Collaborative Creativity in Requirements Engineering: Analysis and Practical Advice

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Requirements engineering (RE) often entails interdisciplinary groups of people working together to find novel and valuable solutions to a complex design problem. In such situations RE requires creativity in a form where interactions among stakeholders are particularly important: collaborative creativity. However, few studies have explicitly concentrated on understanding collaborative creativity in RE, resulting in limited advice for practitioners on how to support this aspect of RE. This paper provides a framework of factors characterising collaborative creative processes in RE. These factors enable a systematic investigation of the collaboratively creative nature of RE. They can potentially guide practitioners when facilitating RE efforts, and also provide researchers with ideas on where to focus when developing methods and tools for RE.

I. INTRODUCTION

A typical definition of creativity describes it as “the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive to task constraints)”[1]. This definition is known as the socio-cultural definition of creativity [2], which suggests that creativity must exist within a socio-cultural context to make sense. The context poses two central questions: Novel compared to what? Appropriate for whom? In this view, creativity is by nature collaborative, because the creator does not exist in isolation, but within an environment that has a significant influence on what can be created [2].

Further, creativity experts distinguish individual from collaborative (or group) creativity because the latter explicitly relies on interactions within a group to achieve the creative outcome. For example, Sawyer explains: “Psychology cannot provide a complete explanation of group creativity; we need a group level of analysis, and we need to incorporate methods and concepts from sociology, communication, and organizational behavior” [3]. Lena et al. agree and emphasise the importance of this kind of creativity within a contemporary industrial setting: “recent research has begun to paint a more complicated picture of creativity that highlights the importance of social interactions, mentoring, and collaboration in creative work. The importance of analyzing creativity in this more holistic sense is readily apparent when one considers that most creative pursuits in industry involve interdisciplinary teams working together to develop a product that cannot be created by a single individual alone.”[4].

The topic of creativity has received much attention from Requirements Engineering (RE) researchers over the last decade. RE has also been shown to be an inherently creative discipline, as recently summarised by Maiden et al. [5]. In this paper, we suggest that RE is not simply a creative process, but a collaboratively creative process. The difference is important to the discipline because, as we noted above, individual and collaborative creativity are known to be qualitatively distinct, and thus require different processes, skills and techniques [3]. We argue that RE activities nearly always require collaborative creativity, because development teams need to reach a consensus on a new and valuable system they want to build. This also implies that the findings in the rest of this paper apply to most RE projects.

Indeed, as we suggest that RE is a collaboratively creative discipline, we realise that the level of understanding of situationalist processes in RE is particularly low [6]. Consequently, the main contribution of this paper is to propose a list of factors, structured as a conceptual framework, that influence collaboratively creative tasks in the RE process. These factors outline what should be considered when tailoring a method, technique or a specific work environment for the collaboratively creative part of RE efforts. Being largely absent from the literature on creativity in RE until now, these factors are potentially ignored by practitioners and researchers alike. In this paper, we aim to raise awareness of these factors, and give some initial advice on how to deal with them.

The paper starts by discussing related work in section II, where the contributions of this work to analysing collaborative creativity in RE are also illustrated. Section III presents the research method underlying this paper, while section IV argues that almost all RE endeavours must include strong elements of collaborative
II. RELATED WORK AND CONTRIBUTIONS

According to a recent systematic mapping study of the RE literature concerned with creativity [7], studies in this field are centered around theories, models, techniques, workshops, and tools to enhance creative thinking in RE activities. The authors of this mapping study show that most studies propose and validate solutions, mainly for the elicitation phase. Some discuss the topic more philosophically, from motivating the need for creativity to describing how the requirements process fits with the creative process. None of these studies has been dedicated to explaining collaborative creativity in RE, or the factors that influence the collaboratively creative tasks in RE. However, these are important steps in order to propose methods and tools that support various activities of the RE process. In section V, we argue that the use of a creativity technique or method (the focus of most related work) is only one of many factors that influence success in the creative parts of RE endeavours.

