Measuring and Visualising Projects' Collective Method Rationale

Fredrik Linander, Kai Wistrand, Fredrik Karlsson

Measuring and Visualising Projects' Collective Method Rationale

Fredrik Linander[1,2], Kai Wistrand[1], Fredrik Karlsson[1]

[1] CERIS, Department of Informatics, Örebro University School of Business, Örebro, Sweden]
{fredrik.linander,kai.wistrand,fredrik.karlsson}@oru.se
[2] Saab Dynamics AB, Karlskoga, Sweden
fredrik.linander@saabgroup.com

Abstract. Existing research provide frameworks for analysing the rationale behind engineering methods and how this rationale matches the rationale of individual project members. As methods are used in groups, this raises questions about how to study method rationale on an aggregated project level. We propose an elaboration of method rationale theory to enable this type of analysis. We introduce the concept of collective method rationale together with metrics to capture this aggregated rationale. The conceptual work is implemented in a computerized tool, which enables analyses of collective method rationale in product development projects. These are the results of an action research project and we present a pilot test of the computerized tool to demonstrate the concept.

Keywords: Method rationale, Collective method rationale, Modelling rationale

1 Introduction

Organisations choose to apply engineering methods for many reasons. These methods provide guidance through complex scenarios and tasks. Methods can be regarded as theories about actions to perform in order to reach given goals. This implies that they have an inherent conception of a desired target state. Subsequently, there are relations between this target state and the proposed actions [1]. Ultimately, methods can be viewed as reason based statements regarding target states, and as such they represent rationality [2]. The concept of method rationale has been suggested as a way of describing the underlying arguments for a method's appearance [e.g. 3, 4].

The concept intends to capture the relations between a method, or parts thereof, and the goal that this method (part) aims to fulfil. A potential method user has goals and chooses between method parts that can help reach his/hers own goals. A wise choice of method parts would of course be parts that have goals overlapping those of the method user, i.e. to achieve rationality resonance [5].

As methods usually are put to use in groups, this raises the question about how to study the phenomenon of method rationale on an aggregated project team level. Most of the studies on method rationale have focused how the concept can be used as a

adfa, p. 1, 2011.

facilitator for planning a project based on individual rationality resonance [e.g. 6, 7, 8]. An exception is Wistrand [9] and Karlsson [10], they have aggregated individual rationality resonance into a collective concept. Still, both of them build on the individual preferences towards the selection of certain method parts. Moreover, there are few studies that have focused on method rationale in retrospection, i.e. studying what kind of method rationale a project has emphasized when it was carried out.

Therefore in this paper we pose the following research question: *how can we measure and visualise method rationale on a project level?* For this purpose we introduce the concept of "collective method rationale", complemented with newly developed metrics operationalizing this concept, and a computerized tool where the metrics are implemented as part of a process modelling approach.

2 Existing Research on Method Rationale

Several scholars [e.g. 11, 12, 13] have concluded that methods are based on the rationale of the method engineer, which has provided guidance through the method design. Hence, each engineering method is founded in a goal and value system [1]. Fitzgerald et al. [14] have suggested that methods are adapted when applied, which is in line with Argyris' and Schön's [15] theory on organizational learning. Argyris and Schön [15] have highlighted that organisations' explicit action strategies, such as prescribed engineering methods, are enacted and realised through the actions taken by the individual practitioners. In other words, it has been shown that action strategies are adapted to the current situation based on the situational and local character of knowing, where the project member's rationale come into play. Argyris and Schön [15] have distinguished between "espoused theory" – an ideal established by the organisation "to explain or justify a given pattern of activity" – and "theory-in-use", representing "the performance of that pattern of activity".

In the quest for situational methods, both Ågerfalk [16] and Wistrand [9] have stressed the importance that the rationale of project members and the prescribed method need to match. Both scholars draw on the concept of rationality resonance [5]; rationality resonance occurs when the (private) rationale of the project member and the (public) rationale of the method match and the method is perceived as support.

Most of the above-mentioned research takes an individual approach to 'theory-in-use', i.e. situational methods, and method rationale. They either focus on rationality resonance between the individual project member and the chosen method [e.g. 5, 16], or how the private rationale of a project member can be used to transform a prescribed method into a situational one [e.g. 6, 17]. Few studies have focused on the rationale that exists on a project level. Wistrand [9] is a notable exception; he introduced the concept of collective rationality resonance in a group. However, he did not discuss how to collect data to fill and visualise this concept. Karlsson [10] proposed a data collection and analysis technique for collective rationality resonance based on self-reports coming from project members. But, this approach still departures in an individual approach towards method rationale whilst focusing on resonance.

