You Can't Manage What You Can't Define: The Success of Blockchain Projects Beyond the Iron Triangle

Completed Research Paper

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Abstract

Companies across industries aim to disseminate blockchain through respective projects that evaluate, design, or implement use cases. However, due to its novelty and complexity, blockchain poses novel challenges in carrying out such projects. Companies use success criteria to constantly evaluate projects. Even though literature provides frameworks for the general evaluation of projects, no research yet investigated if success criteria fundamentally differ for blockchain projects due to the characteristics of the technology. Therefore, we assess success dimensions and criteria, deduced and evaluated from an in-depth interview study with blockchain experts from 12 different projects. We contribute to the theory on blockchain project management by introducing a new success dimension and specific success criteria for blockchain projects. Our findings help to elaborate the value of blockchain in companies and novel possibilities to evaluate respective projects. We provide additional insights by assessing their relative importance and discussing implications for theory and practice.

Keywords: Blockchain, Project Management, Project Success, Success Criteria

Introduction

Over the past decade, blockchain technology has attracted public attention and experienced substantial dissemination (Du et al. 2019). Blockchain technology is a subset of Distributed Ledger Technologies, which combine distributed networks with cryptographic algorithms to provide a retroactive immutable ledger across the participants (Chong et al. 2019). Due to its characteristics, blockchain technology can provide advantages in security, integrity, transparency, and transaction costs (Beck and Müller-Bloch 2017; Fridgen et al. 2018b). Thereby, blockchain technology has a potentially transformative impact on various industries (Chong et al. 2019; McLean 2016). Overall, blockchain advocates even saw it as the silver bullet for all current information-related issues (Beck et al. 2016). The research firm Gartner estimates the added business value of blockchain to increase to $3.1 trillion in 2030 (Furlonger and Valdes 2017). However, the corporate blockchain hype decelerated in the last years, shifting from an open experimentation phase towards developing productive systems. Thus, corporate agendas shift from understanding how blockchain works towards grasping how to use blockchains operatively in the respective company (Deloitte 2020).

Information Technology (IT) projects, particularly blockchain projects, help transform and grow businesses in the digital age (Miterev et al. 2017; Turner and Müller 2003). Through these projects, the adoption of blockchain by companies foremost means integrating the technology in the corporation. They do so by conducting blockchain projects with a defined time, budget, and scope (Chong et al. 2019). At the end of 2017, most blockchain applications were either in a strategic starting phase or at a proof of concept stage. In the last three years, many companies started to transfer their prototypes to pilot projects and further implementation efforts. As such, the importance of appropriate project management increases to ensure a successful project (Du et al. 2019).

In contrast to established technologies, the inherent characteristics of blockchain as a decentralized and emerging digital technology confront companies with management challenges, demanding a new way of handling respective projects (Fridgen et al. 2018b; Zavolokina et al. 2020). The frequent creation of blockchain consortia, hence inter-organizational initiatives to evaluate technical aspects as well as to develop standards for platforms, pose further challenges to companies (Zavolokina et al. 2020). Such challenges, which arise from inter-organizational cooperation (Guggenberger et al. 2020; Riemer et al. 2020), need to be addressed by appropriate project governance. Literature on blockchain project governance guides managerial actions through structured project management approaches (Holotiuk and Moormann 2018). Du et al. (2019) emphasize the need to clearly define the goals of a project to determine the appropriate management approach. To address this issue, organizations need to understand in which way and to what extent blockchain projects add value to their business. Therefore, Labazova (2019) suggested evaluation methods, which rely on sufficient success criteria.

While early project management literature proposes the iron triangle of project management, incorporating time, budget, and scope, as success criteria (Wit 1988), more recent literature suggests that these success criteria are insufficient to evaluate projects holistically (Atkinson 1999; McLeod et al. 2012; Shenhar et al. 2001). Especially for the high number of explorative blockchain projects, it is questionable whether established success criteria such as time, budget, and scope are applicable. Further, Shenhar et al. (2001) ascertain that the importance of the success criteria varies on the level of technological uncertainty. Nevertheless, no framework elaborates on the difference which arises from the distinction between intra- and inter-organizational projects. Since blockchain is a relatively new and complex technology (Chong et al. 2019), we posit that the holistic evaluation of blockchain projects demands success criteria beyond the iron triangle. However, to the best of our knowledge, no research yet addresses the question of which criteria are appropriate to measure success in blockchain projects. To fill this gap in research, we define the following research questions:

RQ1: Which success criteria can be used for the evaluation of blockchain projects?

RQ2: How do success criteria differ in their relative importance?

We address these research questions by following an interview study approach. For our study, we conducted interviews with project managers, IT consultants, and Chief Technology Officers (CTOs) from 12 blockchain projects in Germany and Switzerland. We used a multi-layer coding process to identify relevant success criteria and dimensions from our data. Using an established framework for project success criteria (Shenhar and Dvir 2007), we propose a new framework of specific success criteria for blockchain projects. Next, we evaluate those criteria based on their relative importance to gain further insights into how they are used in practice. Thereby, we want to identify specific criteria for blockchain projects to help project managers to guide decisions. Further, we want to provide a starting point for academia to gather further insights on how blockchain projects are carried out.

The remainder of this study is structured as follows: in our foundations, we highlight the characteristics of blockchain technology and the importance of success criteria and dimensions for project management. Next, we introduce our method. Here, we explain how we collected and analyzed our data. Following, we present our results. We demonstrate the success criteria we found during our study and classify them into individual success dimensions. Afterward, we provide a detailed examination, quantitative evaluation, and classification of all project success dimensions. Subsequently, we discuss those findings for their theoretical contribution as well as managerial implications. Finally, we outline the limitations of our work as well as future research opportunities and provide a conclusion to our study.

