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ENGINEERING CHANGE MANAGEMENT FROM THE VIEWPOINT OF CORPORATE REPUTATION

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Abstract
Engineering change management (ECM) decisions affect the corporate reputation (CR) either valuable or up to total destruction. This work investigates the gap between ECM and CR for decision making. This literature grounded study decomposes and synthesizes diverging aspects in both ECM and CR: focus, execution, participants, motivation, timing, process design, decision assessment, and decision options. Merging and comparison identified traditional understandings and combination requirements implying that CR-based ECM may control the intangibles. Further research is suggested.

Keywords: engineering change, corporate reputation, project management, design strategy

1. Introduction
Changes are expected to occur from the product development start until the product's end of life. Circumstantially, the changes should positively affect the product development and its market acceptance. Nevertheless, some changes raise bad attention due to bad engineering change decisions, and thus the image and reputation of the company that produces and sells the product.
The global recall list (OECD, 2017) counts hundreds of faulty designed products that reach the market periodically, and which at some extend might negatively affect the company's corporate reputation (CR). Under certain circumstances, the products are forced for recall (Hertzberg, 2005). Despite crisis communication strategies to mitigate the CR consequences, product harm events (van Heerde et al., 2007; Chen et al., 2009) can cause the company's downfall by decreasing competitiveness (Gatzert, 2015), or the company does not survive the crisis because it cannot regain its confidence quickly enough (Zhao et al., 2011). The consequences to the CR also guide a psychological halo effect, for which customers are willing to pay surcharges, lenders are willing to lower interest rates, and good employees work at more favorable terms, which add value, so it is important to maintain a good CR (Fombrun, 1996).
The CR is certainly not influenced solely by the effects of faulty designs. The CR literature states that aspects such as attractiveness, social behavior, efficiency and quality are forming factors of CR (Schwaiger, 2004). This means that all the company's activities are somehow relevant for the CR perception (Fombrun, 1996). While the CR literature is mainly concerned to CR creation, assessing and issues mitigation (Gatzert, 2015), the global recall list (OECD, 2017) shows that product design and decisions taken today, might later impact the CR. One particular type of decision are the engineering changes, which are usually controlled and decided by the engineering Change Management (ECM) (Boeing, 2013).
ECM also encompasses change control and decision making questions for defining the changeability of the product early in the design phase to evaluate their impact and make them more easily and quickly to realize (Mihm et al., 2003; Pektaş and Pultar, 2006; Giffin et al., 2009; Koh et al., 2013). In addition, it

is concerned with cooperation within the company as well as with suppliers (Terwiesch et al., 2002; Wagner, 2012; Leuschner et al., 2013). Other topics from ECM include knowledge management (Lee et al., 2006; Chen et al., 2008) and IT support (Cho and Eppinger, 2005; Wang and Che, 2007; Steffens et al., 2007; Sosa et al., 2013; Schoenherr et al., 2015).

Yet, neither the ECM nor the CR literature provide clear guidance on how to make ECM decisions while explicitly taking into account CR. This work aims at investigating this gap, by identifying discrepancies and misalignments between CR management and ECM, and proposing a preliminary integration approach, which can be used as the basis for further research in corporate reputation-based engineering change management. This is examined by an unusual approach in ECM and CR literatures were the authors analyse the literature applying a grounded theory approach on the level of definitions where they are used as data. Definitions normally should purposeful coordinate subordinate activities of a research subject were this approach contributes to the literature in several ways. The literature will be enriched with aggregated views of the traditional understandings of the subjects ECM and CR individually. Furthermore, it opens research directions and improvement potentials for ECM from a CR respectively a branding perspective. The embodiment and the details for ECM-behavior, -collaboration, -decision-making, -processes, -methods, knowledge management and - (IT-) tools will be left to further studies and are outside of the scope of this work.

This paper is organized into 6 sections. Section 2 explains the methodology used. Section 3 presents the results from a grounded theory analysis to the data of a literature review, with its decomposed aspects of individual diverging definitions created over time. Section 4 presents then integrated traditional understandings of CR and ECM side by side and highlights some challenges to combine them. Section 4 also suggests adjustment potential for research that could be approaches to improve ECM from the viewpoint of CR. Section 5 summarizes and integrates then all those observations to a, based on the gathered and aggregated information, subsequent and potentially guiding definition for a CR based ECM. Finally, Section 6 closes the paper with the authors' conclusion, contributions and limitations as well as ideas for future research.

