
When asset management and organisations meet: accounting for employee experiences

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Abstract: For some time, organisations have encountered challenges when implementing asset management, particularly when closing the gap between how the asset management is understood by employees and how they support it in practice. Maturity models, common applied evaluations for implementing asset management, have so far only addressed the extent to which implemented asset management matches prescriptive standards. In this paper, we argue that, beside the value of maturity evaluations, shortcomings of maturity models remain in accounting for employee experiences with specific operational characteristics that challenge implementation. We then offer a criteria-free, employee-based approach to complement maturity models known as Rumelt's tests. By applying this approach to the case of a Dutch transportation agency, we show how employees understand the organisation's strategy behind asset management and how they coordinate asset management activities in practice.

Keywords: organisation; asset management; Rumelt's tests; maturity model.

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1 Introduction

Over the last decades, asset management (AM) has emerged as an approach of “systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving its organizational strategic plan” (BSI, 2008). One of the main characteristics of AM is seen in the interconnection of “the organization’s asset management policy, asset management strategy, asset management objectives, asset management plan(s) and the activities, processes and organizational structures necessary for their development, implementation and continual improvement” (BSI, 2008). Although many organisations have started implementing formal AM systems and followed the prerequisites laid down in standards or manuals, they frequently encounter problems during the implementation. For example, Pantelias et al. (2009) found that AM implementation in the USA has been a very lengthy endeavour with many hurdles, e.g. to integrate and coordinate different activities and practices. In their survey, 24 out of 40 State Departments of Transportation had already been eight years in the planning phase of implementing an AM system following the publication of the AM primer (see FHWA, 1999). Also, in the industrial asset sector, Parida (2012) found that it has been hard to put a proper AM strategy in place, even though many conceptual developments (e.g. reliability-centred maintenance) were already well-researched and available. Especially small and medium industrial enterprises (SMEs) (see Winter and Fabry, 2012), but also municipalities (see Halfawy, 2008), miss guidance on the effective implementation of AM because their ambitions do not correspond to the available prescribed implementation options. Such problems are not surprising. Before organisations have started to widely implement AM standards, guidelines and tools (e.g. APCC, 2001; FHWA, 1999; OECD, 2002; TAC, 1999; Association of Local Government Engineers of New Zealand et al., 2006; BSI, 2008), they mainly relied on fragmented systems and strategies to manage distinct objects (Flintsch and Chen, 2004). The challenges in implementing AM many organisations face emerge from the comprehensiveness with which AM affects and interlinks different organisational layers and units. The implementation success strongly depends on how an organisation’s AM strategy is understood by the organisation’s employees and ultimately coordinated in practice (Ratnayake, 2013; Van der Velde et al., 2013; El-Akruti et al., 2013).

In order to evaluate the progress of AM implementation and to identify areas for improvement, organisations often use evaluation techniques such as benchmarking (see Ozbek et al., 2012; Zeb et al., 2012) and more specifically maturity models (see Macgillivray et al., 2007; Volker et al., 2011; Laue et al., 2012). Maturity models evaluate the progress in implementing predefined standards along a desired path of discrete stages describing an organisations capability to comply with these standards (see Baldassarre et al., 2009). A prerequisite for applying maturity models is having criteria that constitute the desired stages of implementation. Typically, maturity models for evaluating AM implementation use specific criteria representing the strategic perspective of an organisation on AM. Although such a view can provide insights in how an organisation develops such standards, it remains limited in its ability to identify whether employees understand the organisation's strategy behind AM and how they coordinate AM activities in practice. A criteria-free perspective for evaluating the presence of discrepancies between an employees' understanding of the organisations' AM strategy and their activities of it would be advantageous to complement maturity models (see Henderson and Venkatraman, 1993).

The objective of this study is to propose an employee-focused, criteria-free evaluation approach that identifies discrepancies between the way in which employees understand the organisation's AM strategy *and* coordinate their activities to achieve it. We argue that such an approach can fruitfully complement AM maturity models and we demonstrate that a set of four tests, as proposed by the strategic management scholar Rumelt (1979), are sufficient to establish the approach. Rumelt's tests provide four open questions for practitioners aimed at drawing out experiences (i.e. particular concerns or issues) and identifying recurring patterns in them (i.e. finding emphasis). This open-ended, and hence criteria-free, evaluation helps to identify and specify challenges in employees' contribution to the AM ambitions of an organisation and the coordination of AM activities and decisions within an organisation.

2 Challenges with implementing asset management

Several challenges during AM implementation have been reported in the literature which can be characterised as integration and coordination challenges.

2.1 Integration challenges

Integration of organisational systems is prescribed in many AM standards (e.g. BSI, 2008; FHWA, 1999) and failing to integrate systems is recognised as an implementation challenge. Organisations may fail to integrate several systems (among others information, decision support or business process systems) when they implement separate systems at different times, each with its own characteristics (e.g. López Campos et al., 2013) or maintained by different areas within the organisation (e.g. Sitzabee et al., 2009). Another challenge occurs if an integrated set of systems cannot be redesigned or updated quickly (López Campos and Crespo Márquez, 2010). Today, AM standards recommend dynamic updates or process redesigns of AM systems. However, it is only recently that

organisations have been moving away from inflexible maintenance applications and towards adaptively designing and updating AM practices (López Campos and Crespo Márquez, 2010). A danger in implementing inflexible AM systems is that sunken costs remain when a hasty implementation results in suboptimal system designs, such as ones lacking appropriate lifecycle planning, being deployed (Sturtevant et al., 2012). Finally, some researchers have reported that implementation can be negatively affected if AM is not properly linked to the organisational strategic plan, a link which many AM standards view as essential. El-Akruti et al. (2013) argue that current AM systems focus on the lifecycle of engineered systems and that too little is done to link them to the organisational strategy. The link between the organisational strategic plan and an AM system is often made explicit through an asset performance assessment (Parida, 2012). A weak link is likely to result in a failure to integrate various stakeholders and changing requirements when assessing strategic asset performance and this remains a challenge in many industries (Parida, 2012).