Novel Challenges for Project Management of Blockchain Technology

Blockchain emerged as the underlying technology of the cryptocurrency Bitcoin in 2009 (Nakamoto 2008) and can be described as a cryptographically secured distributed ledger technology governed through a consensus mechanism (Beck et al. 2016). Using a decentralized ledger, it captures and stores transactions in an immutable, chronological, and transparent log among all its actors on a distributed peer-to-peer network (Chong et al. 2019). A blockchain is distributed between all its users on a network of computers, called nodes. All nodes have an identical copy of the ledger, consisting of a chronological sequence of a growing number of data blocks (Nærland et al. 2017). Blocks are cryptographically linked together with a hash function. This structure ensures the rejection of altered data once validated by the decentralized nodes, creating a blockchain with a high level of retroactive immutability (Nærland et al. 2017). Further, blockchains can also incorporate smart contracts, which are computer protocols executing the terms of contracts. They provide the possibility of receiving transactions or verifying conditions that enable applications, such as automated payment execution, transfer of ownership, or compensation mechanisms (Fridgen et al. 2018b).

Numerous possible application areas are evaluated for blockchain use, e.g., transforming supply chains, the energy market, and the public sector (Beck et al. 2016; Fridgen et al. 2018b). Blockchain advocates perceive blockchain as a technology with a disruptive force, forming new business models (Chong et al. 2019). The financial sector and many other industries recognized its potential to radically change established markets (Chong et al. 2019) and started various projects to implement and evaluate blockchain-based solutions. Despite its potential, blockchain still includes several technological and organizational challenges that aggravate respective projects (Chong et al. 2019; Rieger et al. 2019).

Blockchain challenges organizational capabilities. Knowledge about the technology, assessing its value, and detecting associated risks, is critical (Akoka and Comyn-Wattiau 2017). Project managers monitor and determine if present knowledge resources are sufficient. Missing knowledge has to be built up, bought in, or obtained through cooperation with key stakeholders (Wheatley and Wilemon 1999). Parties involved need to lower their boundaries to exchange knowledge with each other (Beck and Müller-Bloch 2017). These options differ in taken time, costs, and possible know-how drainage. Collaboration with external stakeholders is one opportunity for companies to engage with those associated challenges (West and Bogers 2017). More particularly, many blockchain use cases essentially require intensive cooperation between different companies. However, the management of different external stakeholders with distinct agendas and expectations again poses another challenge for managing blockchain projects (Beck and Müller-Bloch 2017).

Even though IT projects have been characterized by uncertainty and ambiguity before (Jørgensen 2016), missing experience and lack of knowledge regarding blockchain technology increase the importance of these aspects (Chong et al. 2019). Those attributes negatively influence the degree of predictability and control in projects, posing a challenge to managers. Hence, when planning such projects, clearly defined goals and clear termination conditions increase the manageability of a project (Wheatley and Wilemon 1999). However, the ex-ante planning of projects with many uncertainties poses a major challenge to companies. Uncertainties can lead to long and unpredictable developments in blockchain projects.

Furthermore, even with pre-determined goals, it remains a problem for companies to evaluate whether success has occurred ex-post (Zwikael and Meredith 2019).

To ensure effective cooperation, all stakeholders must agree on clear and common goals. These goals are ultimately the common vision towards which all parties involved should work. Nevertheless, given its novelty, defining such goals and eventually measure the success of blockchain projects is regarded as a major challenge for project managers (Du et al. 2019).

How to Define a Successful Project?

Even though literature studied project success comprehensively (Ika 2009; Pinto and Slevin 1988), neither consensus on what success means nor a standardized framework to explain the success of projects exists (Shenhar and Holzmann 2017). The same applies to the conformity of measuring IT project success (Thomas and Fernández 2008). Two of the most important streams in the field of project management research deal with *success factors* and *success criteria*. *Success factors* refer to settings, conditions, and events contributing to project outcomes (Ika 2009). Through success factors, project managers can increase the chances of positive project results (Turner and Müller 2003). In contrast, *success criteria* refer to a set of targets and principles that determine and assess if a project is successful (Ika 2009). Therefore, success criteria help measure and judge the success of projects (Turner and Müller 2003). As we aim to better understand what defines a successful blockchain project, we will focus on success criteria, building a foundation also for research beyond this research stream.

Research agrees on meeting stakeholders' expectations as the essential part of delivering a successful project (Davis 2014; Wit 1988). Project success can be seen as a multi-dimensional construct, recognizing different perceptions in the evaluation from different stakeholders at different times (Shenhar et al. 1997). In the literature, many approaches exist to make project success more tangible by finding the right criteria and constructs (Ika 2009; McLeod et al. 2012). The iron triangle of cost, time, and scope is still used as a foundation for later constructs (McLeod et al. 2012). While the measurement of project management success still focuses on more of these traditional targets, holistic evaluation of project success includes overall objectives of projects (Shenhar et al. 2001). Projects can be successful, even with poor project management performance (Wit 1988). Similarly, projects meeting targets of time, budget, being executed as planned, and reaching planned performance targets, may still be unsuccessful by failing to produce real benefit for organizations or customers (Dvir et al. 2003). Project management efficiency is just one dimension of project success, though not holistically evaluating overall project success (Basten et al. 2011). This drawback has also been demonstrated for IT projects (Ojiako et al. 2005; Trisnawaty et al. 2021). As a result, project evaluation models now include long-term success criteria such as further consideration of project outcomes or new skills and capabilities through team learning and growth (DeLone and McLean 2003; Trisnawaty et al. 2021).

One of the key project success evaluation models (Zwikael and Meredith 2019), summarizing and classifying success criteria, is the multi-dimensional strategic concept of Shenhar et al. (2001). The model proposes four main dimensions of project success: *Efficiency, Impact on customer, Impact on team, Business and direct success*. In a later publication, Shenhar and Dvir (2007) proposed an advancement by adding *Preparation for future* as another dimension. The authors build their framework based on data from intra-organizational projects dealing with complex and new technologies (Shenhar and Dvir 2007). As such, we see a good fit for our study and use the work on intra-organizational projects as a foundation for success dimensions and criteria in blockchain projects, which by design have an inter-organizational focus. Further, the applicability of the framework to explain the success of IT-related projects has been demonstrated in prior studies (Jinasena et al. 2020). We elaborate on the five dimensions of the framework from Shenhar and Dvir (2007) in the following.