2. Method

In order to uncover the CR-ECM discrepancies and propose a CR-based ECM the authors choose a multi-step approach. Essentially, (1) a systematic literature search was carried out, (2) a grounded theory procedure (Corbin and Strauss, 2008) was applied to the results of the literature search, and (3) the best explanation approach (Lipton, 2004) was used for summarizing and consensus of the current view of the sources. This procedure was both applied to the ECM and the CR literature. In sequence, these steps are described in more detail.

While in the initial analysis of the articles we identified a literature stream in CR which statistically substantiates the factor-based definition (Sarstedt et al., 2013) of the CR, no such promising literature stream was found in the ECM, which led us to two different approaches for reducing the hits counts.

For the relevant literature identification the chosen database was the Google Scholar™. This choice is identified by availability, article coverage rate of 90% in the field of engineering (Meier and Conkling, 2008), and the possibility of citation ranking in order to select high quality articles. The initial search using the terms "Engineering Change" and "Corporate Reputation", considering the period between 1940 and 2016, resulted in 32.990 and 21.601 hits for CR and ECM, respectively.

To reduce the ECM hit counts the authors decide to focus on peer reviewed journal articles despite the criticism of (Armstrong, 1997) and ignore conference contributions, books and other sources from quality considerations. The considered journals were only those with minimum Q2 (Scale Q1-Q4; Best Q1) in the past 5 years, according to the 'SJR Journal Ranking'. After, this process we identified articles which capture the ECM baseline content. After reading the selected starting literature, we followed the citations from these articles to capture the boundaries of ECM research. (for the full list of the analysed literature - N=87 - see Web Appendix C page ECM, at https://osf.io/gruh5). For further processing, we selected the articles which contained definitions about the ECM (N=14); the cited authors were selected because they provided evaluable statements (Table 1).

For CR literature the authors identified the literature stream of CR measurement as relevant, following the citations which ended up by 21 sources to be considered (for the full list of the criterion based literature selection, see Web Appendix C page CR, at https://osf.io/gruh5). The authors selected then articles which contained definitions about the CR (N=7); the cited authors were selected because they provided evaluable statements (Table 1).

After the literature selection the method grounded theory (Corbin and Strauss, 2008) was used to identify similarities and differences through the coding process described there. The grounded theory is a comparison approach results in codes used to compare aspects of the found definitions. As coding technique to synthesizing diverging observations of authors we used the best explanation approach (Lipton, 2004), once it allows higher level descriptions and thus using every source as a valid observation. The coding procedure was carried out within the definitions of the individual literary streams. In the context of this study we refer the codes to as aspects of the definitions (Table 1, 2 and 4, left column), since it highlights the parts from the definitions which are considered to be related. One found aspect was then searched for in the definition of the other literary stream definition, which led to the development of the comparable aspects reproduced in the results (Table 1 and 2) (for the full list of definitions selected and the by grounded theory decomposed aspects, see Web Appendix A for CR and Web Appendix B for ECM at https://osf.io/gruh5/).

After this definition analysis, it remains unclear how ECM or CR process discrepancies, what benefits are targeted, and what the decisions yield, which the authors consider important to gain a traditional comparable definitional understanding of the current literary status. For this reason, the search for an aspect has been expanded to individual selected literature, whereby 3 further comparable aspects could be found (Table 2).

On the one hand, all aspects can then be contrasted and compared independently. On the other hand, from the aspects which constitute an aggregate of individual opinions, a general definitional understanding of the subareas can be aggregated (Table 3). From this analysis, the authors recognize incompatibilities between CR and ECM; challenges that would have to be overcome if ECM wanted to be optimized in terms of CR objectives. In this way, possible research directions can be proposed (Table 4).

3. Understanding aspects of engineering change management and corporate reputation

This section reveals several comparable aspects of the traditional understandings of CR and ECM.

The authors' decided to juxtapose both topics, coincide different sources diverge in their explanations and confuse ECM's and CR's traditional understandings. For this purpose definitions and circumstances were selected, decomposed in their common constituent's and synthesized to consent aspects to facilitate the comparability. Section 3.1 presents and compares the decomposed aspects of the ECM and CR definitions. Section 3.2 decomposes ECM and CR decision-making circumstances to support the definitional analysis from Section 3.1.