2.2 Coordination challenges

Another view has been offered more recently, explaining that challenges may also arise by the way in which employees conceive AM and coordinate their activities to achieve the specific vision that the organisation has defined for their AM strategy (Ratnayake, 2013; Van der Velde et al., 2013; El-Akruti et al., 2013). For example, a framework (i.e. vision of the organisation) might not supply employees with the know-how to translate organisation's AM strategy to their individual and operational activities. Such a discrepancy could arise from the complexity of the framework, and, as a consequence, implementation might fail when employees are not able to understand the framework (Al-Najjar, 2012) or when the framework may have an infeasible ambition (Winter and Fabry, 2012) or infeasible business horizon (see Bai et al., 2012) for the organisation. Besides, the implementation of the AM strategy can also be negatively affected when employees evaluate and make decisions on more measurable risks and exclude these actions from evaluating and making decisions on less measurable risks. Catrinu and Nordgård (2011) show that experts at an electricity distribution companies, in their AM, address risks and allocate resources that are quantifiable in financial terms, an exclude decisions from less quantifiable risks such as personnel safety or environmental damage. When employees are excluding decisions and evaluations with dissimilar risk visibility and measurability, then critical, less visible risks might not be coordinated altogether, see the example on geotechnical risks as addressed by Sanford Bernhardt et al. (2003). Finally, in uncertain and dynamic times, employees may attach several meanings to AM and lose focus on what an organisation's AM strategy means for their work (Davies et al., 2011). When goals of implementation are still being developed, this creates a possibility for organisations or forums to influence the development of these standards (Davies et al., 2011). Conceptual misinterpretation and lack of overview can lead to coordination problems which undermine implementation efforts and AM strategies (Parida, 2012).

The described challenges raises the question: by which means can these challenges be properly identified and analysed? To answer this question we review maturity models frequently applied to evaluate AM implementation.

3 Maturity models

Scholars, who have studied integration challenges during AM implementation are quite clear on the merits of applying maturity models (e.g. Närman et al., 2012; Woodall et al., 2013). Maturity models support AM implementation for several reasons. Firstly, maturity models measure the extent to which management practices comply with a certain standard, providing evidence of an organisation having achieved compliance (Baldassarre et al., 2009; Dhaliwal et al., 2011) on multiple levels (Hefner, 2003). For this reason, maturity models incorporate a set of criteria that describe a desired practice (e.g. a standard or procedure) and measure the compliance of current practical processes along those criteria (De Haes and Van Grembergen, 2005; Becker, 2009). Volker et al. (2011) and van der Lei et al. (2011) specifically used maturity models to empirically evaluate the compliance of public organisations in the Netherlands with the AM PAS-55 standard. Hence, AM maturity models can provide a normative description of good practices (Volker et al., 2011), and help to evaluate compliance with other standards that contribute to AM performance (van der Lei et al., 2011).

Another merit of applying maturity models is that, when criteria are clearly defined they provide an agenda for change. For example, Närman et al. (2012) find maturity models helpful in identifying which industrial maintenance management tools are most often used in an organisation and why that is. Woodall et al. (2013) mention that maturity models help to guide organisations in properly collecting and ensuring asset information quality.

Maturity models are also beneficial to tailor to the specific criteria that matter (Baldassarre et al., 2009; Peng et al., 2011) and further tailor the implementation's steps of growth that define progress for an organisation. The flexibility in tailoring criteria has made maturity models widely applicable, including to project management and people management (Peppard and Ward, 1999; Batenburg et al., 2005). This wide potential application makes maturity models relevant when designing an evaluation for multiple standards (see Baldassarre et al., 2009), while also instilling a need to argue and defend the chosen coverage of criteria (Ravichendran and Lertwongsatien, 2005; Becker, 2009). The flexibility in tailoring growth steps means that maturity models are able to take sequential snapshots during the management of change (Becker, 2009). These snapshots make maturity models relevant when wanting to define a clear upward development path for organisations (e.g. Batenburg et al., 2005).

Despite these benefits of maturity models, criteria used are often sketchy and poorly justified by researchers (Becker, 2009). A good start would be to clearly provide an extensive account of the criteria development. However, even a well-motivated maturity model does not necessarily ensure a focus on direct employee elicitation. Criteria can be politically set (Grembergen and de Haes, 2005) or based on commercial interests (Becker, 2009), for example to benefit particular stakeholders or executives. It is also hard to know in advance how comprehensive (required for successful implementation) the criteria selection has been (Ravichendran and Lertwongsatien, 2005), and this eventually forces some subjective assessment on the criteria (Zhou and Cai, 2011) and on the maturity levels (Versendaal et al., 2013).

In addition, the ideal circumstances, that criteria are intended to represent, may make the maturity model a vulnerable approach to evaluate AM implementation. For example, separate criteria may be described as separate ideal circumstances. An evaluation then overlooks possible conflictive relationships between the optimum state of one criterion

and the optimum of another (Mettler, 2011). Criteria are also not necessarily equally applicable to all industries' aspirations or nature of business (Grembergen and de Haes, 2005) and may trigger incomparable assessment from employees in different industries.

The assessment of criteria of a maturity model might be also influenced by the evaluator's opinion about the most mature description of the ideal situation. An employees' opinion may well be a critical aspect to account for, since employees may have different perceptions of what is ideal asset management (Nyström and Söderholm, 2010). And as such, employees might have different opinions or different approaches to evaluate the maturity level of their AM, if asked. Ravichendran and Lertwongsatien (2005) estimate that it takes at least four years to develop a widely supported and accepted maturity model of what is an ideal description of criteria in the model. They found that when organisations tried to base their implementation on a maturity model they often failed to systematically develop and invest into the ideal descriptions. In essence, when the implementation of asset management has just begun it is hard to know whether an idealised criterion is going to stand the test of time (see Pantelias et al., 2009; Parida, 2012; Ratnayake, 2013; Winter and Fabry, 2012).