Traditionally, the measurement of project success is based on adherence to planning (Shenhar et al. 2001). The *Efficiency* dimension, containing time and budget, plays a major role in IT projects (Collins and Baccarini 2004; Thomas and Fernández 2008). Cost and time are simple to measure and can be evaluated easily.

Shenhar et al. (2001) assigned scope to the second dimension, *Impact on customer*, thus completing the iron triangle, which still serves as the basis for evaluating success in most projects. However, research suggests that other success criteria increase in importance (McLeod et al. 2012). Foremost, the end product of an IT project that works as expected, i.e., solves problems, brings satisfied users, high reliability, and improved efficiency are some of the most important success criteria (Karlsen et al. 2005). In addition to the broadening view of the scope and its expansion in the customer perspective, the scientific community pointed out the potential high impact of other criteria (Atkinson 1999; Wateridge 1998). Literature shows the relevance of the dimension *Impact on team*, assigning a team's appreciation of a project and the satisfaction of their needs as success criteria (Wateridge 1998). This topic is strongly linked to organizational learning. A software development team can perceive the success of projects very differently, and the evaluation of success can focus strongly on learning and improving their skills (Linberg 1999).

The *Business and direct success* dimension distinguishes between short-term project evaluation based on triple constraints and long-term project evaluation to achieve financial metrics. Even projects classified as failures due to missed objectives in terms of time, budget, and scope can result in successful business objectives (Wit 1988). Consequently, it leads to the counter-intuitive statement that the efficiency of project management and the success of project results are not sufficient to explain project success alone (Bannerman and Thorogood 2012). Thus, the sections concerning profitability and commercial success of projects are relevant for the project's success criteria (Wateridge 1998). IT projects have to cope with fast-changing regulations and uncertainty due to not yet created legal frameworks, e.g., in the legal consideration of digital assets. Therefore, regulatory compliance forms an important success criterion for blockchain projects (Chong et al. 2019). It may not be easy to evaluate projects for the last dimension *Preparation for future*. Nevertheless, this category secures a company's long-term existence, and therefore success criteria of this dimension must find consideration in projects (Shenhar and Dvir 2007). Evaluating the success of a company's projects needs criteria that consider long-term benefits, such as effects on business and strategic benefits (McLeod et al. 2012).

Shenhar et al. (2001) highlight that their generic project success framework might not incorporate all relevant success dimensions and criteria. Further, some aspects might evolve for specific types of projects. Since blockchain technology incorporates specific characteristics, e.g., decentralization and retroactive immutability, other success dimensions and criteria might exist.

Method

We applied an interview study approach to inductively examine success criteria, their dimensions, and project management in blockchain software development projects. Considering the complexity of those projects, we attempt to improve the understanding and future approach of project evaluation and success criteria. We chose a qualitative interview study to gather in-depth information to identify variables, dimensions, clusters, and possible interconnections in a new, complex area (Miles and Huberman 1994). We deduced a range of success dimensions and their comprising criteria from 12 semi-structured interviews with blockchain experts. Table 1 illustrates our research approach, which we elucidate in the following. Further, we used blockchain and project management literature to triangulate our conceptualization of blockchain success factors (Flick et al. 2004).

Data Collection

We conducted semi-structured interviews to gain a comprehensive understanding of blockchain projects and their success criteria (Myers and Newman 2007). Thereby, we gathered an expert sample by approaching multiple companies that deal with blockchain technology. We built the interview guide based on open-ended questions. This approach should encourage interviewees to talk freely and generate unexpected insights (Bhattacherjee 2012; Myers and Newman 2007). In total, we interviewed specialists from 12 blockchain projects (see Table 2) with key knowledge based on either the number of projects participated or a leadership role in the project (Bhattacherjee 2012).

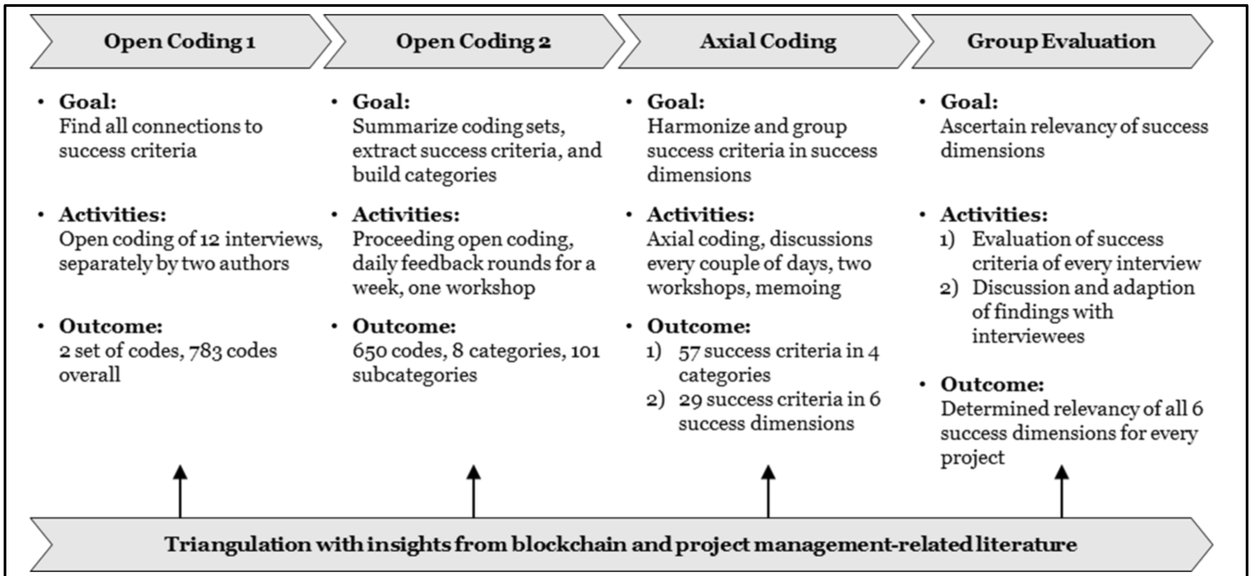

Figure 1. Research Approach

In the interviews, we focused on the interviewees' backgrounds and information about their respective blockchain project. We initially asked about the motivation for the project to compare it with the individual objectives and whether they differ or match. We then asked them to compare previous projects with blockchain projects on all asked questions. The main part involved questions about success evaluation and the respective performance indicators. We further asked questions concerning the project's governance, thus, questions about decision paths, responsibilities, as well as formal and informal influences on the project steering.