The RE community is rooted in the recognition that the stakeholders of a project are the providers of key inputs to the RE process [8], [9]. However, only a few within the RE community have also considered stakeholders as ‘co-creators’ of the requirements. There has been little work in the RE field on the differences between what happens within the brain of a single creative analyst and a creative team of stakeholders. Many authors have discussed issues and proposed solutions for supporting communication among stakeholders, in particular where the context imposes a geographical distance (for example [10]). Research on Group Support Systems (GSS) (such as [11]) has further provided a partial analysis of collaboration in RE. However, we have not found a study that dedicates itself to understanding the factors that characterise collaborative creativity in RE.

In the social sciences domain, several studies have reported results concerning the influence of the work environment on creativity. The most notable study, summarising many others, is by Amabile et al. [12]. Amabile et al. propose a framework of six scales describing work environments that have an influence on creativity. The work reported here supplements this framework in various ways. Firstly, we explicitly focus on collaborative creativity, which was only implicit in Amabile’s work. We used the most recent literature about this specific topic to extend Amabile’s framework. Secondly, we targeted specifically RE, by referring to numerous works from this field, and building a consensus amongst six experts from this field.

While RE has specific concerns, it does not necessarily differ significantly from other disciplines in its use of collaborative creativity. Some of the observations included in this paper may consequently have a broader application than solely for RE. However, conducting a comparative analysis of collaborative creativity in various disciplines is out of the scope of this paper. Generalising the results from this study, that by construction apply to RE only, would require expertise that was not available when conducting the analysis. Readers of this paper with expertise in creativity outside of the RE domain who considers the results here as generic could provide this missing expertise. We would therefore like to hear from such experts.

This is the first time that a study aims to confirm and extend existing findings about collaborative creativity specifically for the RE discipline. Our list of factors that characterise the collaborative creative tasks in RE provides practitioners with a robust mechanism with which to tailor and assess creative RE work environments. Additionally, researchers will have a clearer vision of what should be included in a technique or method to support collaboratively creative activities in RE; we provide them with new materials to assess the impact of their method on creativity in RE. This paper presents the first steps of this theory-building effort. Its results, obtained as described in the next section, will need to be validated and refined through an empirical survey study. The result will inform further theory validation and enhancement through subsequent in-depth case studies.

III. RESEARCH METHOD

3.1 Research Questions

RQ 1: Can RE be considered as a collaboratively creative process?

RQ 2: What are the factors that characterise collaborative creativity in RE?

3.2 Description This research was conducted in two phases to answer RQ1 and RQ2 respectively. The first phase consisted of a multi-disciplinary, semi-systematic literature review of creativity and collaboration. The second phase consisted of a non-anonymous Delphi technique [13]. These two phases are described below.

A literature review was conducted by the first author of this paper, hereafter referred to as the initial corresponding author (ICA). In a previous study [14], the authors used this review to gain an understanding of why and how creativity means different things in different contexts. The study highlighted the importance of collaborative creativity and suggested that more work was needed to understand this specific type of creativity in the RE context more thoroughly. In order to reach this understanding, this current paper uses the same literature with a new objective in mind: finding a preliminary list of factors that influence collaborative crea-
tivity in RE. The ICA compiled this list of factors, which became the starting point for phase 2.

The second phase involved a further analysis of the preliminary list of factors and formulated a conceptual framework of the factors. This phase utilised a non-anonymous Delphi technique, a recognised research approach suitable for conceptual framework development [13], [15]. In this technique, a panel of experts seeks consensus by exchanging opinions in a structured way, in several rounds of facilitated discussion. The ICA invited a list of recognised experts in the field of creativity in RE to analyse and describe the factors in the list, thereby collaborating in the iterative and incremental development of the framework. Five of them accepted, building a team of six experts (including the ICA) for writing this paper.

Experts were selected either by convenience or name, in order to have sufficient coverage of expertise in the domain and sufficient diversity for effective debate. Four of our experts claim practitioner status. Those have been involved in RE efforts for between 8 and 15 years and have been explicitly facilitating collaborative creativity using various tools and techniques. Five of our experts claim researcher status. Each of them has been an author of between 5 and 10 peer-reviewed papers in the field of creativity in RE. Importantly, our research experts represent a diverse spectrum of opinion on creativity in RE, providing coverage of most of the research “families” identified by Lemos et al. [7]. Geographical and cultural diversity is present within the group, with experts from Europe, US, UK and Australia. In the remainder of this paper we use the first-person plural voice (“we”) to refer to the team formed by the ICA and the experts, who are also co-authors of this paper.

