

# A Process for Evaluating the Prudence of Enterprise Architecture Debts

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**Abstract:** Enterprise architecture (EA) debt represents a situation involving the declining quality of an EA in return for gains in other aspects. It accumulates through the sub-optimal architecture decisions made by the projects contributing to the EA. To avoid the reckless accumulation of EA debt, the impact of an architectural decision on EA debt and its prudence needs evaluation. However, as the scope of an EA debt issue tends to cover a wide range of systems and stakeholders, there may be different views on its prudence depending on the evaluation context. Failing to consider all relevant contexts may lead to reckless estimates and justifications for the EA debt. The analysis of prudence and recklessness exists in related fields of study (e.g., technical debt and financial debt). However, research has yet to explore the way to apply these concepts in EA debt management practices. Therefore, this study proposes a process for evaluating the prudence of EA debts, which we developed based on current insights about prudence and recklessness in related fields of study. Furthermore, we discuss some open questions and propose future research directions in this context.

## 1 INTRODUCTION

Enterprise architecture (EA) offers comprehensive support for promoting business-IT alignment, yet coping with misalignment issues remains challenging. Common organizational problems, such as adverse behavior (e.g., poor communication and IT governance) and incautious trade-off decisions (e.g., reusing legacy systems to expedite project delivery), often lead to misalignment issues. If not managed, these issues may gradually slow or even stagnate further evolution of the EA. Thus, the concept of EA debt has been proposed (Hacks et al., 2019).

EA debt represents "the deviation of the currently present state of an enterprise from a hypothetical ideal state" (Hacks et al., 2019). On the one hand, EA debt leads to declining architectural qualities (e.g., higher complexity and lower maintainability) and tends to increase the cost or difficulty of future changes. On the other hand, taking on EA debt as a short-term solution can be deemed necessary to cope with tight constraints or to optimize return on IT investment. Therefore, before taking on EA debt, all relevant stakeholders should be well aware of the consequences and their responsibilities for it.

To ensure prudent decisions on EA debt, enterprise architects must first understand the factors and aspects of prudence and recklessness in this context. However, evaluating the prudence of EA debts can be challenging as stakeholders' views on prudence and recklessness may differ depending on the evaluation context. This issue often occurs in a complex organization where a spectrum of interests and contradictions exist among the stakeholders. Finding a consensus here is necessary to avoid taking on EA debt based on reckless estimates and justifications.

Thus, a process for collaboratively evaluating the prudence and recklessness of EA debt is needed. Although related studies exist in various debt-related contexts, e.g., technical debt (TD) and financial debt (FD), they only describe the basic understanding of prudence and recklessness without addressing ways to evaluate them in practice. More importantly, none has explored prudence and recklessness in the context of EA debt. Therefore, this study aims to gather insights about prudence and recklessness in related contexts to answer the following research question (RQ):

**RQ** How to evaluate the prudence of EA debts in a complex organization?

The remainder of this paper is structured as follows: Section 2 discusses related works on the characteristics of prudent and reckless debts. In section 3, we propose a process for evaluating the prudence of

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EA debts. Then, section 4 demonstrates the process using an illustrative problem scenario. Section 5 summarizes our interviews with EA researchers and practitioners about the process. Section 6 discusses the implications and threats to the validity of our result. Finally, section 7 concludes this paper and motivates future research directions in this context.

## 2 RELATED WORK

Our exploration into TD and FD studies identifies various characteristics of prudence and recklessness. A study introduced prudence and recklessness as two of the four classifiers in the TD quadrant: a concept that helps to decide whether taking on TD is a strategic move or not (Fowler, 2009). According to the TD quadrant, a debt is prudent when the "payoff is greater than the costs of paying it off" but reckless when it "results in crippling interest payments or a long period of paying down the principal." Meanwhile, other TD studies consider debt prudent when all possible consequences are well-understood before incurring the debt, including the positive, negative, short-term, and long-term consequences (Clair, 2016) (Codabux et al., 2017) (Sas and Avgeriou, 2019) (Silva et al., 2018) (Waltersdorfer et al., 2020) (Zalewski, 2017); all relevant stakeholders have deliberately consented to take on the debt (Sas and Avgeriou, 2019) (Silva et al., 2018) (Waltersdorfer et al., 2020); when feasible measures to repay the debt have been clarified (Brenner, 2019) (Silva et al., 2018); and when the underlying premises of the debt are valid as well as well-documented (Brenner, 2019) (Ernst et al., 2015).