As mentioned above, we focused each interview on one particular project carried out with the interviewee's involvement. Nonetheless, we let them talk about their experience from other projects as well. The interviews took place from late November 2020 to early January 2021 and lasted between 29 and 60 minutes, resulting in a total of 508 minutes of recorded interviews. We carefully transcribed all interviews and eventually analyzed the data.

Project	Company Sector	Number of Employees	Job Title of Interviewee	Participated Blockchain Projects
P01	Legal	>100	Research Consultant	>5
P02	Public	>1,000	Research Consultant	>5
P03	Pharmaceuticals	>50,000	Innovation Leader	>10
P04	Finance	>1000	Innovation Leader, Architect	>5
P05	Automotive	>50,000	Research Consultant	>5
P06	Finance	>5,000	Project Leader, Architect	>5
P07	Construction	>100	Founder, Management	1
P08	Conglomerate	>50,000	Blockchain Mobility Leader	>10
P09	Public	>5,000	Research Consultant	>5
P010	Mobility	>50,000	Head of Blockchain	>10
P011	Finance	>5,000	Blockchain Leader	2
P012	Finance	>10,000	Senior Project Manager	>10

Table 1. Composition of the Interview Sample

Data Analysis

For our qualitative data analysis of the 176 pages of transcripts, we used the software tool ATLAS.ti. We used cycles of interview debriefings, discussion of newfound topics, comparison to previous interviews, and a final meetup to digest and reflect on all data before starting to code. We ensured the validity of the results throughout the research process by keeping the results independent of the observer (Corbin and Strauss 1990). Thereby, we always considered inter-coder reliability to ensure objectivity (Gwet 2014). The entire coding process took over four weeks, with three coding workshops.

Two authors started the coding process by applying open coding to create a set with 783 codes, which we then summarized in 650 codes due to duplicates. From those, we derived an initial set of eight categories and 101 subcategories. We then started with axial coding to define characteristics more precisely and find possible success dimensions of given categories and subcategories (Corbin and Strauss 1990). We used memoing to better reflect on data during the process and build a nascent understanding (Saldaña 2016). In the following iterative workshops, we improved our categorizations through reclassifying and renaming. Finally, we built a set of four success dimensions and 57 success criteria. Next, we compared our initial categorization with project management literature to triangulate our conceptualization (Flick et al. 2004). Henceforth, we transferred categories in success dimensions and allocated success criteria. Again, we reviewed our dimensions and criteria, which left us with six success dimensions and 29 success criteria.

Next, we conducted a further analysis of our findings. Two authors separately started to evaluate all success dimensions for each project. Thereby, we were able to rule out self-reporting biases and ensure intercoder reliability (Gwet 2014). Here, we used a five-point Likert scale to evaluate the relative importance of the dimension. We placed success dimensions that emerged but played the least significant role regarding setting goals for blockchain projects in category one. In contrast, we assigned the success dimension with the highest relevance in goal setting to category five. In the following, we contacted every interviewee again to separately let them evaluate all success criteria for their respective project to further investigate the relative importance of the success dimension. For this purpose, we send our framework and the description of the respective dimensions and their criteria to each interviewee to determine which success criteria seemed most relevant to them. Thereby, we received the evaluation for 8 projects by the respective interviewees. Next, the authors iteratively discussed their respective ratings and the evaluation of the interviewees within the author team. We examined discrepancies in detail and made adjustments when appropriate, also for projects where we did not receive a response. In cases of uncertainty, we checked again with some of the experts to clarify questions regarding the importance.

The final result was a numerical evaluation of the relevance of all success dimensions for each blockchain project from the individual interviews. Finally, we found that the individual projects differed greatly in their scope. Therefore, we classified them according to their project stage to better understand the relative importance of success dimensions in different blockchain projects.

Results

Identification of Success Dimensions

We structured the success criteria of blockchain projects into six success dimensions (see Figure 1, bold font represents new criteria). Five dimensions were derived from interviews and matched with the literature (Shenhar et al. 2001; Shenhar and Dvir 2007), as suggested by Jinasena et al. (2020). We added a new sixth success dimension, *Impact on environment*, to provide a fitting framework for all found success criteria. In the following, we explain the success criteria we discovered in the interviews, their importance, and the necessity of proposing the new dimension.

Efficiency

In the first project success dimension, *Efficiency*, we deduce the relevance of characteristic goals of time and cost in blockchain development projects.

Schedules are a relevant factor. For all analyzed projects, clear timelines were established. These range from three months to four years. When companies made the first contact with blockchain or a new field of application, they aimed for a short project duration, from which follow-up projects with a longer duration could emerge. However, while all projects set schedules for their project deliverables, the time frame was often adjustable to grant more freedom to project teams: *"At the end, project completion took half a month to a month longer"* (P02), and *"we realized that we needed another one or two weeks more"* (P01).

In the beginning, all projects had an assigned budget. For the smaller, shorter projects, contractors explicitly reported clear cost expectations. However, it was noticeable that the client decision-makers had an observable financial decision-making range. *"If the prototype needs it, we would have increased the budget. We had a certain corridor, which of course should not have been as much as 30, 40 percent more than planned"* (P01). Nevertheless, according to the interviewees, all projects remained within the defined budget. Even though blockchain technology remains complex, this can be explained through the limited scope and low interdependencies of many early-stage projects.