Despite their clear and well-accepted benefits, maturity models fall short when it specifically comes to the evaluation of systems and practices where employees from different organisational layers and units are involved, as is the case with AM. Ratnayake (2013), for example, argues that organisations reliant on industrial assets depend on the ability of human authority to realise the forthcoming demands of their stakeholders and to exploit assets to their maximum ability and achieve a balanced and sustainable asset performance. Van der Velde et al. (2012) explain that employees are invaluable because they can interpret data and convey an understanding of failure causes and severity of the failure to senior management positions in the organisation. To address the aforementioned shortcomings of maturity models, we are seeking to develop an employee-focused, criteria-free evaluation approach.

4 A criterion-free approach for eliciting employee experiences

In order to objectively address criteria-free comments, we propose that a systematic way helps to understand AM conceptualisations by employees. When AM is not at all clear within an organisation this may be due to different perceptions among employees, or various ambitions within the organisation (Vamanu et al., 2010). Consequently, rather than collecting data on discrepancies between how employees understand AM and coordinate it in practice, we need to compare how the understandings and actions concerning asset management correspond between employees. In essence, we are seeking an approach that helps us to follow an employees' AM conceptualisation of a strategy and its coordination. For such studies, Rumelt (1979) offered an approach to test how thorough a conceptualisation has been thought through. Rumelt (1979) noticed that any strategy can prove conceptually weak if the theory behind it cannot provide solutions to four possible reasons as to why the strategy might fail in practice. To assist, the author developed four possible tests to assess the possible discrepancies between the conceptualisation of a strategy and the strategy-in-practice. In other words, Rumelt's tests help identifying a conceptually effective strategy by uncovering the parts that can make the strategy ineffective in practice. We believe this approach could enable employees to determine detailed areas of improvement.

The tests that Rumelt (1979) proposed are focused on thoroughly answering four strategic analytical questions and then evaluating how well thought out a strategy appears to be. First, the *goal consistency test* seeks to specify the primary goals and to avoid inherently conflicting objectives. Second, the *frame test* seeks to distinguish important from unimportant factors and to define the critical sub-problems that must be resolved. Thirdly, the *competence test* seeks ways to use organisational skills, resources and competences to resolve critical issues. Finally, the *workability test* aims to provide a reasonable expectation that the desired results can be achieved if the strategy is appropriately applied. These tests suffice as a criteria-free approach, provided that these tests do not focus on the content of what is conceptualised, but on how thorough that conceptualisation has been.

Lengnick-Hall and Wolff (1999) further elaborated on the application of these tests by formulating the questions more precisely. They demonstrated that this application of Rumelt's tests was able to identify similarities and contradictions between multiple theories in strategic management. Following from that, Rumelt's test can be used to evaluate the multiple conceptualisations that exist between employees, and locate their opinions on similar subjects. For that reason, we followed the questions proposed by Lengnick-Hall and Wolff (1999) and adjusted them slightly to draw out employee-focused experiences.

Table 1 Rumelt's four tests for evaluating strategies

<i>No.</i>	<i>Test</i>	<i>Question</i>
1	Goal consistency test	What are the primary aims of your work?
2	Frame test	What are the most critical sub-problems and critical issues that have to be addressed within the domain of your work?
3	Competence test	What feasible solutions to solvable sub-problems can you suggest?
4	Workability test	How are your actions linked with results? Which issues influence the results? What are examples of success?

5 Case study

To apply our approach we focus on an organisation where a vision for asset management has just been formulated and is in the beginning stage of being implemented, and where employees within the organisation might not yet have a clear understanding of its asset management. Such an organisation is still searching to explicate the criteria that they find important for the longer term (Ravichendran and Lertwongsatien, 2005).

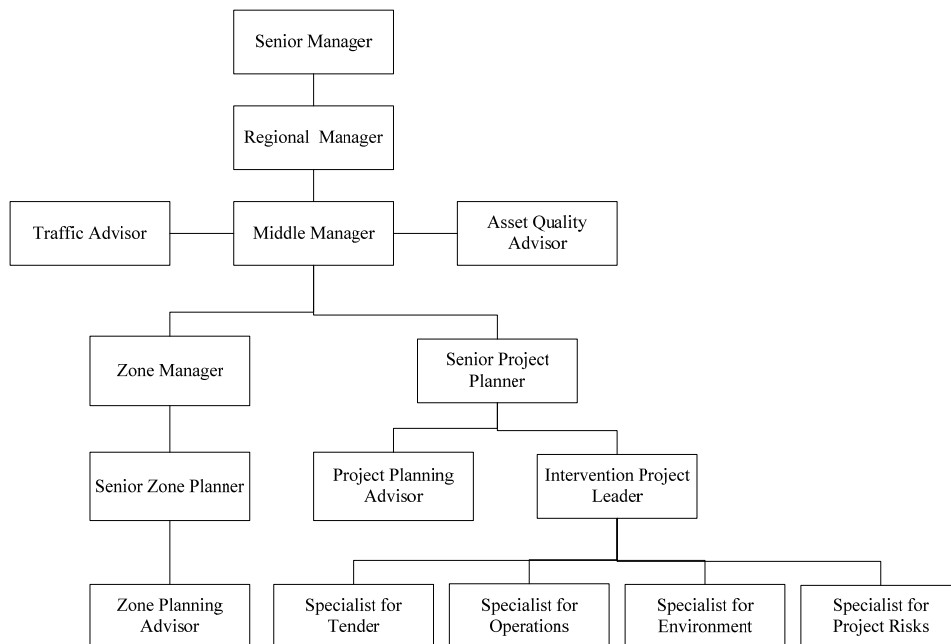
A suitable case that matched this situation concerned the Dutch transportation agency in the Netherlands, who just formulated a vision to asset management in 2008 and was at the start of their implementation efforts in 2011. This agency manages the main part of the Dutch transportation infrastructure. We were granted the opportunity to interview key AM employees in the beginning of 2011 to uncover possible discrepancies between their understanding of AM and their coordination of activities.