3.1. Comparing engineering change management and corporate reputation by definition

This section presents the decomposed common constituent's aspects from a selection of ECM and CR definitions and compares these to gain insights into the subjects understanding (Table 1), and to identify the challenges of aligning ECM and CR (for the full list of definitions selected and the by grounded theory decomposed aspects, see Web Appendix A for CR and Web Appendix B for ECM at https://osf.io/gruh5/). This approach was selected by the authors, since definitions function to explain and to deduce contents. As described in Section 2, a quality-based criteria was applied for selecting the relevant statements. Table 1 presents the final results of the focus, execution, participants, motivation and timing, which were decided as comparable from the decomposition analysis. The ECM differs from CR in each aspect which will be discussed as follows.

Table 1. ECM vs. CR by definition-decomposed aspects

Aspect	Engineering change management		Corporate reputation	
focus	engineering change to manage	Dale (1982), Wright (1997), Pikosz and Malmqvist (1998), Huang and Mak (1999), Terwiesch et al. (2002), Chen et al. (2002), Rouibah and Caskey (2003), Tavcar and Duhovnik (2006), Lee et al. (2006), Jarratt et al. (2011), Reddi and Moon (2013), Hamraz et al. (2015), Shivankar et al. (2015), Storbjerg et al. (2016)	CR is assigned to the organization to be evaluated and includes the behavior of each assigned individual	Fombrun (1996), Gray and Balmer (1998), Bromley (2000), Gotsi and Wilson (2001), Schwaiger (2004), Helm (2005), Dowling (2016)
execution	a modification of any size to at least one individual element belonging to a product necessary to proceed systematically		conscious or subconscious reflections of observations; those could be moderated from comparison to competitors and other opinion-building influences	
participants	supply chain stakeholders		sum of all directly or indirectly affected persons	
motivation	involved by any focus-relevant issue to achieve company's overall benefit		to build an opinion for the purpose of judgement	
timing	triggering an installed process; its duration is defined for the lifecycle		an undefined time at the moment of judgment	

ECM implements changes by focus on the product, whereas CR focuses on the behavior of the company. The examined definitions do not appear to exclude each other. Unconnected to further defining aspects and in detail, ECM only concentrates on the engineering change issue without controlling the behavior that ensures a good organization evaluation; vice versa, CR only ensures the behavior of avoiding consequences and excludes the ECM activities.

The execution of ECM and CR also differs in the details. ECM pays attention to any size changes from an entire design change to the smallest possible modifying iteration, whereas CR addresses the reflection of each stakeholder, which is moderated by exogenous factors and process opinions. The two management approaches are not mutually exclusive in this aspect but are disconnected with each other and consequently provide a potential for unwanted results because of unexpected reflections. Moreover, ECM considers it necessary to systematically perform the changes, so the CR conception defines no implementation type or regularity to ensure that the behavior of ECM individuals is reflected as expected. In addition, CR takes into account competitor performance, which is not reflected in ECM. Thus, this lack of interrelation causes missing systematic behavior control, missing competitor feedback and potential CR target deviations.

Moreover, the management concepts consider different parties. ECM considers the procedural participants, which are defined as over-the-supply-chain stakeholders, giving the impression that ECM only considers the change implementation relevant. However, CR involves all potential affected parties to maintain the overall stakeholder relations. Thus, from the CR perspective, ECM can ignore important affected groups in its decision making or underestimate their needs. Meanwhile, from the CR definition, the groups to involve are not clear defined. These unaligned participant groups carry the potential for wrong decisions and target conflicts from a CR viewpoint if not all affected people are involved during the decision-making procedure.

Furthermore, there is a difference in motivation. ECM triggers through a modification constraint and aims to contribute, not further specified, to the company's overall benefit. Conversely, the CR motivation generates opinions. This consideration is not excluded through the ECM's motivation, but it

is not directly recognizable that ECM creates opinions or that the opinion formation can be a business advantage. There is also a lack of priority setting because the smallest trifle can cause a tremendous CR loss. Generally, the ECM definition lacks a certain amount of CR care.
The last defining aspect is the temporal understanding in ECM, which deviates from CR. ECM appears to end and diverge from CR understanding. ECM is triggered after it recognizes a strategy deviation in the product lifecycle, but it takes no further action after process completion. Thus, ECM is a reactive management approach without continuous improvements. Meanwhile, CR expects a permanent external assessment without knowing the certain moment of judgment that results from the internal company's behavior. This expectation requires CR to guide the ECM for each issue to proactively ensure that the evaluation is as expected. The strategy setting of both remains undefined.