3 Conceptual Framework

Given the aim of this paper and the state-of-the-art in existing research there is a need for additional conceptual work in order to measure the collective method rationale of a project. Fig. 1 presents the main concepts of the existing research together with our additional concepts for addressing rationale as a project group phenomenon. The figure is illustrated using a UML Class diagram.

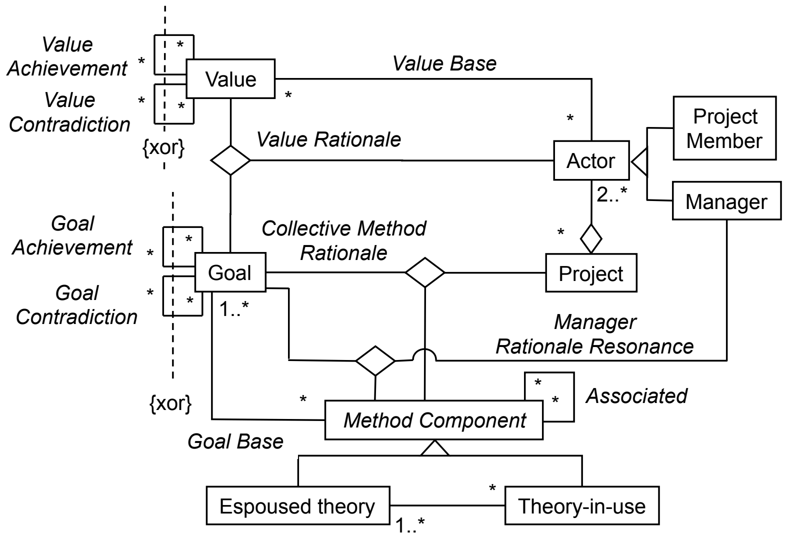

Fig. 1. Modified method rationale theory

The conceptual framework builds on the method component concept, which is in line with Wistrand [9] and Karlsson [10]. Method components as espoused theories offer possible achievable goals that are anchored in values. Project members have selected method components as a means to receive guidance concerning project tasks. The goals of the selected method components constitute the collective method rationale, either as a plan (espoused theory) or as executed (theory-in-use).

In order to measure collective method rationale we need to discuss the internal structure of the method component concept. A method component is a self-contained part of an engineering method, and consists of five types of method elements that all are related to goals: artefact, actions, actor role, concept, and notation [18]. *Action* expresses the activities that need to be done to transform input *artefacts* into defined output *artefact*. *Actor role* expresses who should carry out or participate in a specific action. *Concepts* guide the actor towards certain aspects of the engineering task. Finally, the method element *notation* expresses how the results should be represented when documented.

When examining the method elements, actions are of particular interest. Project members propel projects forward through actions that consume time. Time is often considered one of the most important volume metrics of a project, and shows the emphasis put on specific parts of a project. Time is also part of official project artefacts such as project plans and time report sheets. Hence, we have added time as a characteristic to the action method element. Considering that an engineering method contains a number of selected method components we can define the *relative collective method rationale* towards a specific goal, X, as follows.

$$\frac{\sum_{k=0}^{\substack{Number\ of\ method \\ components\ targeting \\ overall\ goal\ X}} Time\ units\ for\ method\ component\ k}{\sum_{n=1}^{\substack{Number\ of\ method \\ components\ in\ the \\ engineering\ method}} Time\ units\ for\ method\ component\ n} \quad (1)$$

and

$$1 = \sum_{m=1}^{\substack{Number\ of \\ overall\ goals}} \begin{matrix} Relative\ collective\ method \\ rationale\ for\ overall\ goal\ m \end{matrix} \quad (2)$$

This definition of measuring relative collective method rationale introduces a restriction on the method component's conceptual model. In the original concept [18], actions can be performed with multiple goals in mind. However, in these metrics a method component only have one overall goal.

4 Research Method

The research approach applied in this study is characterised as action research [19], carried out as a collaboration project between academia and industry. The parties involved are companies from defence and motorsport industry. The approach follows the traditional "canonical" action research process-model with iterations through the five stages of diagnosing, action planning, action taking, evaluating and specifying learning [20]. The paper covers the second of four planned iterations to develop a method and a computerized tool for benchmarking project and organisations with regard to the rationale behind chosen engineering methods. The first iteration has been reported on in Karlsson et al. [21]. Below we discuss each of the five stages of the second iteration.