We have to stress that these discrepancies mark a snapshot of the agency’s implementation challenges pertained to 2011. This agency also supplied us with secondary data from a first maturity model evaluation (which also occurred in early 2011) to properly compare the identification of challenges that originate during AM implementation with both our employee-focused, criteria-free approach and maturity models.

5.1 Unit of analysis

The unit of analysis refers to the aggregation level of the data collected. To objectively analyse potential challenges we have to account for the role of each employee. In so doing, we regard the working relationships between employees as our unit of analysis, because employees work together and through them assets are managed. We started with interviewing three process experts from the organisation which helped us to select relevant employees. The experts were asked to point us towards job occupations which they thought would cover in the relevant functions for AM in the organisation from top to bottom. Using such informants, we were able to study the developments in activities and events as they occur through the links between job occupations that cover the organisational structure. In sum, our unit of analysis involves the work relationships between a set individual job occupations, relevant to AM, from which we compare their conceptualisations about AM.

Figure 1 Selected AM-related employees and their work relationships



5.2 *Sample selection*

A necessary step in identifying the employees' role in organisational challenges was to select a sample of employees who corresponded to the identified job occupations. We required proficient employees who were able to think and analyse AM based on their experience in the organisation. Further we needed to select employees who were directly connected when participating in AM-related activities and events. In operational terms, we would then be able to find possible discrepancies between the understanding and coordinating activities of employees because we were not limiting ourselves to specific predetermined criteria and were open to hearing experiences from employees on issues from their overall work environment. This helps in contrasting their views related to the same issues.

We identified 15 employees from a regional office of the Dutch transportation agency and a member of senior management who was responsible for AM and finally crosschecked our intended sample with the three experts. The interviewees' functions are shown in Figure 1 and we carried out interviews over a period of two months in 2011. The data retrieved are also reflective of that period.

5.3 *Data collection and analysis*

It is important that we remain sensitive, during data collection, to any issue that employees regard as relevant. The interview data, therefore, describes a discrepancy between employees' understanding of AM and their coordination, providing us a good description of the problems during AM implementation. We adopted, as our main interview questions, the four tests of Rumelt (see Table 1). In this way we were able to collect issues arising in the form of discrepancies between the AM understanding of individual employees and their coordination of AM activities at the agency. When documenting interview data it is important to determine in which way the data capture discrepancies. To ensure this, we applied a range of techniques to draw out examples of discrepancies. First, during each interview, we noted the responses that we understood as primary answers and crosschecked them with the interviewee before moving on to the next question. To reduce the possibility of respondents not answering the Rumelt-test questions, we asked the questions in the 'what' or 'which' form shown in Table 1. We also asked them to provide examples and clarify how events and activities marked their experiences. We followed the suggestion of Zappavigna and Patrick (2010) by asking 'how' and 'who' questions to learn more about the context and preceding and succeeding events and activities. Zappavigna and Patrick (2010) explain that capturing tacit knowledge by actively asking for clarification about an interviewee's grammar-in-use enables the interviewer to access a more subconscious level. Furthermore, we recorded and transcribed the interviews to ensure nothing was missed.

We expect that the interviews with connected employees and managers reveal a rich account of situations where multiple employees were involved. Therefore, we operationalised individual remarks at the collective level by coding similar examples addressed by two or more employees when answering Rumelt's tests questions. When colleagues refer to the same situations, we can contrast them and identify the resultant challenges between their understandings and actions. This way we could reconstruct

individual stories into a sequence of events that tells a story in detail with multiple actors who were constantly tested with unexpected developments or issues. The employees that we interviewed gave clear clues to these developments. The interviews were conducted within a short timeframe of two months, to ensure that employees' responses to the open-ended questions would reflect a fairly consistent work situation. A catalogue of these details could constitute an agenda for organisational challenges that could help remove barriers to achieving the organisational strategic plan.

We used the reconstructed stories of multiple employees to discuss differences with a maturity model evaluation, which was conducted at the agency. We collected secondary data from this evaluation which was conducted in the identical period and at the same regional department where we conducted our Rumelt's tests. We were cleared to use two interview reports from this maturity model evaluation¹. These were one-hour conversations performed by two interviewers and two interviewees each. During the conversations, interviewees were asked to evaluate seven criteria along with a five categorical scale of maturity².

6 Results with Rumelt's tests

To illustrate the context from which the interviewed employees interact, we first describe the background of our case. Particularly, we describe how each individual employee sees his or her goal in asset management and their work relationship with other interviewed colleagues in asset management. We then provide examples where their individual positions require them to interact with other employees. We selected three examples that related to comments that were provided on several maturity model criteria³ at the agency from 2011 (for a summary see Table 2).

6.1 Background of employees' work relationships

As of the operating year, 2011, senior management of the agency initiates and prepares a business plan for achieving the agreed service levels with the higher authorities (i.e. the asset owner) for a four-year period. To ensure that the business plan is met, the agency's senior management team meets once a year with the regional managers to formulate a strategy for each region and agree on priorities, milestones and available resources.

Once these managers have agreed on the decisions that have to be taken to achieve the business plan, they sign a service level contract that applies for one operational year. After it has been signed, a regional manager is responsible for the overall costs of his or her region and delegates most primary responsibilities relating to infrastructure services to its water and road divisions. The middle manager manages the road division and acts as the internal client for project teams who tender the construction and maintenance work and formulate requests for proposals to contractors. The middle manager receives information to define maintenance and construction work from the heads of every infrastructure zone in the regional department. When the infrastructure zone heads inform the middle manager, they also advocate an intervention plan that their maintenance planning department has optimised for the district.