The collaborating experts mainly shaped the content of sections V-VII, which represents the main body of this paper. Initially, the ICA prepared a shared online spreadsheet containing the raw list of factors gathered from phase 1 [16]. For the first iteration, each expert chose a number of factors and started to discuss their importance for RE. They also began to offer advice on how to deal with each factor in practice. In subsequent iterations, other experts discussed the initial contributions, until a consensus was reached on all factors, leading to a richer and more complete picture. We applied classical abstraction techniques to select, specialise, generalise, and aggregate factors. The ICA then summarised the contributions in a draft of section V, and all experts were then invited to review the paper as a whole.

There is insufficient space in this paper to present the rich discussion arising from this process. Instead, we present the final consensus that resulted from the collaborative effort. However, the original collaborative spreadsheet containing all experts discussions and the planning for the first submission of this work is available online [16].

IV. PHASE 1: RQ1 - COLLABORATIVE CREATIVITY IN RE LITERATURE

In this section, we use the literature review from our previous work [14] to analyse the collaboratively creative character of RE (RQ1). As we expected, the RE literature supports the view that RE can be seen as a collaborative creative process.

Describing RE as a “wicked problem” calling for creativity and collaboration, Mich et al. [17] mention the multitude of stakeholders involved, their interdisciplinary backgrounds, the dynamic context, the large uncertainty, and the many possible trade-offs. In this context, Potts [18], Boehm et al. [11] and Arias et al. [19] indicate that requirements are rarely to be found well-defined and complete, ready to be collected, but rather emerge from the interactions, and sometimes conflicts, within the group. Maiden and Robertson [20] report on the need for stakeholders, both internal and external to the development team, with different areas of expertise to work together to generate requirements. Coughlan and Macredie [21] also view requirements elicitation as collaborative and emergent. Nguyen and Cybulski share this view and compare the RE process to an emergent constructivist learning process situated in a collaborative socio-organisational context, necessary to solve an ill-structured problem [22]. Price and Cybulski describe the consensus-building process in RE [23]. Fischer underlines the need for communities, rather than individuals, and for interdisciplinary teams in software design [24]. He suggests that the use of some collaboration model is essential and relevant for software design, and coins the term “social creativity”, because of the importance of collaboration in design projects. Nguyen et al. [25] conducted experimental studies to show how practitioners follow an unpredictable, opportunistic, improvised process to perform RE in poorly understood problem situations. This leads to a creative process comprised of cycles of structured building and opportunistic restructuring of the requirements model [26]. Holtzblatt and Beyer claim: “All aspects of requirements definition ultimately succeed or fail based on how well people work together.” [27]. Participative design (for example [28], [29]) also emphasises the collaborative nature of RE.

In industry, innovation, collaboration and agility are often central to the strategies of IT departments [30]. Social networks and “Web 2.0” collaborative technologies are also significant business drivers. The success of books such as “Requirements by Collaboration” by Gottlesiener [31] reflects the interest of practitioners in this topic. The Agile Manifesto [32] contains four statements, the first and third of which make direct reference to collaboration. The move towards agility in systems design ([5], [30]) suggests a trend towards collaboration that requires understanding and support.
Commercial requirements management tools are also embracing collaboration. For example, IBM’s Rational DOORS website states that DOORS will “improve quality by optimizing communication and collaboration and by promoting compliance and verification” [33].

We can learn two key lessons from phase 1 in relation to RQ1 (Can RE be considered as a collaboratively creative process?). Firstly, the complexity and multi-dimensional nature of the problem and solution space in RE inevitably result in conflicts and trade-offs that are optimally addressed by inventing together. Secondly, we often have to work collaboratively to be creative, and we have to be creative in a particularly collaborative fashion.

V. PHASE 2: RQ2 - FACTORS CHARACTERISING COLLABORATIVE CREATIVITY IN RE

In this section, a number of factors characterising collaborative creativity in RE are presented and each is briefly discussed. The section summarises the results of the long discussion process described in section III. The original discussion conducted using the Delphi technique [16] runs to over 14,000 words, and the experts participated in each step of this summarisation process. In particular, they contributed to and reviewed the paper several times, as the best mechanism to ensure that this paper accurately summarises the original discussion. Below we use the conceptual framework (Figure 1) to explore and illustrate collaborative creativity in RE in a systematic manner. A first level of classification distinguishes between team and individual factors.