4.1 Diagnosing

During the diagnosing stage, we analysed a subset of the overall industry and research problem. In addition, the identified state-of-the-art research was analysed together with our industrial partners during a series of workshops. Based on the results we formulated an aim for the second iteration: to develop a concept, a metric and a computerized tool to capture and visualize the collective method rationale employed in a product development project.

4.2 Action planning

During the action planning stage, we focused on conceptual work and elicitation of the requirements for the second version of the computerized tool. We introduced the concept of collective method rationale into the existing conceptual framework of method rationale. In addition, we operationalized this concept as a metric to be implemented in the computerized tool. The operationalization resulted in a number of requirements (user stories) concerning modifications and extensions of the tool. In parallel with implementing the computerized tool we searched for a suitable goal nomenclature to use during process modelling. Given the industry problem of comparing projects and organisations with regard to the rationale behind chosen engineering methods, we needed a nomenclature that could be used across projects as well as organisations. We chose to use the goal structure in the Capability Maturity Model Integration for Development (CMMI-Dev) v1.2 [22]. It contains an established set of generic goals for product and service development. These goals are structured in a hierarchical fashion; goals that can be found across projects and organisations.

4.3 Action taking

During this stage we made a first full-scale test of the modified tool and the newly developed metrics. Data from an implemented product development project at a motorsport partner were collected, modelled and analysed using the computerized tool. The project was chosen based on reasonable size and complexity, and availability of data and contact persons. The data collection took place at the premises of the motorsport partner at two separate occasions. Given the industry's overall benchmarking interest of actual practices, we chose to model the theory-in-use version of the method. This meant that we collected data about the enacted method.

We used semi-structured interviews, project reports and log books to reconstruct the project. Our interview questions focused on executed method components and their parts, including goals, deliverables, start and finishing dates, main activities, consumed time and applied outsourcing strategies. The interviews were held with the project manager. In the case a method component targeted multiple overall goals, the project manager was asked to a), if possible, divide the method component into two or more components, or b) pin point the main overall goal that had consumed the most work effort during the method component's execution. Notes were taken during the interviews and the project manager reviewed the documentation in order to validate the data and to authorise that it could be used as part of the research project. These notes were used for reconstructing the method in the computerized tool. Finally, each of the 23 identified method components was traced to one of the 22 top-level goals in CMMI-Dev. This analysis was carried out together with the project manager.

4.5 Evaluation

During the evaluation stage we arranged a joint workshop to discuss the initial results. First, we presented the current version of the conceptual framework and the metrics used. Second, we presented how the chosen project had been modelled. Third, we presented the analytical results (see Fig. 2) and how to interpret the way collective method rationale is visualised. Finally, we conducted a feedback session where we discussed a) the usefulness of the analysis in relation to the industry problem, and b) problematic aspects during data collection and modelling.

4.6 Specify learning

During the specify learning stage we structured and assessed the results into lessons learned and change requests for the next iteration. Lessons learned contained advices on how to use the conceptual framework, the metrics, and the computerized tool.

5 Results – Empirical Example

Our chosen motorsport partner develops, designs, sells and leases cars for rally cross and extreme motorsport. The company also operates its own team internationally in several rally cross championships. The analysed motorsport project was a 13-months development project of a new car. The project was executed in a fifty-fifty work share division between our motorsport partner and a business partner. Our motorsport partner had the main responsibilities for the development and the final assembly of the cars. Marketing activities of the new car were integrated into the project and executed jointly with validation activities related to driver experiences resulting in signed car contracts prior closure of the development project.

5.2 Results from action taking – modelling and analysis

Fig. 2 illustrates the results of our analysis using the relative collective method rationale as a radar diagram. This enables us to create a visual profile of the project's employed rationale, where the relative collective method rationale of each analysed goal is plotted as a value between zero and one.

The radar diagram has seven axes, one for each goal we have identified. Approaching the goals in descending order, the figure shows that the motorsport project employed most of its collective method rationale related to the "technical solution"-goal. Technical solution according to CMMI-Dev means, "to design, develop, and implement solutions to requirements" [22]. Almost 43% of the efforts have been put into this particular goal. The "verification"-goal is the second most employed rationale in the project, accounting for approximately 17%. Verification means spending resources "to ensure that selected work products meet their specified requirements" [22]. The "validation"-goal, i.e. "to demonstrate that a product or product component fulfils its intended use when placed in its intended environment" [22], is the third most focused part of the collective method rationale. In the project it accounts for 15%. The goals "product integration" and "supplier agreement management", each account for approximately 8%. Product integration aims "to assemble the product from the product components, ensure that the product, as integrated, functions properly, and deliver the product" [22], and supplier agreement management means that the project has put effort into activities in order to "manage the acquisition of products from suppliers" [22]. Finally, the collective method rationale that has been employed the least in the project is "requirement development" and "project planning". They account for approximately 4% each. Requirement development aims "to produce and analyse customer, product, and product component requirements" [22] and project planning means "to establish and maintain plans that define project activities" [22].