Table 2 Comparing examples with Rumelt's tests and maturity model details from 2011

<i>Rumelt's tests example</i>	<i>Details identified by Rumelt's tests that describe the example</i>	<i>Noted by which employee(s)</i>	<i>Details identified by maturity model evaluation that relate to the same example</i>	<i>Noted at which criteria</i>
Replacing a traffic light	• An accident occurred with failing traffic light	• Zone manager	• Coordination between regional and corporate department operates well	• Internal coordination
	• The accident caused commotion	• Asset quality advisor	• Regional department needs to report improvements as new facts to corporate planning department	• Market approach
	• Municipality proposed a roundabout as safer alternative for traffic light	• Zone planning advisor	• Risks are systematically identified and qualitatively justified	• Risk management
	• Trade-off between roundabout or traffic light	• Middle manager	• Technical solutions are often provided	• External coordination
	• Regional department advocated roundabout		• Alternatives are weighed	
	• Corporate planning department would not cover the roundabout		• Regional department takes lead managing risk with municipalities	
	• Roundabout required multiple funds		• Budgetary problems prevent a high maturity	
Addressing Frost damage	• Winter causes much frost damage	• Zone planning advisor	• Quantitative data is not complete in systems	• Information management
	• Frost damage is deferred maintenance		• Regional department gives attention to environment management	• Risk management
	• Money was reserved for other conditions	• Zone manager	• Performance indicators (failure frequency or downtime) not applied to assets	• External coordination
	• Roughness had no worse impact than frost damage	• Senior zone planner	• Risks are systematically identified and qualitatively justified	• Market approach
	• Preventive measures for roughness could be postponed for frost damage	• Asset quality advisor	• Technical solutions are often provided	
Addressing Frost damage	• Scenarios are possible to weigh between frost damage and other failures		• Alternatives are weighed	
	• Frost damage may occur with very open asphalt concrete roads			
	• It is politically motivated to correcting frost damage over preventing roughness			
Maintaining a road along the top of an embankment	• Embankment controls the water flow	• Traffic advisor	• Data is widely distributed in organization	• Information management
	• Embankment attracts tourism		• Some questions exist for jurisdiction between divisions	• Internal coordination
	• Road runs along the top of the embankment	• Specialist for project risks	• Regional department gives attention to environment management	• External coordination
	• The road has severe maintenance requirements		• The embankment has a level 4 maturity	• Risk management
	• Traffic advisor finds maintenance not a road divisions' mandate		• Job scope and definitions are not always clear	• Processes and roles
	• He requested action by a colleague at water division			
	• Colleague found embankments' function to control the water flow was not affected			
	• Traffic advisor amplified that road deterioration meant loss of reputation			
	• Road was not described as function of the embankment			

The infrastructure zone managers are likely to provide the middle manager with plans that are optimised for their own district. Consequently, a traffic advisor and the asset quality advisor advise the middle manager on a broader network plan for maintenance and construction work across the districts, and they advise on the best moment to intervene on the regional roads. In particular, they inform the middle manager how particular plans will impact on the traffic and road quality.

A project planning department groups the activities to provide a compilation of the required maintenance work to the middle manager. This department is staffed by a senior project planner and several project planning advisors. To arrive at a sound plan, the project planning department tests whether projects can be realistically initiated based on the personnel capacity that they can allocate to project teams. Once the middle manager allows a project to proceed to the preparatory phase, a project team is manned with an intervention project leader, a specialist for project risks, a specialist for operations, a specialist for tender and a specialist for environment. Each of these team-members acts as a specialist with a main area of focus during the entire development of the project.

6.2 Rumelt's tests example 1: replacing a traffic light

The zone manager views the occurrence of a single accident as a critical issue because it can lead to the organisation receiving a lot of political and public attention. On this issue, he remarked that "last year there was an accident at a crossing with a defective traffic light. ... There was a lot of commotion and political attention to this accident" (zone manager, identifying critical issues).

As a consequence of this attention, the organisation was triggered to bring forward a decision to replace the defective traffic light. While the traffic light was due to be replaced the next year, a municipality proposed that the agency co-invest in a roundabout as a safer alternative. The municipality would cover half the costs. The zone manager was eager to consider this initiative: "This is a nice decision, what is the better option – a roundabout or a traffic light? What would be the lifecycle costs of each option?" (zone manager, identifying a solution). The zone planning advisor was inclined to analyse these options "a roundabout could be more expensive to construct but the reduced need for maintenance could pay back the investment" (zone planning advisor, identifying critical issues).

The discussions between the municipality and the infrastructure zone led to the preparation of a few decision alternatives to weigh costs and benefits for replacing the traffic light. Firstly, the trade-off would require changing existing plans and cost more than the funds available: "we calculated the payback period, and the roundabout turned out more expensive" (zone planning advisor, identifying a solution). For this reason, the corporate planning department was not willing to consider the options and "warned us that they would only cover our costs if we opted for the traffic light" (zone planning advisor, identifying an action linked to results).

Despite the warning by the corporate planning department, the zone manager offered the alternatives to the middle manager and her advisors: "what would you like – a roundabout or a high quality traffic light?" (zone manager, identifying a solution). The middle manager was inclined to favour a roundabout, but she found it a challenging question since the corporate planning department had warned of the withdrawal of funds: "it meant that we had to find money through other subsidies, an internal programme and a municipality. It is quite complicated to fund projects in this way" (middle manager,

identifying critical issues). Her asset quality advisor was unenthusiastic towards the roundabout given its higher investment: “A roundabout would offer greater traffic safety but would require a higher investment. However, frankly, we have not received a budget to replace that traffic light with a roundabout” (asset quality advisor, identifying critical issues). His response as a solution was frank: “I approached it purely from my perspective: and the answer was no” (asset quality advisor, identifying a solution).