3.2. Comparing engineering change management and corporate reputation by decision circumstance

After the definition analysis, it remains unclear how ECM or CR process discrepancies, what benefits are targeted, and what the decisions yield. This section decomposes aspects from an ECM and CR circumstance search selection; then, compares these aspects to derive a common understanding which supports the analysis performed in Section 3.1 using the same approach to obtain insights to understand each subject and the challenges of aligning them.
Table 2 presents the decomposed aspects: process design, decision assessment and decision options, which were decided to be comparable and answering the open issues of this section. The methods used are described in Section 2; the cited author selection followed a focused research. The syntheses show that the presented in ECM differ from those in CR.

Table 2. ECM vs. CR by circumstance-decomposed aspects

Aspect	Engineering Change Management		Corporate Reputation	
process design	Strategy discrepancy → assessment of solution and impacts→ solved or rejected problem	Maull et al. (1992), Jarratt et al. (2011), Kaloyanova and Mitreva (2012)	CR strategy → stakeholder observations and judgments → feedback loop incl. adjustments	Rindova and Fombrun (1999), Bromley (2000)
decision assessment	*High:* impact on project costs *Medium:* impact on project revenue *Low:* impact on project follow up risks, impact on brand image, impact on project leadership position, priority immediate impact customer safety/defect, priority mandatory, impact on project undefined, priority convenience, impact product improvement	Diprima (1982), Barzizza et al. (2001), Steffens et al. (2007), Kaloyanova and Mitreva (2012)	economic performance, qualitative performance, social performance, attractiveness performance	Hutton (1986), Fombrun (1996), Gray and Balmer (1998), Bromley (2000), Gotsi and Wilson (2001), Schwaiger (2004), Helm (2005), Walsh and Beatty (2007), Fombrun et al. (2015), Dowling (2016)
decision options	precede, revise or reject	Maull et al. (1992), Jarratt et al. (2011)	adjustment	Rindova and Fombrun (1999), Bromley (2000)

The processes in both ECM and CR rely on strategic inputs. In contrast, they differ in conception. The ECM process is built similar to a one-way road with resolved or rejected problems as a result. In contrast, CR is organized as a loop, where turning introduces corrections. Furthermore, the ECM process requires strategic discrepancies to be triggered, whereas the CR process executes strategical loops and permanently adjusts based on corporate identity and corporate communication measures. A corporate identity discrepancy can cause CR adjustments, which requests/triggers the ECM process with an engineering change request to the product, but the ECM process can reject it without CR gaining knowledge of risks. In addition, the strategy interpretation is a potential for faults. Their connection is not shown; therefore, this process set up prioritizes the ECM process for the final result; the consequences are not CR-risk-controlled and can negatively affect the CR targets.

The decision assessment in ECM is also not explicitly adjusted to CR, but they do either not exclude each other. The decisions in the ECM assessment traditionally affect the project costs, project revenue, leadership position, and follow-up risks. Some of these are resolved and used as measurements, which do not contribute to this work (see sources Table 2; line decision assessment). However, according to the cited authors, the brand image and follow-up risks are less common as evaluation criteria, and there are no higher resolutions or hints to measure them. The average importance of the cited authors in decision assessment criteria are also specified in Table 2. The impact on project costs and project revenue are prevailing decision assessment criteria in ECM. In addition, ECM is in a position to prioritize decisions. For example, the priority for immediate execution of engineering changes is usually concerned with customer safety or defect issues. The additional assessment criteria, though, receive less importance according to the authors. Meanwhile, CR suggests measurable decision assessments in terms of economic performance, quality performance, attractive performance and social performance. In addition, assuming that there is no trade-off in the ECM process that complies with the decision's contribution to CR, a risk assessment appears to be less pronounced in the ECM, and the focus appears to be on the cost-benefit aspect. With the exception of customer safety or defects, there are degrees of freedom in the decision making for mandatory issues or convenience issues. In summary, adjustment to strategic CR targets and decision scales are missing in ECM and may cause CR harm.

The decision options also differ in both areas. ECM knows three possibilities to formulate decisions: the engineering change is supported and implemented, ordered for improvement revision, or rejected. Therefore, it remains unclear which alternatives will replace the rejected changes, what occurs to them, or whether effectiveness checks will be performed from the CR or ECM viewpoint. No insight can be found on how to revise or where an alternative selection is decided. Without the CR assessment, the ECM decisions are suboptimal estimations that hinder correct CR adjustments.

4. Traditional engineering change management, traditional corporate reputation and the challenges to align them

The literature review reveals several aspects of the traditional understandings of CR and ECM. In Sections 3.1 and 3.2, the authors broke down the ECM and CR definitions and circumstances.