Furthermore, some studies on FD defined several characteristics of prudence. These studies argue that debt is prudent when all relevant risks and expenditures to hedging against the debt have been assessed (Denton et al., 2003); when the premises underlying the debt and following conclusions are deemed valid before incurring the debt (Becha et al., 2020); and when all relevant stakeholders are well-informed about the debt's cost-benefit analysis (Wolf, 2013).

Despite all these insights about *what* prudence and recklessness are, little is known on *how* to evaluate them specifically for EA debts.

## 3 PROCESS FOR EVALUATING THE PRUDENCE OF EA DEBTS

Based on our exploration into related literature (as described in section 2), we developed a process that al-

lows various stakeholders to collaborate in continuously evaluating the prudence of EA debts, ensuring an up-to-date and comprehensive view in this context. As shown in figure 1, the prudence evaluation process (PEP) contains six interrelated sub-processes and detailed activities as described in the following.

As suggested in (Becha et al., 2020), (Brenner, 2019), and (Ernst et al., 2015), evaluating the prudence of debt requires an understanding of the underlying premises. Therefore, we propose that the PEP starts with the **Debt Context Analysis**, which focuses on identifying the various contexts, circumstances, and stakeholders to be considered in analyzing the EA debt. This sub-process starts with *identifying the debt contexts*: the organizational contexts in which the EA debt and its effects are present. A debt context can be as general as some organizational layers (e.g., business, application, security, infrastructure) or as specific as some organization entities (e.g., capabilities, applications, processes, standards). Some ways to identify the debt contexts include having discussions with the relevant domain experts and analyzing the available documentation (e.g., EA models). Once the debt contexts are known, this sub-process continues with *identifying the debt circumstances*: the organizational factors that support or oppose the need for the EA debt under analysis. A debt circumstance can be some specific organization rule, constraint, or requirement that turns the EA debt into an advantage or disadvantage for the organization. Next, based on the debt contexts and circumstances identified, the sub-process proceeds with *identifying the debt stakeholders*: the people whose understanding and cooperation are necessary for the further management of the EA debt under analysis. A debt stakeholder can be the person in charge of, e.g., the processes or applications within the scope of the debt contexts and circumstances. We argue that all these activities can help to put the EA debt into a broader perspective and thus allow for a more reasonable evaluation.

Furthermore, after identifying the debt stakeholders, it is necessary to ensure they are informed about all possible consequences of taking on the debt, as suggested in (Clair, 2016), (Codabux et al., 2017), (Sas and Avgeriou, 2019), (Silva et al., 2018), (Waltersdorfer et al., 2020), (Wolf, 2013), and (Zalewski, 2017). Therefore, following the Debt Context Analysis, we propose the **Collective Debt Assessment**, which focuses on preparing and conducting a collaborative debt assessment among all debt stakeholders. This sub-process starts with *communicating the debt* to its stakeholders. To effectively communicate the debt, it may be necessary to tailor the debt representations according to the debt stakeholders' spe-

