presents the proposed phases to develop hardware and software jointly, supported by agile methods.

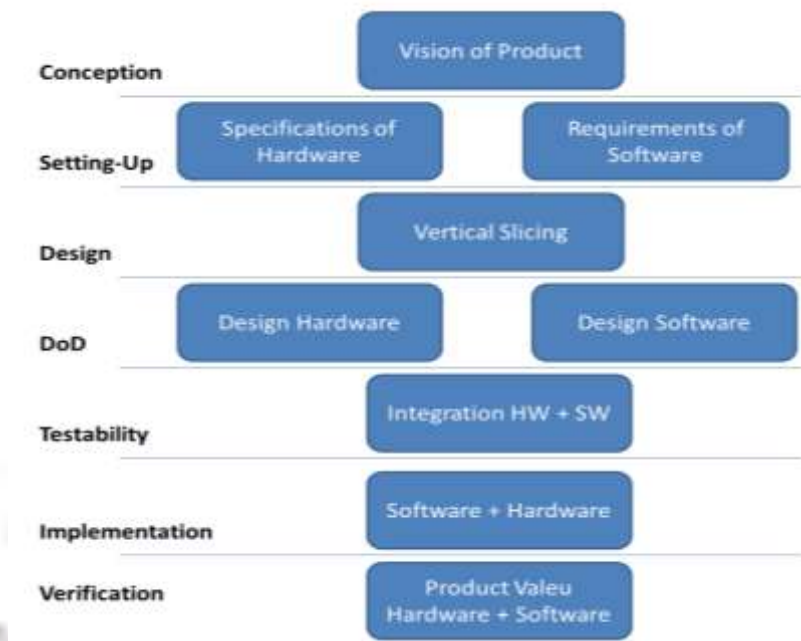


Figure 2. Proposed Phases - Agile and Co-Design

Description of proposed phases:

- Conception – Both hardware and software teams work together to make the Product Vision Statement.
- Setting-up – Both teams discuss about the capabilities and limitations of the Project based on the integration requirements of the hardware and software.
- Design – Vertical Slicing technique is applied (Hardware + Software) to define deliverables of hardware and embedded software.
- DoD (DefinionOf Done) – Integration actions to be taken are defined by the teams describing a point that the deliverable can be considered as done, including software and hardware.
- Testability – Software and hardware teams imagine how to test the functionality and implement the tests.
- Implementation – The teams work together developing valuable deliverables that joint hardware and software.
- Verification – The deliverable is verified and presented to the costumer.

With the strong described interactions between the hardware and software teams it is believed that:

- Decrease of the number of requests of technical changes in the Project;
- More synergy between hardware and software projects, enabling the Project to quickly respond to necessary changes;
- Be prepared for incidents.

In this proposed model the flow is resumed, until the entire project is completed and accepted by the customer.

CONCLUSIONS

With this approach we have adapted an agile development method to the development of hardware and software jointly constructed through agile methodologies.

This approach provides a deep interaction between teams from different areas of knowledge, promoting the exchange of knowledge, stimulating innovation and achieving better designed tests for verification and validation of the final product.

As an example, the technique Hardware Unit Testing where fragments constructed of software verification and validation of hardware parts is still under development.

Developing this proposal, we evidenced the possibility of developing a framework of integration between hardware design and embedded software, tailored to agile methodology extended to include hardware development.

RECOMMENDATIONS

It is recommended as the project starts that the main architecture and the set of tools that will be used be defined. This way the team members will be able to focus on necessary training.

The authors also recommend the use of automated testing tools and procedures to accelerate the development process, while increasing the quality of the product.

REFERENCES

- [1]. Portal AgileManifesto, "Manifesto Agile". Available at: <http://www.agilemanifesto.org/>. Accessed at October, 15, 2014.
- [2]. Scrum in Mechanical Product Development, Department of Product and Production Development, CHALMERS UNIVERSITY OF TECHNOLOGY, Gothenburg, Sweden, 2013
- [3]. Schwaber, K. & Sutherland, J. (2011) The Scrum Guide – The Definitive Guide to Scrum: The Rules of the Game. [online]. Available from: http://www.scrum.org/Portals/0/Documents/Scrum%20Guides/Scrum_Guide.pdf [Accessed 25 July 2013].
- [4]. Punkka, Timo; "Agile Hardware and Co-Design", Embedded Systems Conference, 2012, Boston, ESC-3008.
- [5]. Luigi, Atzori, Antonio, Iera, Giacomo, Morabito, "The Internet of Things: A survey", Journal Elsevier, 2010.
- [6]. Kaisti et al., "Agile methods for embedded systems development - a literature review and a mapping study", EURASIP Journal on Embedded Systems 2013.
- [7]. Amiri , Zahra Askarinejad, "Challenges and architecture and Weaknesses of Agile Method In Enterprise Architecture", International Journal of Computer Science & Engineering Survey (IJCSES) Vol.3, No.6, December 2012
- [8]. Portal Scrum.org, "ScrumMetodology". Available at: <http://www.scrum.org/>. Accessed at October, 16, 2014.