This section raises several challenges that either EC or CR fails to address and derives the alignment potential from this. Furthermore, this section summarizes the literature review results to present how the authors understand CR or ECM.

Table 3 compares the individual aspects for ECM and CR and suggests improvement potentials for aligning ECM to CR towards a CR-based ECM.

The lack of alignment of CR and ECM can also be seen once again when compared in context.

Assuming that all cited authors' observations are correct and every observation must be derivable, the synthesized traditional understandings for CR and ECM are presented in Table 4.

Table 3. Challenges to align ECM with CR

Aspect	Challenges of aligning CR with ECM	CR-based ECM alignment potential
focus	ECM focuses on the engineering change to manage whereas CR is assigned to the organization to be evaluated and includes the behavior of each assigned individual	CR-based ECM could focuses on the engineering change to manage and the behavior of to the organization-assigned individual
execution	ECM executes a modification of any size to at least one individual element belonging to a product necessary to proceed systematically whereas CR manages conscious or subconscious reflections of observations; those could be moderated from comparison to competitors and other opinion-building influences	CR-based ECM could include a regularity for CR-based ECM decisions at each engineering change of any size
participants	ECM respects supply chain stakeholders whereas CR respects the sum of all directly or indirectly affected persons	CR-based ECM could respect all potentially affected stakeholders
motivation	ECM is involved by any focus-relevant issue to achieve company's overall benefit whereas CR is motivated to build an opinion for the purpose of judgement	CR-based ECM could be re-motivated to achieve an expected judgement
timing	ECM triggers an installed process; its duration is defined for the lifecycle whereas CR needs to be prepared for an undefined time at the moment of judgment	CR-based ECM could be redesigned to a proactive reliable issue evaluation
process design	ECM process design works by strategy discrepancy → assessment of solution and impacts→ solved or rejected problem whereas the CR process design works by strategy→ stakeholder observations and judgments→ feedback loop incl. adjustments	CR-based ECM could be triggered by strategy discrepancy → following an assessment of CR conform solution with which CR conform impacts lead to → CR weight decisions → stakeholder observations and judgments lead to → feedback loops incl. adjustments
decision assessment	ECM decision assessment criterions are mainly cost driven whereas CR targets are a weight of economic performance, qualitative performance, social performance and attractiveness performance	CR-based ECM would respect the economic, qualitative, social and attractiveness performance according to defined strategic target scales for stakeholders
decision options	ECM decisions allow to precede, revise or reject engineering changes whereas CR makes adjustment decisions	CR-based ECM decision options would only allow adjustment decisions without rejects

Table 4. Traditional understandings

	Engineering Change Management	Corporate Reputation
traditional understanding	ECM focuses on an engineering change to manage, which is a modification of any size to at least one individual element belonging to a product necessary to systematically proceed. ECM involves the in-supply-chain stakeholders, by any engineering change to achieve company's overall benefit by setting priorities through assessment of the change impact. ECM triggers an installed strategic influenced process, which results in issue acceptance or issue rejection, where its duration is defined for a product lifecycle.	CR is the result of an evaluation of the organization it is assigned to. It is concerned with the behavior of each assigned individual and manages consciously or subconsciously reflections of observations where the reflections could be moderated from comparison to competitors, and other opinion-forming influences; the sum of all directly or indirectly affected persons are motivated to create an opinion for the purpose of judgement about economic, qualitative, social, and attractiveness performances of the organization towards an undefined moment of judgment. CR is managed by adjustment loops.

The presented understandings do not exclude one another. However, these two management approaches are not ideally aligned (Table 3 and 4) and facilitate CR consequences in each analyzed aspect (focus, execution, participants, motivation, timing, process steps, decision assessment and decisions), which introduce challenges to align them (Table 3).

5. Summarizing engineering change management from the view of corporate reputation

Sections 3-4 identified aspects that ECM could do differently from the CR viewpoint. The results reveal a weak interrelation of the management concepts CR and ECM. In detail, several aspects (focus, execution, participants, motivation, timing, process design, decision assessment, decision options) and the resulting challenges were identified. This condition enables undesirable CR consequences caused by the traditional ECM. The Sections 3-4 uncovered some improvement potentials that could be improved to strengthen the interaction of CR and ECM solely on the basis of the definition of the individual literary streams. The authors therefore try a definition to better aligning CR and ECM, which could guide research in this area and to better control CR consequences during ECM. Therefore, the authors summarize a CR-based ECM using again the "best explanation" approach (Lipton, 2003) which results as follows:

Corporate reputation-based engineering change management focuses on managing CR-orientated behavior, including each organization-assigned individual. CR-based ECM decisions are executed based on consistent regulatory at each engineering change of any size and respect all potentially affected stakeholders. It is motivated to achieve an expected judgment of all stakeholders. A proactive reliable issue evaluation is always ensured. The process design ensures that the strategy discrepancy triggers a solution assessment that conforms to CR, and the recognized CR impacts lead to CR-weighted decisions. These decisions respect the economic, qualitative, social and attractiveness performance according to the defined strategic target scales for stakeholders and cause adjustments.