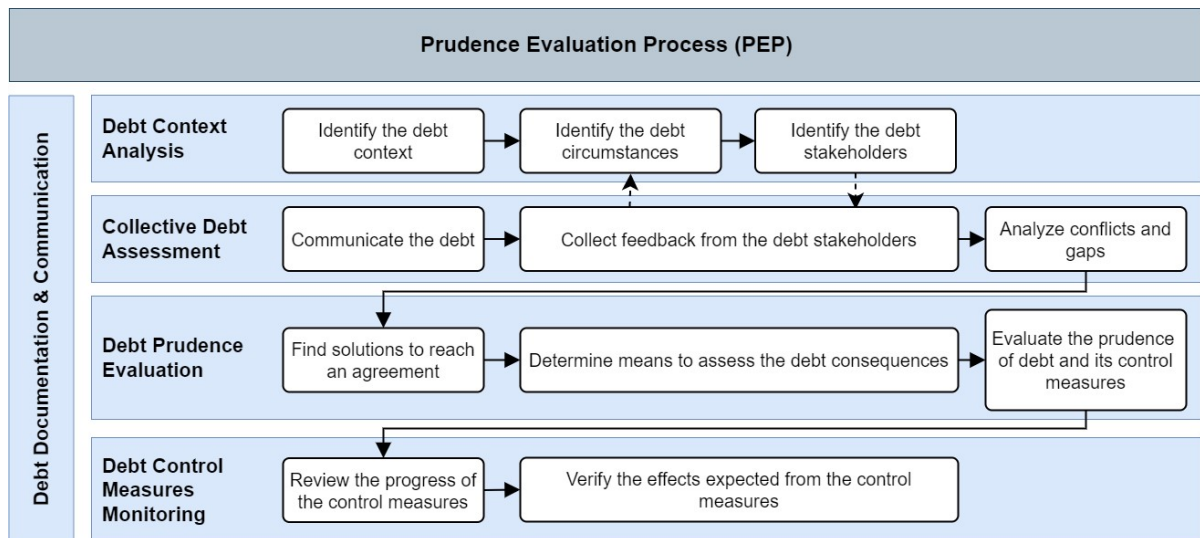


Figure 1: An overview of processes for evaluating the prudence of EA debts.

cific viewpoints (Maqsood et al., 2022). Next, to obtain a comprehensive view of the debt's consequences from all relevant perspectives, we propose to *collect feedback from the debt stakeholders*. During this activity, it is necessary that all kinds of consequences (e.g., financial, functional, strategic consequences) receive the debt stakeholders' attention, as suggested in (Denton et al., 2003). Thus, using approaches to elicit structured feedback (e.g., questionnaire, checklist) should be considered. Also, looking into the stakeholders' feedback may identify new debt contexts and circumstances that require further examination by other stakeholders. The identification of debt circumstances and stakeholders may thus repeat until the needed level of comprehensiveness is reached. Then, as there are often some contradictions and discrepancies among stakeholders, we propose to *analyze conflicts and gaps* within their feedback. Concretely, a conflict means a disagreement among the debt stakeholders, whereas a gap refers to the lack of shared awareness about the debt's consequences. The conflicts and gaps identified should then be discussed with the corresponding stakeholders to correct misunderstandings and improve the shared understanding.

Further, as suggested in (Brenner, 2019), (Sas and Avgeriou, 2019), (Silva et al., 2018), and (Waltersdorfer et al., 2020), it is necessary to ensure that the debt and its possible control measures are deliberately consented by all relevant stakeholders. Therefore, we propose the **Debt Prudence Evaluation**, which focuses on achieving consensus among the debt stakeholders about the prudence of the debt under analysis and the feasibility of its control measures. To achieve this objective, the debt stakeholders must first agree

on the debt's consequences. Thus, this sub-process starts with *finding solutions to reach an agreement* in the mid of conflicting interests, needs, or attitudes among the debt stakeholders. To support this activity, the use of conflict management strategies and the presence of a moderator may be necessary. As the moderator, we suggest choosing someone knowledgeable of the organization's methods, projects, and stakeholders. The next activity is to *determine means to assess the debt consequences*, namely the criteria and tools for evaluating the prudence of debt. When selecting the evaluation criteria, it is necessary to consider the organization's goals, principles, and general recommendations, e.g., considering debt as prudent when its "payoff is greater than the costs of paying it off" (Fowler, 2009). After the evaluation criteria are selected and accepted by the relevant stakeholders, we suggest determining the suitable metrics and tools for measuring them. Apart from the metrics specific to the organization, some key performance indicators of EA management (as proposed in (Matthes et al., 2012)) can also be used. Finally, this sub-process proceeds with *evaluating the prudence of debt and its control measures*, which focuses on measuring the debt's consequences and possible control measures using the criteria, metrics, and tools selected in the previous activity. Also, different weights and thresholds can be applied to the evaluation criteria to reflect the organization's priorities and tolerance on various aspects. Based on the determined values and trade-offs among the evaluation criteria, stakeholders can classify the debt as either prudent or reckless.

