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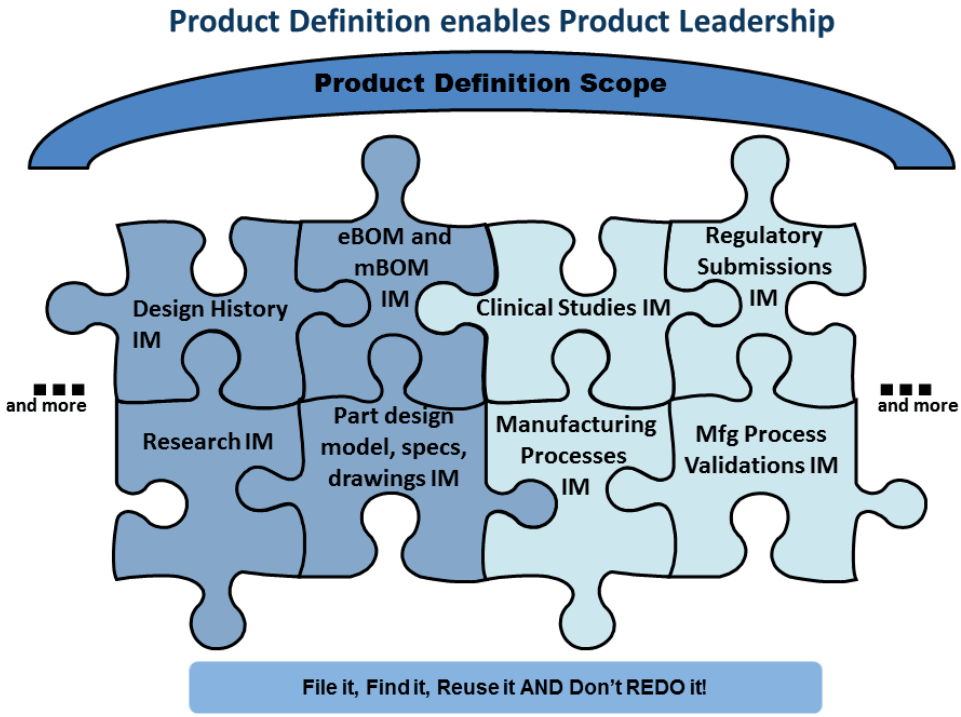
Dan McKay Matheson

SAMEM: A Methodology for the Elicitation and Specification of Requirements for Agile Model-driven Engineering of Large Software Solutions



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Hrsg: Prof. Dr. rer. nat. Bernhard Rumpe

SAMEM:
A Methodology for the Elicitation and Specification of Requirements for Agile Model-driven Engineering of Large Software Solutions

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Kurzfassung

Die Software Agile Modeling and Engineering Methodology (SAMEM) ist eine pragmatische Methodologie zur Entwicklung von Lösungen, die darauf ausgerichtet ist, einen iterativen und auf Zuwachs bezogenen (incremental) Projektmanagement-Ansatz (agile) zu kombinieren mit dem Schwerpunkt auf Modellbildung von Projekt-Artefakten (Model-driven Development oder MDD). Die Modellbildung beginnt bei SAMEM am Anfang des Projekts mit den Lösungszielen und setzt sich fort in der Implementierungsarbeit. Zur effektiven und effizienten Kommunikation wird die Verwendung von graphischen oder visuellen Modellen zur Darstellung der Projekt-Artefakte maximiert Die Entwicklung der Artefakte erfolgt über viele kurze Zyklen (iterations) und den Aufbau in mehreren kleinen Schritten (increments).

Der iterative & incremental Ansatz ist eine Technik zur Risikominderung, um durch eine kurze Feedback-Schleife ein Scheitern des Projekts zu verhindern. Projekte haben eine Dynamik, die auf der Ansammlung von Entscheidungen und der geleisteten Arbeit beruht. Die Bereitschaft von Menschen, schlechte Entscheidungen oder mangelhafte Arbeit zuzugeben, die Arbeit, besonders nach erheblichen Investitionen, zu verwerfen und neu anzufangen, ist selten. Je umfangreicher die Arbeiten waren, die verworfen werden, desto schwieriger ist es, erneut anzufangen. Kleine Schritte mit der Überprüfung der Korrektheit der Arbeit und der Übereinstimmung mit den Projektzielen schaffen eine Situation, in der möglicherweise nur eine geringe Investition verworfen wird. Kleine Verwerfungen sind leichter zu akzeptieren und können oft als Designuntersuchungen gewertet werden.SAMEM wendet den iterative & incremental Ansatz auf allen Ebenen für die gesamte Lebensdauer des Projekts an.