A. Factors Relating to the Team

When developing a system, the people who share an interest in the system to be developed are called the ‘stakeholders’, many of whom will be part of the project’s creative team. We distinguished between factors relating to the team context, the team values that are shared among the team members, and the team structure that describes how the team is organised internally.

**Team Context** Risk Profile: Many authors suggest that creativity best arises at the edge of chaos, as the environment for creativity should neither be too conservative (nothing novel will come) nor too innovative (nothing adequate will come) [34]. Amabile argues that management should be supportive of novel and therefore risky ideas [12], while Regev et al. explain that an idea will be accepted if and only if the risk incurred by accepting it is equal to or lower than the risk incurred by rejecting it [35]. Mich et al. claim that creativity can also be seen by companies as a threat [36], and Dallman analysed experimentally the willingness of people to take risks and their degree of conformity as factors influencing the creative process in RE [37]. Sawyer illustrates the innovation–tradition trade-off by analogy to a jazz music group, in which each musician and the group as a whole must balance two competing tendencies: the expectation of creativity and inspiration, and the need to maintain coherence both with tradition and within the group. As a result of the discussions between the ICA and the experts, we agreed that norms have to be made clear before they can be broken, and that recognising norms requires an external facilitator. The risk of a new idea is seen as proportional to the distance between the idea and the norm, thus distinguishing between incremental and radical innovation [39]. To foster creativity within conservative organisations, our experts suggested incremental innovation, using risk management techniques.

**Shared Objective**: For a team to be able to act cohesively, it must have a common vision of what needs to be done: the team’s objective. To ensure motivation and personal commitment, there must be an alignment between the team’s objective and the personal objectives of each team member [31]. Shared objectives must neither be too strictly defined (which tends to restrict creativity) [38] nor too fuzzily defined (which can lead to chaos) [31]. In RE, a problem or objective is often refined and reframed, as the teamwork progresses and the situation changes, and as individual sub-objectives are progressively made clearer to the group. We suggest that setting a shared objective is partly a product of preparation and facilitation. Doing this participatively and regularly is recommended due to the inter-subjective and evolutionary nature of goals in RE. Ensuring alignment requires understanding the personal objectives of each individual, which depends significantly on the skills of the facilitator.

**Time**: There must be an investment in time for collaboration to occur [39]. However, we discussed the delicate balance between insufficient time (which impedes incubation, exploration and discussion) and too much time (which may hinder focus and the feeling of challenge, both of which are necessary for effective team motivation) [12]. We suggest limiting the time...
spent on any RE process, but remaining flexible, because creativity is not predictable and does not emerge as a result of a deterministic algorithm or rigid process.

Culture: At various levels (company, division, and individual), a social group is characterised by one or more cultures, defined by the set of habits and values shared by the RE team. We argue that understanding this cultural mix is a prerequisite for dealing with it. Facilitators should therefore understand this mix or engage assistants with such knowledge. RE projects are increasingly likely to cross cultural borders, so requirements engineers must build the necessary bridges between these. A useful framework for understanding cultures and their potential impacts on projects is given by Hofstede’s dimensions for cultural distance [40]. However, such frameworks are not well recognised and we see a need for further exploration of this in the RE context. We believe that cultural awareness, experience, and training are necessary to facilitate collaborative creativity in RE.

Reward Mechanisms: Amabile et al. [40] shows how intrinsic motivation is superior to extrinsic reward mechanisms for creativity. Ideally, if individual objectives and shared objectives are aligned, the attainment of these objectives should constitute a strong enough intrinsic reward such that people will participate fully. We note that in many companies, individual reward mechanisms may act against the team and favour disruptive political behaviours. Further, team rewards may decrease an individual’s willingness to provide effort as each individual effort is diluted in the team’s accumulated efforts. In collaborative creativity, it is impractical to determine who is responsible for which part of the outcome. This is because the result is not the sum of individual contributions, but is the emergent result of the team’s interactions. This causes problems when attempting to reward individuals [41]. In RE projects, we suggest giving visibility to any contribution that is made to the team’s project and to use the diversity of the team’s members as an opportunity to reward individuals for what they most value. We also believe that reward is strongly dependent on culture. For example, the value of group achievement over individual achievement is quite different between the oriental and occidental cultures [40].