Classifying debt into prudent or reckless provides an outlook of the debt's future impact on the organi-

zation. This outlook will remain valid provided the debt and its circumstances are controlled as planned. Therefore, we propose the **Debt Control Measures Monitoring**, which focuses on continuously tracking the progress and results of planned debt control measures. This sub-process starts with *reviewing the progress of the control measures* to inform stakeholders about the current status, supporting factors, and inhibitors of the debt control measures. Here, collaboration management tools can help to ensure that all the responsible stakeholders deliver the needed contributions in time. Next, upon completing the debt control measures, we suggest *verifying the effects expected from the control measures* to confirm the costs and benefits of their implementation. As such effects may propagate through the dependencies among the affected systems or projects, analyzing these effects should take a broader perspective. Thus, the use of dependency analysis approaches can be helpful here.

Finally, cutting across the above sub-processes of PEP, the **Debt Documentation and Communication** sub-processes focus on ensuring up-to-date and meaningful documentation of all information involved in the PEP as well as facilitating the communication of it among the stakeholders. In this way, stakeholders are less likely to rely on "tribal memory," which often happens in enterprise-level management (Brenner, 2019) (Klinger et al., 2011). To achieve consistency in this context, one should consider using structured documentation and communication approaches (e.g., forms, reports, catalogs).

## 4 EXAMPLE

This section introduces a toy use case and presents the process of applying the proposed PEP to evaluate the prudence of EA debts contained in this use case.

### 4.1 Use Case

A company has been working on a core functionality project. Due to its complexity, the project grew to require many dependencies, making maintenance harder. Thus, the company decided to invest in reducing the project's TD through refactorings and enforcing updated architectural guidelines. The new architectural guidelines include, among others, avoiding further dependencies between newly developed functionalities and the non-refactored parts of the legacy solution. However, due to time and budget pressure, the company managed the refactoring only partially while still having to deliver the new functionality quickly. To cope with this situation, a stakeholder

proposed temporarily deviating from the guidelines and incurring EA debt by reusing some parts of the non-refactored systems for the new functionality.

The system under study consists of two sub-systems: Modern System and Legacy System. Modern System uses a popular language—it is easy to find programmers knowing it. However, Modern System is dependent on some functionalities of the Legacy System, which uses an old language—its programmers are rare and expensive. The whole system has three applications of interest (see Figure 2). Application A is already modernized and decoupled from the Legacy System. Application B is still a legacy application and depends on another, i.e., Application C.

The new functionality requires the introduction of Application D, which requires some functionalities of Application B. Going forward, there are two decision alternatives: The first is to deploy Application D on the Legacy System. The second is to deploy Application D on the Modern System and establish a cross-systems communication with Application B. These decision alternatives are subject to EA assessment.

### 4.2 Process

Due to various perspectives and needs, the EA managers decided to use PEP for their assessment. In the **Debt Context Analysis**, the EA managers identify the context of the debt. The company is currently working on modernization. The development budget for the legacy system was reduced after the decision to modernize it. Additionally, the number of experienced programmers for the legacy system has significantly diminished over the past few years, while the number of modern system programmers has increased. In the next step, the circumstances of the debt are analyzed. One of the circumstances is the guidelines requiring new functionality to be built independently of the legacy system. As they analyzed the documentation, they identified the debt stakeholders - a modernization team leader, a group of programmers working with the Modern System, a group of programmers working with the Legacy System, and finally, the requirements analyst, who was working with the client on the new functionality requirements. All findings are documented to support the further steps of the process.

All debt stakeholders are invited to discuss the two options, as per **Collective Debt Assessment**. The EA managers communicate their findings to the gathered stakeholders, inviting a discussion. Each of the invited stakeholders is asked to provide feedback. The feedback is documented during the discussion, and the relevant information is identified. For example,