	Project success dimensions					
	Efficiency	Impact on customer	Impact on team	**Impact on environment**	Business and direct success	Preparation for future
Project success criteria	▪ Meeting Schedule ▪ Meeting budget ▪ Other efficiencies	▪ Meeting requirements and specifications ▪ Benefit to customer ▪ Brand name recognition ▪ Customer satisfaction and loyalty ▪ **Knowledge development** ▪ **Technology fit**	▪ **Knowledge building** ▪ Skill development ▪ Employee satisfaction	▪ **Blockchain community development** ▪ **Ecosystem development** ▪ **Business network growth** ▪ **Society empowerment** ▪ **Sustainability** ▪ **Knowledge diffusion**	▪ ROI ▪ Turnover ▪ Market share ▪ Regulatory approval	▪ New technology ▪ New market ▪ New product line ▪ New core competency ▪ New organizational capability ▪ **Cultural change** ▪ **Digitalization**

Highlighted: new dimensions and criteria in comparison to Shenhar and Dvir (2007, p. 28)

Figure 2. Blockchain Project Success Dimensions and Success Criteria

Impact on Customer

In the second success dimension, *Impact on customer,* the key customer could either be external or internal. Compared to Shenhar et al. (2007), we identified new success criteria in this dimension.

For companies, the initial question was, how exactly can blockchain be used to create added value for customers. Many projects had potential savings as clear goals predefined by internal customers. It was easier to approve projects based on a clear business case with such goals. Process improvements were a ubiquitous goal in all projects. In one project, the goal was to cut costs by saving resources. In most projects, it was a clear target to set up a new system to replace previous ones. Here, the technology presented an opportunity to solve previous problems of feasibility.

In our study, internal customers often focused on the external image of the project. In the early stages of blockchain projects, it was a major goal to position themselves in the field through strategic communication to the blockchain community and the public. *"We were driven for a while by the idea that when we have completed a use case, we should make a press release"* (P12). Some projects were able to create an enormous amount of attention and a positive reputation beyond their industry. Thus, one interviewee mentioned that some investments could have already paid off through the positive marketing effect of the project.

Strong internal and external customer involvement and collaboration also took place to fulfill one of the biggest criteria for successful projects, knowledge development. *"[…] in [our company] we want to have the knowledge as well, because otherwise how can you make sensible decisions? How can you manage something if you don't really have hands-on experience? […] we need internal people with the right knowledge"* (P03). Thus, a key requirement of internal customers was knowledge development within the company. When companies had the first contact with blockchain, they took different paths to achieve these goals. On the one hand, some interviewees worked in companies that could be defined as early adopters.

Thus, being the first companies dealing with blockchain in their industry. At that early time, neither external service providers nor consultants could help with this potential key technology. On the other hand, service providers and consultants play a major role in most observed projects. They contribute a large part to help with lack of knowledge. For many companies, it was very important to build up the knowledge for one project in the short term and retain it in the long term. Nevertheless, especially smaller companies and projects did not expect to build up the knowledge to be more independent in the future.

What customers generally wanted to find out in many projects was whether there was a technology fit for them and potential future usage. Therefore, in some projects, the primary goal was to identify and evaluate feasible applications for blockchain technology. This research character had a strong influence on the goals of the project. Such projects started with application ideas or soon found a use case. However, if it had become clear after a short project duration that they could not implement it in this way, those involved in the project had the feeling that it would not be seen as a failure. *"From the beginning, it was mentioned, [...] if we realize during the project [...] that it does not make sense, then that would have been in the sense of the client nonetheless"* (P01). *"And in the negative case, the outcome would have been a learning that it does not work for these certain reasons"* (P09). Although at least a proof of concept or a prototype was always an objective for the project, companies learned that the technology might not add any value at all. This learning effect was reflected in short initial project times to determine the technology fit during early stages. Thus, *"fail fast principles"* (P12) could help with potential risks of no direct benefits gained from the respective project. Because of the learning effects of possible usage in different company areas, respondents did not even talk about failure when they did not find a clear use case or not built any prototype. We describe this case as a positive failure.

Although previous points influence customer satisfaction, Shenhar and Dvir (2007) added this aspect as a separate success criterion. In our study, interviewees also explicitly emphasized customer satisfaction. Many of the project goals were set high, thus creating high expectations. However, a new technology certainly entails high risks for projects. Customer satisfaction can be difficult when not achieving identified goals. Therefore, the goal to ensure their satisfaction becomes even more important. Most companies used a high level of customer integration as an opportunity. Key customers were usually very much involved from the beginning, thereby building up an understanding of the technology. This early involvement enabled potential problems to be identified and addressed at an early stage. If these problems could not be solved, there was a higher chance that failure was rather connected with the uncertainties of new technology than the implementation process.

Impact on Team

In their projects, companies made active efforts to promote knowledge growth and skill development (Cheney et al. 1990). The goal was mostly not to find and recruit potential specialists. In contrast to already established technologies, the interviewees stated that blockchain required fundamentally new knowledge, e.g., in cryptography, distributed databases, and governance mechanisms. Hence, many companies wanted to retain knowledge in the long-term, building up their own employee's knowledge. *"[We] recognized that it is a topic that will remain in the long-term. [...] then I can't cover it with a permanent consultant"* (P05). Companies often used blockchain projects to gather experience with the technology by building knowledge and developing skills in their organization. Thereby, workshops and training were common practices, either internal or through external experts. One company highlighted that they offered their employees the opportunity to acquire certificates in this area.

Only in one project, an interviewee spoke about specific goals of employee satisfaction and morale. Employee satisfaction was very much emphasized and surveyed through qualitative questioning. If the whole team shows a high level of satisfaction, one project goal has been achieved. In all projects, interviewees reported a positive project atmosphere. With mentioned opportunities and freedom for employees, this leads to the conclusion that others pursued this goal as well.