In the end, funding was sought from the corporate department for a roundabout: “We presented a financial plan complete with RAMSSHEEP criteria, and demonstrated the cost-effectiveness of the roundabout option. However, our own organization then proved unable to make that decision” (zone manager, identifying an action linked to results). Both the zone manager and the zone planning advisor felt this hampered their ability to deliver increased traffic safety.

Despite the rejection by the corporate department, the middle manager decided to look for other sources to fund the roundabout: “we raised money from the traffic systems budget, another little fund for maintenance and a contribution from the municipality” (middle manager, identifying a solution).

The experience of seeking other subsidies, raised second thoughts about whether it was all worthwhile. When they had almost raised the required funds, “the citizens from the municipality started a court hearing and objected to the construction ... and due to that delay one of the subsidy programmes expired” (middle manager, identifying a solution). The zone planning advisor showed signs of regretting this whole journey in trying to replace the traffic light: “the traffic light needs replacing soon, and we already have a fund to replace it with a traffic light. ... the risk of more problems is increasing ... formally we are not allowed to replace the traffic light with a roundabout.” (zone planning advisor, identifying an action linked to results).

This example shows the persistence of both the infrastructure zone and the corporate planning department in proceeding to coordinate their actions in line with their own understandings. The corporate planning department did not recognise and act on the persistence shown by the infrastructure zone for a safer alternative. Conversely, the infrastructure zone did not see and act on the insistence of the corporate planning department to upgrade the traffic light. This example illustrates the consequences of these discrepancies. The endless pursuit of alternative subsidies confronted the zone manager and middle manager with a complexity of problems that they later would regret having attacked.

Discussing related maturity model details for example 1

At first glance, the details provided by the maturity model confirm remarks when replacing the traffic lights. For example, the maturity model evaluation describes that the agency takes the lead in managing risks that are affected by them and municipalities. In extension Rumelt’s tests example illustrates that particularly the infrastructure zone has taken the lead to find funds for the safer alternative, although it was proposed by a municipality. The maturity model evaluation generically describes that alternative solutions are oftentimes technically elaborated and weighed. The Rumelt’s tests detail this endeavour where the regional department prepared a trade-off between an already planned traffic light replacement and the roundabout.

Rumelt's four tests also revealed a detail contradicting to some justifications for a maturity level on the internal coordination criteria. The maturity score for internal coordination at this regional department was evaluated by employees close to four out of five. According to the model this level 4 represents a department coordinates all infrastructure problems within budgetary requirements and jointly communicates bottlenecks. One interview that was conducted for this maturity evaluation motivated this score with the remark that "communication and coordination, among other departments, the corporate planning department, was good". Another interview that was conducted for this evaluation remarked that "we communicate and coordinate our planning and eventual problems intensively with the corporate planning". Yet, the remarks made by employees regarding the same work relationship detailed the persistence by both departments standing their ground on their solution to replace the traffic light. The maturity model evaluation does not overlook this detail per se, since a general remark was made that budgetary problems prevent the agency from reaching a higher level of maturity. However, it did not specify that the complexity of gathering multiple funds may serve as the underlying explanation. This detail complements the maturity model evaluation.

6.3 Rumelt's tests example 2: addressing frost damage

Frost damage is known to occur as a result of hard winters and sometimes repair budgets do not seem to be available. In the winter of 2011, the zone planning advisor of the infrastructure zone studied commented that they "encountered a lot of frost damage to the roads, but actually this was more a consequence of deferred maintenance" that they "did not have enough money to cover" (zone planning advisor, identifying critical issues). This existing annual budget was "intended for measurable conditions (unacceptable roughness and deep ruts) and already allocated. However, we also had to do something about the frost damage" (zone planning advisor, identifying critical issues).

To solve the problem of budget constraints, they decided to weigh the risks associated with frost damage and with unacceptable roughness and rutting. They found arguments in favour of repairing frost damage at the expense of meeting roughness criteria: "We looked at the performance indicators and tried to determine how the damage impacted on the organizational objectives. ... Roughness concerns could be resolved by placing warning signs along the road to inform road users. With the remaining budget, we could then address much of the frost damage" (zone planning advisor, identifying a solution). Also, the senior zone planner welcomed this solution: "we believe that an accident occurring as a result of frost damage is more risky than a roughness problem on a minor road" (senior zone planner, identifying a solution).

On reflection, employees do not seem to agree on this approach to frost damage. The zone manager commented: "we constantly get away with saying that we have damage as a result of hard winters but, strictly, it is not that, it is bad preventive maintenance" (zone manager, identifying critical issues). The asset quality advisor substantiated the view that frost damage could be avoided by replacing the road surface: "you just know that frost damage occurs most frequently with very open asphalt concrete roads. When the asphalt reaches the end of its lifecycle, this is inevitable" (asset quality advisor, identifying critical issues). However, this preventative approach was stopped due to budget limitations: "even if you know that you need to replace the top layer of a road you have to postpone this plan if the available budget is used up" ... "However, this postponement has occurred three years in a row" (asset quality advisor, identifying critical issues). As

such, employees seem to agree that addressing frost damage by switching budgets from roughness repairs to frost damage repairs is a fire-fighting intervention and a poor example of preventive maintenance.

The experience of employees mainly revolves around the need to make clear choices based on realistic expectations of failure types with different materials. The zone manager believes that making clear choices starts with outlining what you know: "If we consciously allocate less money to preventive maintenance and more money to corrective maintenance, then this is what happens ... however, in that case, you shouldn't call it frost damage but see it as a corrective measure" (zone manager, identifying a solution). The asset quality advisor adds to this by saying that causes of failure need to be openly labelled: "the very open asphalt concrete could be completely replaced. In the media, our organization calls this frost damage but strictly it is just very open asphalt concrete that is at the end of its life" (asset quality advisor, identifying critical issues).