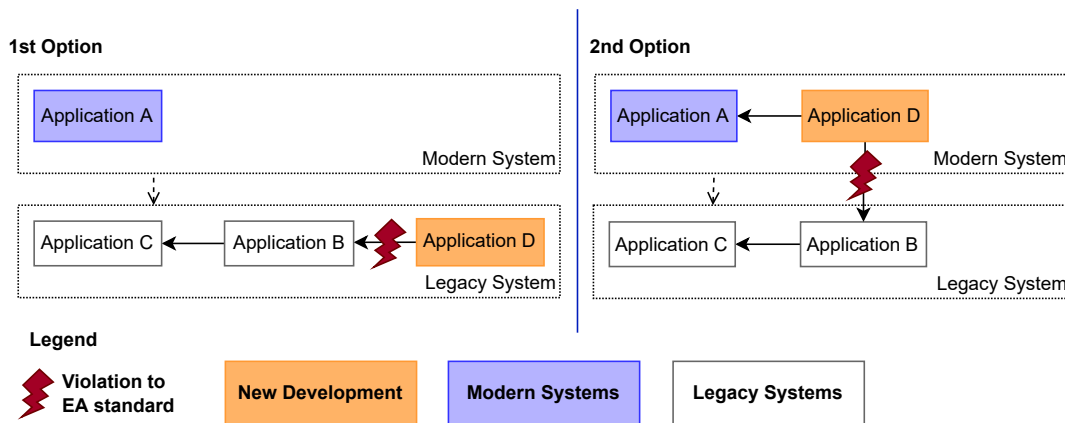


Figure 2: Example of evaluating the prudence of EA debt using the PEP process.

the need to deliver quickly is identified from the feedback of the client’s representative. Another requirement provided by the modernization team leader is that the modernization project is on a limited budget spread over a couple of years. From this, EA managers identify that modernizing Application B to deliver the new functionality on time is not feasible in the given time frame. The Legacy System programmers argue for the implementation involving the Legacy System. Due to their extensive system knowledge, this option would be delivered sooner, saving time and meeting the deadline. Due to their experience, it would also be a more reliable result. Upon this, the EA managers note that this violates the company guidelines and would eventually require the modernization of the new Application D. The Modern System programmers advocate development using the Modern System. They point out the guideline accordance and the integration of new functionality with the Modern System. They are confident in their programming skills but acknowledge lesser knowledge of Legacy System applications, including Application B, on which Application D would depend. They also identify that this option would cost more, as it would require the development of an interface to allow for the use of Application B. The legal representative provides information on the contractual penalty of crossing the time-to-deliver. Based on the stakeholder discussions, the EA managers identifies a conflict of time and cost versus guidelines. They also identify a communication gap between the two teams. This issue leads to another round of discussions.

After listening to all stakeholders and analyzing the conflict, the EA managers started the **Debt Prudence Evaluation**. They evaluate the two options on their cost and resulting benefit (see Table 1). The first option is considered according to the cost of disregarding the guidelines and modernizing in the fu-

Table 1: Costs and benefits analysis of the two options in the toy example.

	Option 1	Option 2
<b>Benefits</b>	faster delivery deadline met reliable	guideline accordance modern technology no modernization needed
<b>Costs</b>	violates guidelines needs additional work higher cost with time	lesser knowledge of Legacy System needs additional interface higher cost now might cross time-to-deliver

ture. Similarly, the second option is evaluated in its worst-case scenario, adding the penalty for crossing the time-to-deliver. Team leaders are expected to provide estimations of their respective solutions. The costs and gains of the two solutions are compared to evaluate the prudence of the debt. The first solution seems quicker and cheaper, but it does not follow the guidelines and introduces additional debt. The second solution follows the guidelines and promises fewer problems in the future, but it is more costly and less reliable. Given the comparison, the EA managers decide to suggest the first solution. However, to mitigate the incurred debt, they propose cooperation between the two teams to simplify future modernization. All proceedings are to be thoroughly documented. The findings of the PEP process are documented and presented to the board for final evaluation and decision.

After a while, the EA managers perform an audit and observe that the modern language programmers are more knowledgeable regarding the Legacy System thanks to the cooperation. All recommendations have been followed, and the documentation is kept up-to-date. This activity is performed as part of the **Debt Control Measures Monitoring**. The entirety of the process is documented for future reference and communicated to all involved stakeholders as part of **Debt Documentation and Communication** activities.

## 5 EVALUATION

The evaluation was planned and performed in the form of an expert interview. Before the interview, the invited participants obtained a short version of the presentation slides, introducing the topic. Three EA Debt experts participated in the evaluation of PEP.

### 5.1 Background

The first section of the interview was participant's background, based on three different aspects. The first aspect was the work performed. All participants have extensive experience in EA research. Two work as associate professor and professor at two different universities (neither being RWTH Aachen University). The third participant has industry background as a Lead Information Architect of a large company.