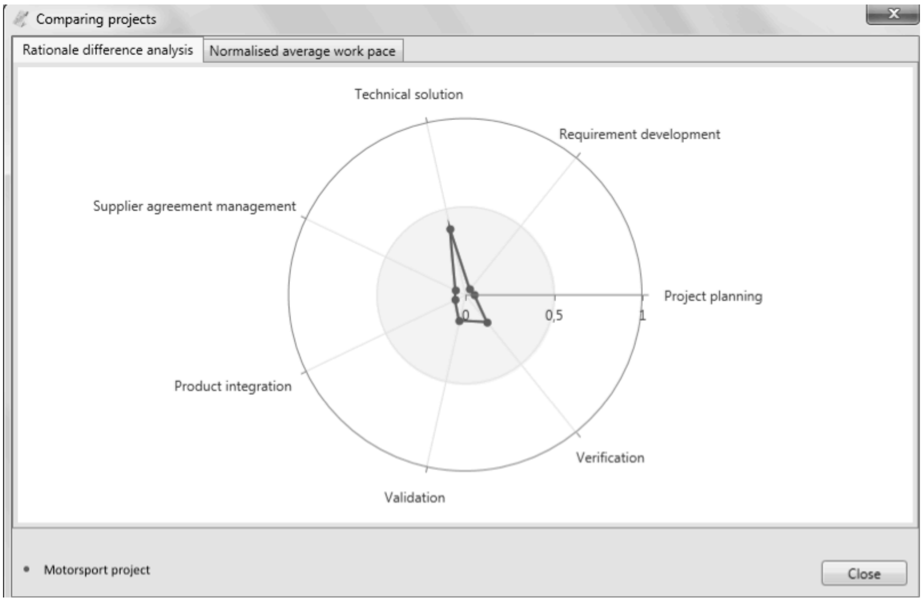

Fig. 2. The motorsport project's collective method rationality profile

5.3 Results from evaluation – workshop with practitioners and researchers

The evaluation was conducted as a half-day workshop. The practitioners concluded that the concept and its operationalization were straightforward and applicable. As an example, one practitioner said: "[T]he informative and straight forward approach gives it a high potential to become widely used in practice in our organisation". However, during the workshop challenges with low data resolution were discussed. The discussion centred on how the size of the method components could affect the collective method rationale profile. Coarse-grained method components give an imprecise profile, which might be sensitive to how the components were classified with regards to the overall goal. The project's resulting profile was perceived as easy-to-grasp. The practitioners used words like "informative" and "simple to interpret". However, the participants discussed how the radar diagram would work when larger projects are modelled that include all 22 goals in CMMI-Dev. This is illustrated by one of the practitioners: "The analysed project has seven goals. A project with a lot of goals will most probably have a less interpretable profile than the analysed project".

5.4 Results from specified learning

Based on the workshop and the modelling activities two lessons learned were made. First, we must be able to handle a larger number of goals than only the seven identified in the pilot project, without cluttering the visual presentation. However, this is still only a potential problem, and modelling of additional projects will show if this must be addressed. We can conclude that we need to use the area in the radar diagram more efficiently, because some of the values get cluttered in the centre of the diagram. Second, there is a need for more fine-grained method components, in order to improve the analytical precision. This does not call for design changes of the computerized tool. Instead, we need to adapt the way data is collected and which kind of data we use.

6 Conclusions

The concept of method rationale has in previous research mostly focused on an individual's preferences towards engineering methods and how project members choose among different method parts based on these preferences. In order to understand how method rationale can be captured on an aggregated level, such as in project teams, we have proposed the concept of collective method rationale. In this paper we have shown how a modified version of the method rationale theory can be applied to capture collective method rationale of a project. We have presented metrics for capturing relative collective method rationale and used it to analyse a project at a motorsport company. We have shown the collective method rationale using a radar diagram in a computerised tool. Based on the feedback from practitioners this seems to be fruitful way to convey the metrics and the analysis.