Team Values This section defines those values that are desirable for a team that sets out to achieve collaborative creativity. The wider cultural mix is a compounding factor, so any action to deal with team values must take this into account. Establishing a common set of values in a RE team, including those needed for collaborative creativity, can be a challenge. The short duration of many projects serves to reinforce this problem. However, using creativity techniques while the values described in this section are not shared can actually be counterproductive. We suggest that regular team building exercises are beneficial, just as a sports team undertakes training sessions to learn to play together.

Trust, Safety, Empathy: A trusting atmosphere is a frequently mentioned precondition for sharing ideas and for having a feeling of safety [9], [38]. Each member of the collaborative team needs to feel that if they “think outside the box” and release their novel ideas (which may challenge the existing dogma or established practice), that the team will be supportive. We suggest that the physical and psychological environments influence the feelings of trust, safety and empathy. In particular, a relaxed environment and a positive tone from a facilitator are deemed important, particularly if the team has not met before.

Freedom, Tolerance, Openness: West mentions the importance of a non-judgemental team atmosphere [42]. This tends to make team members more likely to risk exposing new ideas and opinions. West also stresses the need for a tolerance to diversity of opinion and constructive conflict within the team. In a creative team, opposing opinions are not only offered, but are also debated and critiqued constructively by team members [43]. In fact, opposing opinions are an important source of creativity; they are the sign that the current solution does not satisfy all the participants and therefore something new must be invented [44]. In RE, negotiation is often discussed [11], but it tends to focus on bargaining and cropping or adjusting the stakeholders’ interests. Freedom also necessitates the rejection of unbalanced power games, including status differentials [45], implying a responsibility structure that is evenly distributed among the team members. Grouphink (or “majority influence”, a situation in which people feel compelled to conform to dominant ideas in the group [46]), and Groupshift (or “Social Identity”, a situation in which a group moves towards a more extreme position in the same direction they were originally leaning [46]) must also be avoided by careful facilitation.

Fun, Playfulness, Challenge, Flow: Empirical studies show a positive correlation between playfulness and creativity [47]. However, creativity also demands solid knowledge from which to spark ideas and to select good ones, and skills to take the ideas forward. Csikszentmihalyi [47] uses the term “flow” for a state of heightened consciousness. Flow occurs in individuals during peak experiences, when a person’s body or mind is stretched to its limits in a voluntary effort to accomplish something difficult or worthwhile [48]. Amabile et al. uses the word “challenge” for a very similar concept [12]. Sawyer [41] applied the term “flow” to teams, to describe the situation in which the team is said to jell, and is synchronised. He shows that this state is very much related to creativity. We believe that many aspects of RE can be fun. Creativity sessions, in particular, can be enjoyable for the participants, and fun might actually be a key factor in generating creativity. Fun is a powerful tool in breaking down barriers and allowing participants to free themselves from psychological inertia. A facilitator using a relaxed tone and creativity techniques including elements of play are recommended.
Team Structure: Many factors characterise the way in which a team is structured. Collaborative creativity requires an appropriately flexible structure [31]. Too much or too rigid a structure will constrain freedom and will not adapt to the team’s evolution. Conversely, too weak a structure will lead to chaos. What constitutes the “right” amount of structure depends on the nature of the project. Group creativity theories show that the strength and clarity of the shared structures should match the strength and clarity of the pre-defined extrinsic collective goal [41].