The second aspect was the participants' understanding of EA. Participants agreed that EA relates to a *holistic consideration of the organization, meant to align IT and business needs*. Additionally, the *use of EA models, structure and visualization* was deemed necessary to obtain an overview of the organization.

The third aspect was the consideration and understanding of prudence and recklessness. One participant related debt to a *gap between the holistic perspective and the reality* along with the *delta describing it*. In this understanding, prudence is *trying to reduce the gap*, while recklessness is *allowing the gap*. Another participant focused on *consciousness*. This would place prudence as *making an informed decision*, and recklessness being *not aware or not caring about doing wrong*. The third participant did not decide on the two concepts. They argued that prudence requires common understanding, which requires definitions, examples, and best practices.

### 5.2 Process

The second section focused on assessing the applicability of the proposed PEP. When discussing PEP and its contribution, the process was first introduced to the participants. Then each activity was examined separately to determine the correctness of PEP.

The evaluation of the process was split into two parts. The first focusing on usability, second on reliability of the process. First, questions about the use of prudence evaluation in decision making, the person responsible for the execution of PEP and its collaborativeness were asked. Afterwards, the interview moved towards activity-related questions as presented in Table 2. The final question was concerning the difficulties related to the application of the process.

Table 2: Activity-related process questions.

<b>Debt Context Analysis</b>
Which data/documents can be used to determine the context of a debt?
How can the stakeholders relevant to making a decision be identified?
<b>Debt Collective Assessment</b>
Can comprehensive concerns be determined from the gathering of the stakeholders?
How can it be verified if all relevant concerns were identified?
How to manage potential disagreements?
<b>Debt Prudence Evaluation</b>
Can comprehensive consequences be determined from the gathered concerns?
Given the consequences and based on the provided definition, can the prudence of the debt be determined?
<b>Re-evaluation step</b>
Would a re-evaluation require stakeholders involved previously or only those related to the concern, whose information got updated?
<b>Debt Documentation and Communication</b>
Who and how can document the activities performed?

## 6 DISCUSSION

In this chapter, we will first discuss the results of the evaluation and the contribution of this study, and finally consider the threats to validity of this study.

### 6.1 Evaluation Feedback

Through the expert interviews, we obtained various feedbacks as summarized in the following.

**On Facilitating Common Understanding:** The evaluation showed that although prudence can support decision-making, it needs to be more defined to allow for a shared understanding of prudence among involved stakeholders. PEP requires the context of the decision and the joint agreement of relevant stakeholders. The evaluation showed that the process can be collaborative, supporting expert integration.

**On Helping Identify Relevant Stakeholders:** The process needs to be supported by documentation—EA models were unanimously deemed relevant in the context determination. One problem might be missing documentation. Thus, it might be relevant to develop methods and tools for supporting the identification of context and relevant stakeholders. To achieve such methods and tools, the understanding of the company, relations among its stakeholders, and sources of relevant information is required.

**On Performing a Screening Test:** As it can be challenging to gather all inputs from the stakeholders (due to them being unavailable or simply human error), the process should be supported by a screening test to identify potential disagreements. Such test could show potential outcomes, allowing stakeholders to review the process for correctness. The disagreements could then be prioritized and solved with conflict management methods.

**On Assessing Accuracy Of Evaluation:** The determination of prudence depends on the accuracy of identified concerns and their consequences. The accuracy depends on the method used for evaluation and expected reliability of information. As such, support tools (e.g. correlations between concerns and their consequences) can increase process's reliability.

**On Performing The Re-Evaluation:** Given new or changed information, the iterative steps supporting re-evaluation need to be considered. The re-evaluation should involve as few participants as possible, e.g. a necessary core and a review group. The consideration could require some of the previously identified stakeholders to participate; however, it might also identify new ones. The usual workflow of the company would not be disturbed by each iteration of the process.

**On Keeping a Central Documentation:** All participants agreed that the most important aspect of the documentation is its type. Initially, a wiki is enough, but all in all it should be supported by a dedicated tool containing all necessary information, e.g. about the decisions and relevant stakeholders. The information would be stored centrally, allowing for easy access.

**On Using in Practice:** The process was deemed lightweight, allowing it to be used in practice. However, methods used, governance, and standardization need clarification, improving the ease of use.