Modellbildung oder graphische Representationen der Mehrheit der Projekt-Artefakte ist eine Risikominderung, die inkorrekte Lösung zu erschaffen und die Lösung inkorrekt zu erstellen. Es ist allgemein bekannt, dass visuelle Gestaltung Information in vielen Situationen genauer übermitteln kann als Text. Die bekannte Redewendung “Ein Bild sagt mehr als tausend Worte”, die auch in der kognitiven Psychologieforschung vertreten wird, ist die Basis für die Hervorhebung der Modellbildung. Die Auswirkungen der Risikominderung auf die Erstellung der inkorrekten Lösung, zumindest aus der Perspektive der Interessenvertreter, erfolgen durch die verbesserte und effektivere Kommunikation, die durch die Modellbildung oder graphische Representationen erbracht werden. Ein Beitrag zu graphischer Repräsentation oder Modellbildung ist die Idee einer Lösungs-Überblick-Zeichnung (Solution Overview Drawing, SOD), die aus einer Zusammenfassung auf einer einzigen Seite besteht, indem sie mehrfache Sichtweisen von Anforderungen oder Designspezifikationen integriert.

Zur Sicherstellung der Effizienz der Risikominderung der Techniken von iterative & incremental Projektmanagement und Modellbildung sind zusätzliche Komponenten erforderlich. Während SAMEM auf den gesamten Projektprozess anwendbar ist, besteht

eine Fokusierung auf die Anfangsphasen des Projekts. Die Motivation zur Fokusierung auf die Anfangsphasen des Projekts besteht in den allseits bekannten Kosten der Fehlerbehebung im Verlauf des Projekts. Ein weiterer Beitrag dieser Forschung besteht darin, einen Mechanismus hinzuzufügen, der die iteration & increment Arbeit von dem ursprünglichen Ausdruck der Lösungsmöglichkeiten oder Ziele zur abschlißenden Implementierung führt. Der leitende Mechanismus durchquert die Abstraktionshierarchie von den anfänglichen vagen Ideen zur abschließenden Implementierung. Die Durchquerung ist eine Sammlung von Entscheidungen, wie zum Beispiel die Wahl von einem Lösungsziel gegenüber einem anderen, von einer Anforderung gegenüber einer anderen, von einem Lösungs-Architektur-Design gegenüber einem anderen und einer Implementierungs Technologie gegenüber einer anderen. Die Entscheidungen sind als Projekt-Artifakte repräsentiert und viele können gut als Modelle oder graphisch dargestellt werden. Der leitende Mechanismus für SAMEM ist das Open Distributed Processing – Reference Model ISO standard 10746 (RM-ODP).

Ein weiterer Beitrag, der sicherstellen soll, dass die Risikominderung von iterative & incremental Projektmanagement und Modellbildung effektiv ist, ist eine Gruppe von engineering Prinzipien, die zur Qualitätsüberprüfung der Arbeit beitragen. Diese Komponente von SAMEM ist eine Gruppe von Prinzipien, die während des ganzen Projekts angewendet werden kann zur Prüfung der Entscheidungen und Artifakte auf Richtigkeit und Qualität. Die Prinzipien sind auch von Nutzen bei der Stimulierung von Innovation durch Erklärungen von Annahmen und infrage stellenden Verhaltensweisen. Die Prinzipien sind im Hinblick auf Domänunabhängigkeit konzipiert, aber mit Fokus auf Software zentrierte Lösungen und daher der Name Software Engineering First Principles (SEFP).

Der Nachweis von SAMEM als effektive Methodologie setzt verschiedene Mittel ein. Empirischer Beweis, der durch Umfrage unter den Projektteilnehmern ermittelt wurde, die eine frühe Version von SAMEM in verschiedenen Industrieprojekten über mehrere Jahre hin einsetzten, ist die wichtigste Stütze. Kognitive Effektivitätsmaßnahmen werden bewertet im Hinblick auf die graphischen Kommunikations-Artifakte von SAMEM. Eine Bewertung von SAMEM mit der neuen und sich entwickelnden standardmäßigen Software Engineering Method and Theory (SEMAT) liefert einen Vergleich der Stärken und Unterschiede. Da SAMEM eine praktische und pragmatische Software Lösungsmethodologie sein soll, wird eine Diskussion über die erreichten geschäftlichen Vorteile in den Projekten präsentiert.

Abstract

The Software Agile Modeling and Engineering Methodology (SAMEM) is a pragmatic solution development methodology that focuses on combining an iterative & incremental project management approach (agile) with an emphasis on the modeling of project artifacts (Model-driven Development or MDD). The SAMEM starts the modeling at the beginning of the project with the solution goals and continues through the implementation work. For effective and efficient communication, the use of graphical or visual models is maximized for the representation of project artifacts. The development of the artifacts occurs over many short cycles (iterations) and they are built up in several small steps (increments).