References

1. Ågerfalk, P.J., Åhlgren, K.: Modelling the rationale of methods. In: Khosrowpour, M. (ed.) Managing Information Technology Resources in Organizations in the Next Millennium, pp. 184–190. IDEA Group Publishing, Hershey, PA (1999)
2. Hirschheim, R., Klein, H.K., Lyytinen, K.: Exploring the intellectual structures of information systems development: a social action theoretic analysis. Accounting, Management and Information Technologies 6, 1–64 (1996)
3. Rossi, M., Tolvanen, J.-P., Ramesh, B., Lyytinen, K., Kaipala, J.: Method Rationale in Method Engineering. Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS-33), vol. 2, pp. 2036. IEEE Computer Society Press, Maui, Hawaii (2000)
4. Ågerfalk, P.J., Wistrand, K.: Systems Development Method Rationale: A Conceptual Framework for Analysis. In: Camp, O., Filipe, J., Hammoudi, S., Piattini, M. (eds.) Proceedings of the 5th International Conference on Enterprise Information Systems (ICEIS 2003), pp. 185-190. Escola Superior de Tecnologia do Instituto Politécnico de Setúbal, Setúbal, Portugal (2003)

5. Stolterman, E., Russo, N.L.: The Paradox of Information Systems Methods -- Public and Private Rationality. In: British Computer Society 5th Annual Conference on Methodologies. (Year)
6. Karlsson, F., Ågerfalk, P.J.: Towards structured flexibility in information systems development: devising a method for method configuration. Journal of Database Management 20, 51-75 (2009)
7. Rossi, M., Ramesh, B., Lyytinen, K., Tolvanen, J.-P.: Managing Evolutionary Method Engineering by Method Rationale. Journal of Association of Information Systems 5, 356-391 (2004)
8. Ralyté, J., Deneckère, R., Rolland, C.: Towards a Generic Model for Situational Method Engineering. In: Eder, J., Missikoff, M. (eds.) Advanced Information Systems Engineering, 15th International Conference, CAiSE 2003, vol. 2681:2003, pp. 95-110. Springer, Berlin (2003)
9. Wistrand, K.: Method Rationale Revealed - Communication of Knowledge in Systems Development Methods. Swedish Business School, vol. PhD. Örebro University, Örebro (2009)
10. Karlsson, F.: Longitudinal use of method rationale in method configuration: an exploratory study. European Journal of Information Systems (2012)
11. Jayaratna, N.: Understanding and evaluating methodologies. McGraw-Hill, London (1994)
12. Russo, N.L., Stolterman, E.: Exploring the assumptions underlying information systems methodologies: their impact on past, present and future ISM research. Information Technology & People 13, 313–327 (2000)
13. Brinkkemper, S.: Method engineering: engineering of information systems development methods and tools. Information and Software Technology 38, 275-280 (1996)
14. Fitzgerald, B., Russo, N.L., Stolterman, E.: Information Systems Development - Methods in Action. McGraw-Hill, Berkshire, UK (2002)
15. Argyris, C., Schön, D.A.: Organizational learning II. Theory, method, and practice. Addison-Wesley Publishing Company, Reading, Mass. (1996)
16. Ågerfalk, P.J.: Towards Better Understanding of Agile Values in Global Software Development. In: Krogstie, J., Halpin, T.A., Proper, H.A. (eds.) Eleventh International Workshop on Exploring Modeling Methods in Systems Analysis and Design (EMMSAD'06), pp. 375-382. Namur University Press, Namur, Belgium (2006)
17. Karlsson, F., Ågerfalk, P.J.: Method Configuration: Adapting to Situational Characteristics while Creating Reusable Assets. Information and Software Technology 46, 619-633 (2004)
18. Karlsson, F., Wistrand, K.: Combining method engineering with activity theory: theoretical grounding of the method component concept. European Journal of Information Systems 15, 82-90 (2006)
19. Baskerville, R., Wood-Harper, A.T.: Diversity in information systems action research methods. European Journal of Information Systems 7, 90-107 (1998)
20. Susman, G.I., Evered, R.D.: An Assessment of the Scientific Merits of Action Research. Administrative Science Quarterly 23, 582-603 (1978)
21. Karlsson, F., Linander, F., Von Schéele, F.: A conceptual framework for time distortion analysis in method components. The 19th Exploring Modelling Methods for Systems Analysis and Design (EMMSAD 2014), Thessaloniki, Greece (2014)
22. Software Enginnering Institute: CMMI for Development, Version 1.2. Carnegie Mellon University (2006)