Team Composition and Roles: Teams should be heterogeneous enough to “bring a range of knowledge, ideas, and approaches to problem solving that improve the teams’ creative performance” [49], but must also be sufficiently coherent that the individuals are able to understand each other. In RE, we are used to generating a list of stakeholders from whom information needs to be gathered. Indeed, there is no point wishing to collaborate creatively if the right information sources are not available. However, we should recognise the personality and skills mix that is available, and compare it to what is expected from the individuals, from the team, and the factors presented in this paper. We discussed the importance of “dynamics and balance” within a team. Any effective team blends the strengths of the individuals, rather like a sports team. For example, a football team must include individuals with a range of strengths, such as defending, passing, tackling and scoring goals. This shows the importance of diversity, but also that clear roles ensure work and responsibilities are well distributed, and helps the team to understand how they are supposed to interact. However, roles must not be too strictly defined as this can restrict the freedom to be creative. Existing research gives some advice on processes and roles for the efficiency of a team, suggesting explicit roles such as facilitator, scribe and time keeper [31]. New roles for managing creativity could be added to complement this. Team composition could also be dependent on the collaborative creativity techniques adopted for RE on a given project and so could change in the different stages of the project. Communication Channels: There are many ways to exchange information, which vary in a number of dimensions. For example: on-line or off-line, formal or informal, synchronous or asynchronous, push or pull, point-to-point or broadcast, physical or virtual, textual or multi-media, fixed or mobile. Each communication channel has an impact on RE, and on collaborative creativity in particular. Since the exchange of ideas is central to collaborative creativity, the communication mechanism inevitably has a significant impact. Much has been written on communication in RE, since any documentation or modelling technique is in effect a communication medium. Analysing the impact of the communication channels used for collaborative creativity in RE is beyond the scope of this work. Nonetheless, the experts mentioned the existence of online collaborative creative tools and studies assessing their utility regarding not only communication, but also with respect to other factors mentioned in this paper [11], [50]. For example, mobile multimedia communication tools are available to help capture and exchange ideas as they appear “in the wild” [51], and offline group communication tools, such as posters and smart walls, can also aid collaborative creativity. The geographical spread of stakeholders further impacts the communication channels and patterns, as discussed by Damian et al. [10].

Processes and Techniques: Various processes for supporting creativity have been developed, including for teams. These include games or methods that help teams to generate and select ideas, by proposing rules that will have a positive influence on the factors presented in this paper. For example, a technique may foster playfulness, encourage an open and non-judgemental atmosphere, or exploit diversity of opinions. A diversity of creativity techniques should be used to support any collaborative creative RE process and positively influence the factors described in this paper. The idSpace creativity technique repository is an annotated knowledge base, designed to select creativity techniques, which can be used for this purpose [52], [53]. However, no technique by itself is able to guarantee that all factors for a successful collaborative creative effort, as described here, are present. Consequently, when employing creativity techniques, the environment as a whole must support collaborative creativity.

Planning: Planning should carefully time-box each of the activities related to the collaborative creativity RE process, as a function of the time and process factors above. However, planning should be flexible and not too constrained, due to the unpredictable nature of collaborative creativity, while also being realistic in order to manage risk. This typically calls for agile ways of working, shortening the delivery cycles to maintain flexibility and control.

Facilitation and Leadership: The experts unanimously emphasised the critical importance of effective facilitation (or moderation) to foster collaborative creativity in RE. In her book, Gottesdiener discusses the role of the facilitator, but without explicit focus on collaborative creativity settings [31]. If we are to recognise the importance of collaborative creativity in RE, then the role of the RE practitioner should also be recognised as being principally that of a facilitator. Unfortunately, there is very little guidance available on the “softer” aspects of this role. The experts agreed that a good facilitator does not act as a leader, but rather members of the team must share the total responsibility for the final output. Hierarchical leadership structures do not work well with collaborative creativity [41]. In collaborative creativity, leadership tends to migrate from one team member to another according to the circumstances [41].

B. Factors Relating to Individuals

Teams consist of individuals. It is crucial that the right subject matter expertise is shared among these individuals, as there is little point trying to develop something valuable and novel if the prerequisite knowl-
edge is not present within the team. This has been the subject of stakeholder analysis within RE for some time [8], so we discuss this no further in this paper. Rather, we discuss what we have called collaborative creativity skills (individual skills that are required from people in collaborative creativity teams), and motivational aspects.

Collaborative Creativity Skills The literature mentions many personality traits associated with individual creativity [6], [46]. The experts were, however, not aware of any work that demonstrates that teams comprised of such individuals are collectively more creative. Indeed, we question whether this would be the case, as the processes of individual and group creativity are quite different [41]. In collaborative creativity, the problem is less concerned with individuals finding ideas and more with them listening and building upon each other’s partial ideas. This has been experimentally confirmed by Rittgen during collaborative modelling sessions [54]. Consequently, we focused on collaborative creativity skills, or skills for efficient team play. While some suggestions are given by Mahaux et al. [55], the experts noted the absence of training possibilities for these skills, and the reliance on actual experience to progress.