The iterative & incremental approach is a risk mitigation technique to prevent the project from going off track via a short feedback loop. Projects have momentum that is a collection of the decisions and work accomplished. The willingness of people to admit to poor decisions or poor work, to discard that work especially after significant investment, and start over is rare. The larger the body of work to be discarded, the harder it is to restart. Small steps with verification that the work is correct and consistent with the project goals create a situation where potentially only a small investment is discarded. Small discards are easier to accept and can often be viewed as design explorations. The SAMEM applies the iterative & incremental approach at all levels across the complete project lifetime.

Modeling or graphical representations of the majority of project artifacts is mitigation against creating the incorrect solution and building the solution incorrectly. It is well known that visual expression can communicate information more accurately in many situations versus text. The well-known idiom of "a picture is worth a thousand words," which has been supported by cognitive psychology research, is the basis for the modeling emphasis. The mitigation effects against creating the incorrect solution, at least from the perspective of the stakeholders, are through the improved and more effective communication provided by models or graphical representations. One contribution for graphical representation or modeling is the idea of a Solution Overview Drawing (SOD) that provides a high-level single-page summary by integrating multiple views of requirements or design specifications.

To ensure that the mitigation techniques of iterative & incremental project management and modeling are effective, additional components are needed. While the SAMEM is applicable to the entire project process, there is a focus on the initial phases of the project. The motivation for focusing on the initial project phases are the well-documented costs of error fixing as the project progresses. Another contribution of this research is adding a mechanism to guide the iteration & increment work from the initial expression of the solution opportunities or goals to the final implementation. The guidance mechanism traverses the abstraction hierarchy from the initial vague ideas through the final implementation. The traversal is a collection of decisions, such as choosing one solution goal over another, choosing one requirement over another, choosing one solution architecture design over another, and choosing one implementation technology

over another. The decisions are represented as project artifacts and many can be well represented as models or graphically. The guidance mechanism for the SAMEM is the Open Distributed Processing – Reference Model ISO standard 10746 (RM-ODP).

An additional contribution that helps to ensure that the mitigation of iterative & incremental project management and modeling are effective is a set of engineering principles that provide quality guidance of the work. This component of the SAMEM is a set of principles that can be used throughout the project to examine the decisions and artifacts for correctness and quality. The principles are also useful in stimulating innovation by shedding light on assumptions and questioning habits. The principles are designed with the intention of domain independence, but focused on software centric solutions, which lead to their label as Software Engineering First Principles (SEFP).

The substantiation of the SAMEM as an effective methodology employs several means. Empirical evidence gathered through surveys from project members that used an early version of the SAMEM on multiple projects over several years is the main support. Cognitive effectiveness measures are evaluated against the graphical communication artifacts of the SAMEM. An evaluation of the SAMEM with the recent and evolving standard Software Engineering Method and Theory (SEMAT) provides a comparison of the strengths and differences. As the SAMEM is intended to be a practical and pragmatic software solution methodology, a discussion of the business benefits achieved in the projects is presented.

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I would like to thank my first adviser, the late Prof. Robert France for his encouragement to pursue a Ph.D. Prof. France made me realize that I had much to offer from my industry experiences and the innovations in the practical software engineering I had developed.

Prof. Michel Chaudron provided very helpful feedback and improvements on the case study survey questions and format. I learned a great deal through his tutorial on Empirical Research in Model-based Software Engineering at the Models 2016 conference in Saint Malo, France.

I have had many colleagues and experiences over the 35 years of industry work (Hewlett-Packard and Integware) that have contributed in various ways to the views embodied in the SAMEM. One of the earliest influences was the introduction to Abstract Data Types just after a failed product. The product failure started me asking questions about avoiding such situations and the waste of effort. Abstract Data Types, an early version of Objects, offered a possible approach to improved product design. The work with Ralph Maderholtz in developing an internal training course for our fellow Hewlett-Packard R&D engineers in Structured Analysis and Structured Design helped to put me on the path of continuous software engineering improvement. The practice of analyzing each project at the end in order to make improvements and sustain good practices was a major influence on the continuous software engineering process improvement I use.

The cooperation on establishing standards with many people at the Object Management Group (OMG) in the late 1990s improved my ability at object-oriented thinking. Some of the more significant influencers on my object-oriented understanding were Jishnu Mukerji, Larry Johnson, and Andrew Watson. I started using the UML in 1996 in of my industry projects for design expressions. My personal use of the UML evolved into the education of my fellow workers, which further evolved into the realization that the UML can be used for more than code design, such as requirements specification. There are many dozens of colleagues that helped refine my understanding of modeling via the project interactions we had.

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