This argument regarding preventive maintenance perhaps shows that having a public-orientation and favouring preventive maintenance could be conflicting approaches to road maintenance. The asset quality advisor explained: "many political things are at work. We score with public opinion by repairing frost damage. We are alert. We repair the roads very quickly ... We have everything under control." (asset quality advisor, identifying an action linked to a result). Effectively, this employee's experiences indicate that there are reasons why less quantifiable and more quantifiable failure types could be decoupled in allocating budget, and why corrective action could have a greater impact on public opinion than preventive action.

Discussing related maturity model details for example 2

Comparing this example with related remarks from the maturity model evaluation further reveals the rich elaboration provided by Rumelt's tests over maturity models. For example, some remarks have been made during the maturity model evaluation that quantitative data is not yet completed in information systems and that performance indicators are not yet applied to assets. Rumelt's tests detail in the case of frost damage that less measurable risks are renounced from systematic risk evaluations and receive budget that has been ring-fenced from already budgeted measures, e.g. roughness measures were postponed for addressing frost damage.

Remarks from the maturity model evaluation particularly relate to the example of frost damage when used to justify the maturity level of the risk management criteria. The maturity score for risk management at this regional department was evaluated by employees close to a four out five. According to the model this level 4 represents a department that prioritises all risks for objects systematically. One interview that was conducted for this maturity evaluation motivated this score with the remark that "risks are systematically identified and labelled and different scenarios are weighed in decisions". Another interview that was conducted for this maturity evaluation remarked that "we have the proper knowledge to reach the highest maturity, however budgetary limitations make that a challenge". Rumelt's tests results have extended the explanation as to why the budget may limit a high maturity level, i.e. because of quick and positive visible action.

6.4 Rumelt's tests example 3: maintaining a road along the top of an embankment

The poor quality of a road running along the top of an embankment illustrates the consequences of separate jurisdictions and limited specifications concerning the functionality of an asset. The issue arose when the traffic advisor was confronted with the poor quality of a road. He learnt that this road was a physical part of an embankment and therefore maintained and managed by the water division since "primarily its function relates to control the water flow" (traffic advisor, identifying critical issues). Further, the traffic advisor noted that "the embankment sees a lot of attention linked to tourism" (traffic advisor, identifying critical issues).

The traffic advisor had appealed to a colleague from the water division and was surprised by the response of his colleague who said that "the function of the embankment in relation to control the water flow is not endangered by the quality of this road" (traffic advisor, identifying critical issues). This moved the traffic advisor to a challenge the single functionality of the embankment. The specialist for project risks had previously been employed by the water division and knew the details of the embankment. When identifying critical issues, he recalled that "the traffic advisor from the road division had emphasized the road's deterioration as a problem and pointed to the potential loss of reputation" (specialist for project risks, identifying critical issues). He questioned whether the appeal by the traffic advisor was fair: "I understand what he means, but do you have to accept another function for this embankment?" (specialist for project risks, identifying critical issues).

In effect, this example shows that workers from different divisions appear to follow their own division's mandate in determining priorities. Concerning mandates, the traffic advisor said that "this road (on the embankment and the water division's responsibility) is not my business, given that I am responsible for the road division" (traffic advisor, identifying critical issues). Nevertheless, he was surprised that his colleague from the water division similarly reasoned when asked to respond to the need to repair the road. Although the specialist for project risks no longer worked for the water division, he retained a water division view when saying "in my view this was just an object with a single function related to control the water flow" (specialist for project risks, identifying critical issues).

Discussing related maturity model details for example 3

Some remarks made during the maturity model evaluation confirm some details of this example. On one instance, maturity model remarks point to the general view that some questions exist over the jurisdiction of both the road and water division at the regional department. Rumelt's tests affirm that the traffic advisor and his colleague both had another view of the jurisdiction of their division to maintain a road along the top of an embankment. Further, Rumelt's tests extend this affirmation by adding that the function of the embankment was interpreted differently by both employees.

In addition, the same test results on different views regarding the jurisdiction revealed a detail contradicting to some justifications for a maturity level on the processes and roles criteria. The maturity score for processes and roles at this regional department was evaluated by employees close to a two out five. According to the model this level 2 represents that employees within a department share a common view of processes and

roles, yet are not completely anchored into job descriptions. One interview that was conducted for this maturity evaluation motivated this score with the remark that “roles for each employee are known, however the processes are not documented”. Another interview that was conducted for this maturity evaluation remarked that “asset management is not yet strongly determined in the process descriptions, however for certain objects we would score a high maturity”. Rumelt’s tests result detail an ambiguity between employees’ view who should maintain a road along the top of an embankment where a maturity level was determined at and a common view of roles.

7 Accounting for employee experiences

In our empirical study we compared the experiences of the employees as they have been drawn out by both approaches. Our data points to several differences on the focus of the Rumelt’s tests and the maturity model evaluations (see Table 3 for an overview). Firstly, Rumelt’s tests focus more on challenges as they emerge through examples, where maturity models are expected to show more deliberated comments about a situation. For example in Rumelt’s tests, a zone planning advisor highlighted the disapproval of the corporate planning department to him considering the replacement of a traffic light by a roundabout, despite him informing them that it could be a possibly safer and cheaper alternative. In the same example, the maturity model comments focused on the criteria of internal coordination and assessed that the coordination between the regional department and corporate planning department was good and indicated that a maturity level 4 out of 5. This level indicates that a regional department coordinates all infrastructure problems within budgetary requirements and jointly communicates bottlenecks.