In “Artful Making”, Austin and Devin [38] emphasise the need for a strong ego (to be bold enough to suggest ideas) and low vanity (to be able to accept one’s ideas are not always useful). Fischer [24] summarises that collaborative design requires a balance between interdependence, collective action, and power of connection; and individuality, autonomy, and trust in one’s own strength. Trust in oneself is complemented by one’s ability to trust others, and to be trustworthy to others. Communication is central to gaining and conveying trust, so strong listening skills, empathy and the ability to make oneself understood are key. Nguyen and Cybulski [22] require team members to act as learners and encourages them to reflect on their own knowledge, to confront it with new external knowledge, and to discuss and debate with peers. As taking turns is required for the leadership of a collaborative creativity RE session, skills are required both in leadership and in following for participants. The ability to remain focused on something specific, but also to be able to switch rapidly from a detailed view to a high level overview are core skills.

Motivation The commitment that people will give to a team process depends upon where the participation in the process and its potential outcome fits in their personal hierarchy of needs [56]. Another significant point is how well their personal agenda aligns with the shared objectives of the group. Amabile shows that intrinsic motivation is much more effective than extrinsic rewards to foster creativity [57]. In this sense, the Fun-Playfulness-Challenge-Flow factor mentioned earlier is likely to be an enabler of intrinsic motivation. Amabile uses terms like “love of the job” and indicates a positive correlation with creativity.

VI. DISCUSSION AND VALIDITY

A. Discussion

Addressing RQ1, there is solid evidence in the literature indicating that RE can be considered a collaboratively creative process. This does not mean that individual creativity moments are not possible or desirable, but that any individual steps taken will be exposed to group processes sooner or later.

RQ2 was investigated through adopting the non-anonymous Delphi method [13]. This approach was chosen for a number of reasons. Firstly, it was able to support asynchronous interaction among the experts, enabling a rich, yet actionable content, maximising contributions while dealing with geographical and time zone distribution. Secondly, and more importantly, we found it interesting to use a collaborative creative process to talk about collaborative creativity. This enabled personal opinions to be debated, and the way in which we reached a consensus was itself a learning process for all of the participants.

The second phase of the research was facilitated by the ICA, who set up a cloud-based work environment in line with his initial understanding of the factors influencing collaborative creativity. In addition to choosing the specific technique, this involved selecting the appropriate team, ensuring that a common objective was agreed and that personal objectives were aligned with this objective. Group values (such as trust, freedom and fun) were established and the communication infrastructure and simple rules were established. As the collaboration developed, it was necessary to undertake planning activities, sustain motivation and to moderate the discussions. Outside the shared spreadsheet used for discussing the content, we used email to communicate about organisational issues. The writing of the paper was managed via email and a drop box folder. The geographical distance between authors does not seem to have had a negative impact on the effectiveness of the collaboration.

The second phase of the research started from an initial list of 35 potential factors. After the participating experts added more factors, the list reached around 40. The discussion then led to refactoring, and the grouping and elimination of factors. The final framework consists of 22 factors that, as agreed by the experts, characterise collaborative creativity in RE reasonably well. While no expert would agree fully with every detail in this paper, all participants are convinced that it represents the best advice that the group as a whole could produce.

The work described in this paper has a number of limitations. Firstly, it is a conceptual development that is only partially validated by the extensive literature it builds upon and the consensus reached among six ex-
erts. Secondly, we offer only partial advice to practitioners and researchers. Questions raised, but not comprehensively answered, include: What must be done in order to have a positive influence on each factor? How does a specific technique or method perform for each of these factors? How do the factors influence each other? Unfortunately, it is impossible to answer all the questions raised by this work in a single paper. Understanding the relationship between culture and creativity in RE, for example, could be the topic of a very ambitious Ph.D. thesis (and culture is only one factor in our framework). Similarly, proving that just one specific technique has an influence on a number of factors might itself represent several years of research.

To summarise, while we would like to be able to give clear and specific advice on how to support collaborative creativity in RE, this work is not yet that mature. At this stage, we can only provide a high-level summary of the factors that need to be considered when tailoring a method, technique or a specific work environment for the collaboratively creative part of RE. This theory-building effort is, however, a necessary first step towards providing an holistic view of the work that must be done in this direction.