Impact on Environment

Shenhar and Dvir (2007) developed a general success framework but emphasized that other relevant dimensions might exist. We realized during our interviews that all observed blockchain projects incorporated goals that were not targeted at one key customer but were much broader and diverse. They affect a wider range of stakeholders, have a major impact on collaboration, positively impact society. To address this fact in our findings, we added a new success dimension to the proposed model of Shenhar and Dvir (2007): *Impact on environment*.

"Early on, we realized that we do not really create value if we launch this internally [...]. The value creation comes from many others, so it is an ecosystem. If everyone is involved, the more, the better" (P03). That is why a common objective was to help grow the network beyond the company and key customers. Thereby, consortia are often used as an organizational structure to coordinate and collaborate in a network. Five of the examined projects were even active in multiple consortia for this purpose. Common objectives for consortia include the industry-agnostic advancement of the underlying technology and the dissemination of an industry standard. *"We are consciously saying you can map a few things well [with the project], but the goal first is to keep the consortium growing"* (P11). Thus, a clear goal was to strengthen consortia and see them grow. Knowledge again plays an important role here. To strengthen consortia, a strong exchange of knowledge took place. Companies helped each other to ensure knowledge diffusion in the consortium and the participating companies. Smaller, non-financial companies were not that active in consortia. Nevertheless, strong contact with other stakeholders, especially in their industry, was striking. They compensated for the lack of consortia knowledge by the high level of involvement of external service providers and the blockchain community.

Interviewees described the blockchain community as a young, growing group where many know each other. There is a strong exchange in this community, and people are involved in various projects. Companies saw enlarging and strengthening the community as a goal. Projects were also targeted on fields *"where I have a large community and everyone's expertise"* (P10). Some companies wanted to give something back to the community because their project directly or indirectly benefited from them. *"Because of the large investment, we discussed for a long time how to proceed with it"* (P06). However, the conclusion was that *"it is best if it is open source [...] and this was something completely new for [us]"* (P06). Companies actively contributed to open-source umbrella projects.

Two companies had the goal of making society more independent and just. *"And that is where a relatively new topic comes into play for us, perhaps making a counterpoint to the big high-tech companies that you do not need to be afraid of"* (P08). Thus, they saw projects as an opportunity to counteract previous, ubiquitous dependencies with a new decentralized system and ecosystem. They also focused on the opportunity to come closer to fundamental corporate goals, such as establishing fair market conditions, free of discrimination. Companies targeted the new possibilities of blockchain technology to get closer to their higher objectives. *"The immediate added value [...] [of some DLT projects] is in the socio-political context"* (P10). Many of the interviewed companies identified this area as an objective for this project and follow-up projects. Two companies included further sustainability goals. For instance, one project aimed to solve a persistent resource allocation problem to improve sustainable development goals. This company takes a stand for sustainability, and therefore sustainability was a priority in this project. For the second company, facilitation for the aging population and environment through resource mitigation played a role.

Business and Direct Success

Return-on-Invest (ROI), turnover, and market share were often stated as immediate business goals. In the case of large companies, interviewees pointed out that projects are much easier to finance and attain management support in the long-term if they are based on a clear business case with ROI and turnover goals. One company even demanded that their project finally needs to deliver a successful *"killer application"* (P03) that proves its profitability. Nevertheless, some projects had high degrees of independence, as they were designed as research and development undertakings. Thereby, ROI was only set at a later stage of the project.

Another important criterion in this dimension is regulatory approval. All projects considered regulation at some stage and in any way. For many projects, interviewees reported that finding out whether a blockchain can be implemented in an application compliant with current regulation was an important goal. In the beginning, some projects operated in regulatory dark space. In one project, the blockchain system architecture was customized with additional features to comply with previous legislation. Further, the project incorporated features that could currently not be used but could be activated if regulation would adapt in the future. Some interviewees mentioned it as *"quite unusual that regulators were very open to blockchain compared to other innovation technologies"* (P10). Consequently, legislation changed rapidly in recent years, posing an ongoing challenge to companies. *"When we started, there was no legislation on it at all"* (P04). *"For example, the whole topic of the General Data Protection Regulation. There are always new statements from the EU, where things that you considered feasible at the time are no longer possible today"* (P01). Therefore, it was important to observe regulations closely, evaluate changing settings, and build on new possibilities in projects.

Preparation for Future

In this dimension, some identified blockchain as a potential key disruptor for their industry, but many perceived it rather as a technology with advantages in specific business areas. The full potential of new technology only emerges over time. Hence, companies need to evaluate their impact constantly. *"[We took the] approach of focusing on the topic very early on and concentrating our expertise. This means that what we are doing now has a solid foundation. [...] That is perceived [in our industry]"* (P12). Thus, many projects aimed to provide new products and services for the company, sometimes even allowing them to exploit markets beyond their current focus.

Projects might also contribute to major future objectives of companies. For many, one of these goals was to advance digitalization. Blockchain projects were directly related to the digitization of prior analog processes. *"We are in the midst of a digital transformation process, as all large, old industrial companies. The main incentive is how well we can now deal with these technologies, how do we understand them, how do we transport them into the traditional business areas"* (P08). The company of P08 perceives blockchain as a chance to change traditional business areas and thereby drive digitalization in systems and minds. Furthermore, companies used the new possibilities of blockchain technology to drive digitalization in prior paper-based areas. *"Especially when I have topics of trust, where digitization has not taken place because I could not prove a secure digital status"* (P10). Another company is also trying to digitalize big parts of its industry. Blockchain technology and its new capabilities are expanding their pool of tools to accomplish this objective.

Another corporate policy to be addressed with blockchain projects is the cultural change in organizations. Companies wanted to target an *"open, externally oriented and collaborative culture"* (P03), and this is *"exactly what blockchain needs"* (P03) to thrive. One company describes that *"we still find it difficult to enter coopetition"* (P08), but it tried to change its culture and *"see competitors as well as partners"* (P08) and thereby exploiting the full potential of blockchain and get further positive effects on its business in the future. This level of openness to the outside was unusual for many. In the end, *"we were in a real open source project in all areas"* (P08).