## 6.2 Contribution

The contribution is twofold. One aspect is the contribution towards the research community. Another are the implications of this study for EA practitioners.

For researchers, the first benefit of this contribution is the consideration of prudence and recklessness in the context of EA Debts. During our work, we found no paper considering the two concepts in this context. This shows a need for further research on aspects affecting the decision making. Another benefit is that PEP aims to increase awareness of EA debt while also allowing to understand specific decisions' reasons, benefits, and risks.

For practitioners, the first benefit is the classification of EA debts into prudent and reckless based on various criteria, as discussed in Section 2. Such classification helps to reason the decisions made, leading to a better overall understanding and management of EA debt. Also, it helps to improve communication among various stakeholders. Another benefit is the support for ensuring a comprehensive understanding of EA debt consequences, which is necessary for prioritization in decision-making. Finally, the proposed process activities provide initial guidelines that can be

adapted according to the immediate needs of a specific enterprise, thereby allowing for a tailored prioritization of the debt based on the goals of the enterprise and the concerns of its stakeholders.

## 6.3 Threats to Validity

Validity was considered with the help of the definitions provided by (Wohlin, 2000).

The concept of internal validity discusses the trustworthiness of the relationship between the study and its results. Due to this, it requires an objective approach when assessing the data. One potential danger to internal validity is subjective assessment and classification. All results presented in this paper were consulted with an expert at each study stage. The results were also discussed and presented to further experts in the form of the performed evaluation. This ensures objectivity in the scientific proceedings. Another essential aspect when considering internal validity is how much the results represent the actual state of the art. To ensure this, the development process was based on the cited scientific works, which had to be reviewed before publication. This means the scientific fundament for this study was evaluated objectively, without the interference of the authors.

The concept of external validity considers the generalizability of presented results to other contexts. For the results to be replicable, we presented the entire procedure that underlies our results. Additionally, we restricted our process to the context of EA but not to other contexts. The presented process is a structure, requiring further work on more detailed aspects. As a result, this process can easily be adapted to other contexts. The measures mentioned in the **Debt Prudence Evaluation** step are to be selected and adapted by the specific project, allowing their application in various contexts. To further strengthen the external validity of our findings, we performed the evaluation not only with scientific researchers but also practitioners.

## 7 CONCLUSIONS

The concepts of prudence and recklessness have been used in TD and FD literature to differentiate good decisions from bad ones. However, the process of evaluating them in the context of EA debt has yet to be defined. Therefore, this paper proposes a process for assessing the prudence and recklessness of EA decisions considering their consequences and root causes. Analysis of the most common causes might lead to discovering a bigger EA problem. Also, understanding the consequences allows stakeholders to realize

and select the most appropriate decision strategies. These supports are necessary for making timely and effective decisions.

This paper also intends to motivate further studies in this context. One possible research direction is to identify relevant decision-making contexts and ways to elicit stakeholders' perspectives on these contexts. However, finding all the contexts and stakeholders related to an EA debt can be intricate, especially when the EA landscape and management structure is large and complex. Therefore, future research should develop methods and tools to contextualize EA debts, collect and organize relevant information from various sources, and bridge communication among the relevant stakeholders. Following this, future research should focus on developing ways to use the information collected for meaningful assessments. Thus, we recommend investigating the relationship between the information pieces and existing debt-related key performance indicators (KPI) and viewpoint-based approaches to assessing EA debt. Finally, future research should develop practical ways to conclude the prudence or recklessness of an EA debt based on the assessments performed and to select appropriate control measures. Thus, we recommend exploring the applicability of existing decision analysis approaches and debt mitigation strategies to determine, e.g., when to mitigate risks and reject the decision.

The second research direction is to evaluate the proposed process in practice. As our evaluation result suggests, many aspects have yet to be considered in the core design of the process, e.g., the financial and project management aspects when evaluating the prudence of EA debts. Thus, we recommend further validation and development of the process to make it more practical, concrete, and well-rounded for real-world industrial scenarios through, e.g., performing a series of workshops with various companies and dedicated experts. Such workshops can help identify the unclear but needed aspects of the process.

The third research direction would be to consider providing a tool to manage all the gathered information in one place. Such a tool should classify the information based on provided parameters and register the relations between various information pieces, helping to find needed information and make decisions.

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