B. Validity

The raw discussions in the shared spreadsheet mentioned above [16] display a reasonable amount of diversity of opinions, multilogues and suggestions experts were unsure of. This tends to indicate an effective collaborative process. Some factors were not discussed as thoroughly as others, either because there was a direct consensus or because experts felt less interested in discussing a particular factor. In the latter case, it is possible that a single expert may have influenced the results in an unbalanced way. Some bias may have been introduced because the ICA provided content as well as acting as the group facilitator. The ICA also suggested the initial list of factors from the literature, potentially pre-framing the experts’ judgement. The experts were explicitly asked to discuss freely, and seem to have done so from reading the spreadsheet, but we cannot exclude a bias here too. However, we believe that groupthink and groupshift [46] have been mostly avoided, as all of the experts were conscious of avoiding such negative effects. If the ICA had interviewed each expert individually, and then tried to summarise and draw conclusions alone, this would probably have introduced a more significant bias. Instead, our approach ensured that each expert’s opinion was visible to all, thereby allowing diverging opinions to be examined to their full extent. This forced each expert to rephrase or justify their opinion whenever opinions diverged, in order to influence the final consensus. Also, since this paper is not trying to validate a pre-existing solution or theory belonging to one of the authors, they had no motivation to skew the results. Consequently, we believe that it is unlikely there was any significant researcher bias. If, however, an expert had an interest in biasing results in a particular direction, we believe that the consensus building process of the diverse team was a satisfactory barrier to this.

The selection of experts may also have introduced a bias. Indeed, as experts in RE with a focus on creativity, they all share a certain mindset about RE, even if they represent a good diversity within the RE creativity field. Further, we covered a reasonably large spectrum of cultures, research families and industry domains, which we believe provides further mitigation against bias in our results.

We put a significant effort into understanding each other, and the consensus reaching process helped in this matter. However, we cannot guarantee that all experts understood each other perfectly, which may threaten the value of some results. The consensus reaching process, seeking consolidation and agreement, provides some form of internal validity. We cannot however be sure that the same study with different experts would reach the same results.

This conceptual development activity is based on literature (phase 1), and the perceptions of professional and academic experts (phase 2). Consequently, despite a certain amount of validation, the results cannot be taken as definitive. Rather, they represent a necessary first step, and further validation through empirical study is recommended.

VII. Conclusions and Future Work

This paper describes how collaborative creativity is both essential to and inherent in the conduct of effective RE. As a result of a collaborative and creative process carried out among the authors of this paper, we present a framework of factors that we believe need to be addressed to facilitate collaborative creativity in RE. The factors are organised into two categories, those pertaining to the team and those pertaining to the individual. The paper discusses each factor in turn, in relation to more general research literature on creativity and collaboration, as well as in relation to the specific context of RE. It also offers suggestions for addressing each factor in practice, arising from the authors’ discussions in the course of their research process.

We believe that the main contribution of this work, the framework of factors for collaborative creativity in RE, can be helpful to both RE practitioners and researchers. RE practitioners can benefit from better knowledge of important success factors for their projects. They can form a new understanding of their discipline, potentially reshaping the way they undertake RE efforts. Where no such reshaping is needed, there is still some important advice in this paper for RE facilitation in general, and for undertaking creative sessions in particular. For RE researchers, the framework gives guidance on what should be included in the objectives of their requirements elicitation method or technique if
it is to support collaborative creativity. We also present directions for future research on creativity in RE.

The paper reports on the first two phases in an overall theory building process. The literature review and the non-anonymous Delphi study have together served to develop the framework. The framework, in turn, builds upon a previous body of knowledge, and informs future validation and further research into collaborative creativity in RE. The next phase in our overall theory building process will be the empirical validation of the conceptual framework through a survey and real-world field studies.

In addition to the definition of the framework, we aim to provide more concrete guidance to practitioners. In particular, we seek to provide practitioners with a means to assess RE techniques and methods against our factors, so that they can select the best approaches for their situation. Fully supporting collaborative creativity in RE processes can be an important step towards a better understanding of business problems and the generation of better business solutions. However, just as the value of any innovation comes with a price, collaborative creativity is not necessarily easy to master. This paper makes an additional step towards mastering this complexity, by extending many references to previous work both within and outside the RE domain. This paper does not claim to answer all the questions about collaborative creativity in RE; rather, it clarifies the questions, offers some tentative answers, and proposes a way forward.

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IX. REFERENCES