Evaluation of Success Dimensions

We investigated the importance of each success dimension for each project, by incorporating our own as well as the perspective of the interviewees, as described in Section 3.2.

Next, we assigned the individual projects studied to the phase of their implementation level. Therefore, we adapted a common theoretical framework for the process of digital innovation. Kohli and Melville (2019) propose three actions for the technical realization in a digital innovation process: *Initiate, Develop,* and *Implement*. Our first project stage, *Initiation,* describes the initial explorative approach in finding novel use cases for blockchain technology. This might include, but is not limited to, the identification and evaluation of use cases. We further take into account a more detailed look at the development action. Thereby, we propose to differentiate between developing a prototype and developing a pilot system. In a prototype project, the general technological feasibility is tested. In contrast, a pilot demonstrates the applicability of the solution on a larger scale. We propose that, due to the high complexity of blockchain technologies (Chong et al. 2019), companies should take a more detailed view of the technological development during the innovation process. Henceforth, we introduce the stages *Prototype* and *Pilot* into the innovation process (Hertzum et al. 2012). Lastly, we build upon Kohli and Melville (2019) to introduce the last stage *Productive Implementation*. This stage includes implementing and setting up a productive blockchain system in one or several use cases. Hence, we derive four different actions towards blockchain innovation from literature: *Initiation, Prototype, Pilot,* and *Productive Implementation*.

We depict the results of our procedure in Table 3 with the evaluated six success dimensions for each of the 12 projects. Green represents higher and red lower values. First, our results show that the general importance of the success dimension *Efficiency* might be perceived lower than the importance of other success dimensions. In this regard, our ratings are considerably lower compared to other success dimensions. Second, our results could indicate the rising importance of the success dimension *Impact on Environment* along with the maturity of project stages. We observe that this dimension might have only a minor role for projects in the first two project stages within this dimension. The importance increases for projects in the pilot stage and is even higher for projects in the last stage. Third, our findings illustrate an overall focus on the success dimension *Preparation for future*, particularly for earlier stages.

Project	Efficiency	Impact on customer	Impact on team	Impact on environ-ment	Business and direct success	Prepa-ration for future	Project stage
P05	3	2	3	2	2	5	Initiation
P01	2	4	4	2	2	3	Prototype
P02	2	4	4	4	2	5	Prototype
P07	4	2	2	1	5	4	Prototype
P11	2	4	3	4	4	3	Pilot
P03	4	3	3	5	2	5	Pilot
P09	2	5	3	5	5	4	Pilot
P10	4	2	3	4	3	4	Pilot
P08	2	3	2	4	4	5	Pilot
P04	4	3	5	5	1	2	Prod. Implement.
P12	2	4	4	5	4	4	Prod. Implement.
P06	5	3	3	5	4	2	Prod. Implement.

Table 2. Evaluation of Project Success Dimensions

Discussion

In this section, we classify and discuss our research results. We refer to and explain dominant success criteria, the newly identified success dimension, and the resulting patterns. We then derive recommendations for future blockchain projects from the insights of our interviews.

Theoretical Contribution

Our results show the importance of success criteria in analyzing blockchain projects. In our identified success dimensions, we found several differences compared to prior research. In the following, we discuss our findings based on our perception of their relevance and contribution. First, we discuss our observation of success dimensions. Second, we debate the observed relevancy of success dimensions.

As outlined in the results section, we identified the new success dimension *Impact on environment,* which we added to our model. The consolidated success criteria emphasize that companies need to think beyond established success criteria to carry out blockchain projects, which often have an inter-organizational focus by design. From a company perspective, it seems intuitively right to collaborate in consortia or the blockchain community. Existing research found that blockchain technologies demonstrate their strengths, particularly when different parties collaborate in ecosystems (Lacity 2018; Zavolokina et al. 2020). Besides, the most prominent and mature technologies in the field are open source and often driven by an active community of developers. Thus, companies focus on collaboration and coopetition plays an important role in defining successful blockchain projects. Shenhar et al. (2007) may not have established this dimension because of their sample. Their study included intra-organizational projects with technologies at various levels of uncertainty but none with comparable network effects. Projects in the sample with the potential of such an effect were defense system ventures, where everything would be kept internal either way.

The concept of *Impact on environment* as a success criterion is not new to literature. There is a macro view of project success (Lim and Mohamed 1999), the emphasis of general benefits for all stakeholders (Atkinson 1999; Karlsen and Gottschalk 2002), and its impact on the community (Atkinson 1999). The model we present adds value to the literature of success criteria because it clarifies the perceived importance of broader dimensions for inter-organizational projects in contrast to intra-organizational projects. The *Impact on environment* dimension again demonstrates with its importance that the strengths of the technology can only be truly achieved through a large, vibrant network.

Within the dimensions proposed by Shenhar and Dvir (2007), we found additional success criteria which we propose to be specific for blockchain projects. In the dimensions *Impact on customer* and *Impact on team,* we observed the incorporation of the criteria *Knowledge development* and *Knowledge building*. We explain this finding through limited available knowledge about blockchain technologies for specific use cases. Further, we find *Technology fit* as a criterion within the dimension *Impact on customer*. Companies evaluate, particularly in early-stage explorative projects, if blockchain technologies are suitable for their use cases. In the dimension *Preparation for future* we observe the criterion *Future technology readiness*. Companies use projects with limited scope to gain first experiences and prepare themselves for future projects if they perceive the technology as mature enough to be productive in their markets. We further identified the success criterion *Cultural change* within this dimension. Multiple interviewees highlighted the importance of promoting a cultural change in their company by or within a blockchain project.