6. Conclusion and final remarks

Neither ECM nor CR literature provided a clear guidance on how to understand and aligning ECM and CR for decision making. This paper investigated this gap and provided direction for further research in corporate reputation-based engineering change management based on the analysis of their definitions. The authors discussed how ECM could be improved using the CR perspective. The fields of ECM and CR show good approaches and scientific background that address their separate understanding, process targets and control. The alignment of both areas promises product development that satisfy the stakeholders' demands. Therefore, wise decisions in ECM, which are made by respecting the CR-based ECM alignment potential, CR targets and CR consequences, can affect the product functionality, performance, and CR beneficiary. Resource misallocation, serious product harm crises, negative effects on public equity, and loss of human lives can be avoided, which are the first-order benefits. In the second order, the easier access to resources is facilitated by a good reputation. Thus, the released resources can be used for the company's well-being and common good, which further strengthens the reputation. The literature comparison reveals differences in several aspects on two important topics that must go hand in hand. The importance of cultivating CR is recognized and discussed by both literary streams. Nevertheless, the interrelation is still weakly examined. CR slowly creates values but can rapidly lose it; therefore, CR requires care and attention. Table 4 shows some misalignments that could cause reputational consequences. In recent research, no attempts have been made to develop methods, tools or process designs to systematically use CR consequence-based understanding in ECM.

Further research in CR-based ECM can be literature structuring, guidelines for strategy goal setting and alignment, appropriate project planning, process adaptation, controlling mechanisms, success measurement, decision-making assessment and priority guidelines, and involvement as well as priority setting in stakeholder groups with and without strategy deviations. The effects of alternative measures using strategy deviations are also of high interest. For design science researchers and project managers, there is the associated additional assessment expense and lead time problem to solve because the revealed discrepancies between CR and ECM seem to need more capacities for the proposed alignment and could cause time-delays in the implementation of changes.

These research suggestions are generally supported. Other researchers call for the creation of appropriate conditions in the corporate structure, which result in efficient CR controlling systems (Wiedmann et al., 2007; Shivankar et al., 2015). In addition, the proposed CR-based ECM construct in this work bridges topics such as branding (Burmann and Zeplin, 2005), a discussion of reconciliation and integration, a delimitation of corporate identity, corporate branding and CR (Abratt and Kleyn, 2012), project and risk management (Mustafa and Al-Bahar, 1991) and stakeholder value vs. shareholder value (Hillman and Keim, 2001).

To respond to limitations, the literature selection was made according to certain quality criteria regardless of the sources that might add information to the understanding. Furthermore, the desired understanding of CR-based ECM was designed using a "best explanation" approach based on grounded theory based findings in the literature, which makes it plausible. However, more investigation and statistical support are required to verify their truthfulness.

The approach of using literature as a basis to derive discrepancies in the written down and word-by-word analysis with a grounded theory method is on the one hand innovative and certainly well suited to making these discrepancies visible in our research documentation. On the other hand a substantiating with statistical methods is essential and not part of this work. Neither can this study give any indication of how well companies really have their change processes under control as measured by the development of reputation.

A key to be able to say which added value can be generated from the elimination of the discrepancies presented here is to establish measurability in the sense of CR measurement theory in order to be able to understand whether introduced changes on ECM can be effective. In any case, the authors find it worrying that a definitional deviation in decision-making between CR targets and ECM assessment has been found in literature, and that the focus of engineering product changes seems to be short-term profit maximization rather than long-term allowing taking expensive risks. The priority of the research should therefore clearly aim to increase the quality of decision-making in the company's CR sense also filling this literature gap.

Finally concluding, a better understanding of ECM from the viewpoint of CR may change the behavior in favor of all stakeholders. Furthermore, it may be highly valuable to seek further improvements in CR-based ECM and its decision making prior to research in the addressed research fields. Further investigations in ECM from the CR viewpoint will open more insights, which promise potential improvement in ECM. The presented understanding is useful for researchers who seek for advancing the field of ECM maybe using the suggested research directions.

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