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Cinders: The Continuous Integration and Delivery Architecture Framework

Journal-First Selected Article – Extended Abstract

Daniel Ståhl
Ericsson AB
Linköping, Sweden
daniel.stahl@ericsson.com

Jan Bosch
Chalmers University of Technology
Gothenburg, Sweden
jan@janbosch.com

ABSTRACT
This extended abstract summarizes an article, which has been published in Information and Software Technology and was selected for the Journal-First presentations at the International Conference on Software and System Process (ICSSP 2018).


CCS CONCEPTS
• Software and its engineering → Architecture description languages; Software development methods; Software configuration management and version control systems; Agile software development;

KEYWORDS
Cinders; software integration; software testing; continuous integration; continuous delivery; architecture framework

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1 SUMMARY
The popular agile practices of continuous integration and delivery have become an essential part of the software development process in many companies, yet effective methods and tools to support design, description and communication of continuous integration and delivery systems are lacking. This paper addresses the problem of constructing systems for rapidly and frequently transforming source code changes into verified and deliverable software product revisions with known content, known functionality and known quality – through software integration and test – in a controlled and methodical way.

Historically, the problem of transforming lines of source code into functioning, verified products running in their target environment could be regarded as a question of enterprise architecture: of organizational responsibilities and manual processes. With the advent and growth of continuous integration [2, 3] and delivery [4, 5], however, and the automation this brings, this is increasingly becoming a domain of software engineering: we see ever more sophisticated software systems being constructed, with the purpose of compiling, integrating, testing, delivering and deploying other software.

While such systems are generally perceived as adding value and increasing the efficiency of the development project, we have found in previous work that the exact nature of these benefits is highly uncertain and varies from case to case [8]. Furthermore, even though there are numerous popular tools that do much of the heavy lifting in these integration systems, they only address isolated parts of a very large problem domain. In all our industry case studies [8, 9, 11, 12] we have never found a complete off-the-shelf solution for continuous integration. Rather, the integration systems we find often use similar tools, but configured differently, put to different purposes and integrated with one another in varying constellations. Not surprisingly, a review of literature reveals that reported continuous integration systems display a high degree of variance [10]. In other words, as a rule, continuous integration and delivery systems are highly customized and purpose-built software products in their own right.

This recognition leads up to the research question that drives the study presented in this article: In what way can the paradigm of architecture frameworks favorably be applied to facilitate the design and description of continuous integration and delivery systems?

Similarly to the variance in system design, there is little consensus on the exact definition of continuous integration and delivery, particularly as opposed to related terms such as continuous testing, continuous release or continuous deployment. For the purposes of this paper, we use the term continuous integration and delivery system to mean any system of automated activities performed in order to transform source code into working and potentially shipable and deployable products with known quality, content and functionality, i.e. including compilation, linking, packaging, testing, profiling, documentation generation and much more, serving to ensure that “the software can be released to production at any time” [4].

In this paper we investigate the applicability of existing architectural frameworks and two built-for-purpose modeling techniques...
There have been two noteworthy developments since the original viewpoint Cinders offers four separate viewpoints, as fits the particular use case and circumstances. This framework is then applied in a workshop format in two separate industry cases, and interviews are conducted with a total of twelve practitioners.

Based on this work it is shown that a single architectural framework can be designed to encompass the previous continuous integration and delivery modeling techniques ASIF and CIVIT, representing their specific concerns as viewpoints rendered from the same underlying data model. It is also shown that this architecture framework represents an improvement over these techniques, in that it separates different types of entity relationships into separate viewpoints, allows the level of abstraction of each viewpoint to be modified, shows confidence afforded by conducted activities, represents both manual and automated test activities, can map activities onto physical environments and can visualize overlapping test activities. In workshops and interviews with practitioners of continuous integration and delivery in two separate companies it is confirmed that Cinders is viewed as relevant and useful in an industry setting, even while areas of possible improvement are identified. Therefore we find that Cinders represents a significant step forward in continuous integration and delivery architecture design and description, constituting a relevant and helpful tool for industry professionals to better document, analyze and communicate their systems.

2 NEW INSIGHTS

The second development is that the Eiffel protocol for real time automated documentation of continuous integration and delivery activities, which is mentioned in passing in the original article, has since been released as open source along with multiple service implementations [1]. The Eiffel protocol is based on similar concepts as Cinders, and even though there is currently no open source implementation of Cinders descriptions generated from Eiffel data, the data model of Cinders is well suited for such automated generation and would fit well into the Eiffel community’s implementation architecture.

3 CONCLUSION

In this article we establish that the construction of continuous integration and delivery systems is an area of considerable investment in the industry, yet lacking in supporting tools and methods, coinciding with a tendency by studied industry cases to not address its challenges using as rigorous an approach as in regular product development. Based on thematic analysis of statements in literature, twelve requirements for an architectural framework for continuous integration and delivery are phrased. Using these requirements, existing architecture frameworks as listed by ISO/IEC/IEEE [6] are evaluated, finding that none satisfactorily addresses the identified requirements.

Consequently Cinders, a new architecture framework designed to address the identified requirements, is presented. Influenced by prominent enterprise and software architecture frameworks, Cinders offers four separate viewpoints of the same underlying data model, with six optional layers of additional information which can be used to adjust the focus and level of detail within each of those viewpoints, as fits the particular use case and circumstances. This framework is then applied in a workshop format in two separate industry cases, and interviews are conducted with a total of twelve practitioners.

REFERENCES