Table 3 Accounting employee experiences with Rumelt’s tests and maturity models

<i>Rumelt’s tests</i>	<i>Maturity model</i>
Focuses on challenges between understanding and action	Focuses on challenges and good situations as defined by criteria
Triggers remarks of great detail that describe the development of a problem	Triggers remarks that describe the characteristics of a situation
Cannot specify whether a detailed example from practice is generalisable	Cannot specify how a generalised observation amounts in practice
Offers direction for improvement by removing problems	Offers a direction for improvement by defining the ideal situation
Requires full transcriptions of interviews	Requires comments to maturity level scores
Selected employees need to have a work relationship	Selected employees need to have experience with criteria

Second, a maturity model is suitable to receive remarks that assess a criterion on a higher level than Rumelt’s tests could, whereas Rumelt’s tests could reconstruct human interactions as a problem develops. We noted with Rumelt’s tests that some descriptions disclosed that employees focused on a certain goal and thereby disregarded other goals. We saw in example 1 that, despite the discouragement from the corporate planning department, the zone planning advisor and the zone manager continued to investigate alternatives to replacing the traffic light. Conversely, the corporate planning department remained blind to alternatives, and eventually the regional department started another

process to find financial support elsewhere. Also, in example 2, we observed how the frost damage initiated a new approach to weigh the risks associated with rough road surfaces against the risks linked to frost damage, and eventually prioritising frost damage. In both examples, a maturity model assessed whether from a risk management criteria view alternative decisions were commonly weighed.

A third difference may mark their complementary value. Despite we encountered great detailed examples, we could not conclude from Rumelt's tests whether these examples carry significance at an organisational level. We saw in example 3, the traffic advisor encountered an inflexible colleague in the water division when it came to maintaining the quality of a road along an embankment. The same situation was verified by the specialist for project risks, but he offered a different view on the situation, in which he argued that roads did not belong to the water division. With this data we can summarise the different perspectives, but we cannot abstract a more organisational observation from it. We needed the maturity model data to support a more generalised remark on this case where employees commented that some questions exist for jurisdiction between divisions (see Table 2). In absence of either approach, the case material cannot link observations from afar to observations that are more close-up and personal.

A fourth difference may mark the added value if both approaches would be combined for a multi-method snapshot. For example, we were surprised to see in example 1, that the zone planning advisor and the middle manager eventually conceded the roundabout option, but only after a variously subsidised project became stranded. The zone planning advisor even admitted that "formally, we are not allowed to replace the traffic light by a roundabout." In essence, this example narrates that employees seem to notice a challenge, but seem to be blinkered as to when they can make a choice. To that extent, Rumelt's tests offer a direction for improvement by removing these detailed problems. When employees verify multiple of these detailed problems, then this could very well justify relevant criteria for a maturity model for offering the higher-level goal to improve similar situations, where Rumelt's tests then have helped to specify the involved management layers and units.

Although Rumelt's tests carry clear benefits in accounting for employees' experiences, it also requires considerable time and a large number of interviews to conduct it. In our case, we interviewed 15 individuals varying between 45 minutes to 2 hours. Rumelt's tests help to uncover clear examples, but require complete transcriptions, because the interviewer may not know the significance of every remark that has been made until the first reconstructions. Rumelt's tests also rely on the cooperation of every single individual link in the relationships between organisational layers and units. This is needed since multiple employees can describe the challenges with up-close and personal examples.

8 Concluding remarks

In this paper, we identified three concerns with current maturity models' ability to deliver advice on implementing asset management. We have reviewed advantages and disadvantages when applying maturity models. We have attempted to relate these advantages and disadvantages to the task of evaluating asset management implementation. The first concern is that maturity models contain criteria and maturity

level measurements that are crudely designed and poorly motivated (Becker, 2009), and hence require justification. From the literature we found that implementation challenges can involve integration challenges with implementing standards on the one hand and on the other hand coordination challenges. Empirically we found that accounting for the latter type would reveal more high-level information with a criteria-specific approach and more up-close and personal information with a criteria-free approach.

A second issue when accounting for employees' experiences is that criteria applied to a maturity model can be a vulnerable approach to evaluate the implementation of asset management. Particularly, we found in literature that a maturity model would make the approach vulnerable to justify the criteria as ideal and an entire range of criteria incomparable across different contexts. From our empirical study we found that a criteria free evaluation can account for details that describe the background of generic statements triggered in a maturity model evaluation. This could be both beneficial to set criteria for a given context preceding a maturity model evaluation or to study the comparability of contexts succeeding an evaluation.

A final issue when accounting for employees' experiences is to consider that maturity models rely on evaluators' ambiguous assessments being a reflection of the truth. Empirically, we have seen how employees can become blinkered and believe that a certain way of solving problems or conducting work is the only way forward. Rumelt's tests enable us to account experiences as unique for an employee, an example and as response to one of the tests. This way we could deliver an employees' understanding of an example by looking at the moment of commentary and finding the similarity or difference of their understanding of a particular example with other colleagues. This way we hope to have provided a revealing new perspective to explore organisational challenges, which we have attempted to demonstrate on the specific context of an organisation assigned to implement asset management.

9 Limitations

Despite the benefits, the Rumelt's tests also have limitations. A first limitation is the shortcoming of generalisability when analysing data. Rumelt's tests draw out up close and personal examples of challenges. When an organisation wishes to follow-up on suggestions to improve their work, then Rumelt's test results are not enough and require more information on the extent that these examples amount to more generic challenges in the organisation. A second limitation is that Rumelt's tests require considerable amount of time and a large number of interviews. In order to evaluate the different organisational layers and units a considerable number of employees, connected with work relationships is needed. Therefore, a researcher or practitioner who considers using Rumelt's tests are advised to focus on a clear work relationships that are not covered by less costly and less-consuming methods, like maturity models. With a dedicated goal to explore or validate challenges, we believe Rumelt's tests can add significant value to other recently developed benchmarking techniques, like maturity models.

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Notes

- 1 Lead author of this paper, participated in the maturity model evaluation in 2011 at the same regional department as Rumelt's tests was conducted.
- 2 Maturity model included frequently applied levels, specifically: 1 = ad hoc, 2 = repeatable, 3 = standard, 4 = managed and 5 = optimal.
- 3 The maturity model evaluation was performed at the agency and contained seven criteria: information management, internal coordination, external coordination, market approach, risk management, processes and roles, and culture and leadership.