The evaluation of the relative importance of success dimensions brought further insight into our results. We observe a general lower rating for the dimension *Efficiency*. This finding contrasts the literature of IT projects where adherence to budget and time is rated as a very important criterion (Joosten et al. 2011; Karlsen et al. 2005; Lech 2013; Thomas and Fernández 2008). The discrepancy could be due to several reasons. Blockchain projects have to deal with a general higher degree of uncertainty (Du et al. 2019) since use cases still have very few best practices and limited available knowledge. Thus, companies face higher uncertainty about the technology and concomitant factors in dealing with blockchain than other, more established technologies (Beck et al. 2016). This uncertainty displays in the unknown demand for resources. We posit that companies experiment with many smaller projects with very limited budgets, scope, and time in the field. Therefore, managers might not put such a high focus on these success criteria. Also, project sponsors often do not need to gather separate approvals from senior managers but can decide to spend further resources based on their judgment. Next, our findings suggest an increase in the importance of the dimension *Impact on Environment* along the project stages. We explain this by the decentralized paradigm and value proposition of blockchain technologies. Since the technology disseminates its value mostly in cross-organizational settings with multiple parties, most implementations in a single company use case would not bring any value. Thus, companies that move towards implementing a productive system focus more on consortia or other partners (Lacity 2018). Thereby, companies also increase their scope to generate impact on society by providing decentralized platforms, which can be used against the increasing centralization through platforms. Karlsen et al. (2005) ranked success criteria of positive environmental and social effects on society as least important in IT projects. We propose that success criteria in blockchain projects vary from other IT projects in this regard. Finally, we observe a high priority on the dimension *Preparation for* Future, particularly for earlier project stages. This finding is coherent with the literature, which suggests that companies often struggle to identify suitable applications for blockchain technology (Fridgen et al. 2018a). Henceforth, companies often perceive higher relevancy of an explorative approach in earlier stages of the innovation process to identify future application areas of emerging technologies.

Managerial Implications

First, managers should consider the dimension *Impact on customer* holistically. We found that the successful development of a prototype or other ex-ante defined objectives does not alone constitute project success (Wit 1988). Companies can achieve other success criteria, e.g., expand knowledge, understand the technology, or initiate follow-up projects, even if a project would otherwise be branded a failure. Since blockchain projects incorporate many uncertainties and ambiguities, it might be advantageous for companies to focus not only on the direct output but also on the long-term impact on the organization.

Second, managers need to consider the dimension *Impact on environment* when evaluating blockchain projects. We found that many companies believe blockchain disseminates a large stake of its value through cross-organizational settings and the impact beyond their organization. Hence, they incorporate success criteria from the dimension *Impact on environment*. They can be actualized through the collaboration in consortia or blockchain communities, e.g., by exchanging knowledge or working on standards that help all involved partners disseminate their products (Lacity 2018). This approach is known to the innovation management research community as open innovation. Thus, the collaboration in networks, e.g., in consortia, fosters innovation (Chesbrough 2003). Research suggests a positive effect of open innovation processes on company performance (West and Bogers 2017). However, before joining a consortium, companies should think carefully about what they can achieve and how they can get involved (Chong et al. 2019). Nevertheless, managers might expect to work on projects internally without providing knowledge and insights to competitors in more traditional industries. Managers should rethink this paradigm of a project limited to the organizational boundaries of a company. We advise companies to consider open-source projects and coopetition strategies when dealing with highly complex and rather new technologies like blockchain (Lacity 2018).

However, companies should carefully evaluate the technology through smaller projects with a limited scope and budget. This approach limits the possible sunk costs if companies perceive blockchains as not suitable for their use cases. Therefore, it is important to be clear about uncertainties, accept risks, lower too high expectations, and set fail-fast principles. Show tolerance for errors, but also define clear termination criteria (Wheatley and Wilemon 1999). Particularly in early project stages, the approach should incorporate hypothesizing and fast iterative development cycles. Further, project teams should be provided with enough freedom to independently identify and evaluate use cases.

Many companies aim to position themselves as leading edge in the industry and the public through the communication of blockchain projects and respective activities. Nevertheless, managers should consider this dimension with care. In industries that dealt with blockchain for a longer period, e.g., the financial sector, such positive effects on the public image are difficult to generate. Higher expectations concerning the public image could be possible in industries and areas in which the blockchain has not yet fully disseminated, e.g., construction or manufacturing (Chong et al. 2019). The implementation of beneficial use cases will bring a positive impact on the public image just by themselves.

Conclusion

This interview study provides a thorough elaboration of the success criteria of blockchain development projects. We used the insights from 12 blockchain projects and combined them with project management and blockchain literature. As a result, we derived six success dimensions and 29 success criteria, adding a new dimension and various new criteria to the literature. To further examine the results, we classified all projects according to their project stage. The results showed high importance of the success criteria from the *Impact on customer* and *Impact on environment* dimension, but low importance of the *Efficiency* dimension. Besides, the importance of the B*usiness and direct success* dimension increased across the project stages.

The contribution of this work is manifold. In particular, we contribute to blockchain and project management theory by discussing our findings against relevant literature. Furthermore, we propose specific guidelines for managers of blockchain projects to consider when carrying out projects.

This interview study is constrained to some limitations, offering opportunities for future research. First, the interview sample size is rather small and focused on the German-speaking area. Further research could reveal additional success criteria and dimensions and different findings regarding their relative importance. Second, this study contains projects of companies of all sizes and from different industries. However, the financial industry was overrepresented, potentially leading to a bias. Therefore, it might be interesting to see whether different industry sectors seek different success criteria. Third, our study did not focus on the distinction between the technical properties of the respective blockchain projects. Due to the required governance, projects dealing with permissionless blockchains might require different project governance than projects dealing with permissioned blockchains. This knowledge gap could also provide a promising path for future research. Fourth, our data might be influenced by a non-response bias, as project managers generally avert talking about failed projects. However, understanding the success dimensions of failed projects could reveal new insights and could differ from our results. Finally, the evaluation of our framework builds on a limited data set. Future research could address this shortcoming by carrying out a large-scale evaluation. Nonetheless, we posit that our insights on the newly identified success dimension and respective criteria provide a valuable starting point for academia and practice to initiate a discussion on the management and impact of blockchain projects.

Research on how to manage blockchain projects is rather unexplored. This has mainly been the reason due to missing empirical data. The ever-rising number of blockchain projects demonstrates the need for knowledge in this area and provides data for rigorous research to better understand related phenomena.

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