

The Social Accumulator as a Concept to Manage Social Energy in the Age of Digital Transformation

An Explanation Model for Digital Interaction among Human Actors

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Abstract—The increasing intensity of digital supported interaction and communication stimulated by the COVID19 pandemic over a period of roughly two years has changed the perception and experiences with those new forms of interaction by human actors. While not being completely new, the massive use of the technologies made a difference for the users that lead to different socio-technical effects. As a result, the concept of the Social Accumulator (SOAC) is introduced in this paper and related to known concepts like Social Energy. It builds on the experiences from the intensified digital interactions both in academia and business life and should serve as an explanation model for the effects of digital interaction that is easy to understand and to apply. The SOAC should help to understand the processes of Knowledge Creation and Knowledge Sharing when being driven by digital tools, which becomes increasingly important in a world that transforms education and businesses towards a highly digitized world.

Keywords—Digital Transformation; Social Interaction; Social Energy; Higher Education; Digital Interaction; CSCW; Communication; Collaboration.

I. INTRODUCTION

In recent years, digitization and digital transformation of the economy and society have emerged as central topics. Furthermore, the global COVID-19 pandemic has acted as a catalyst for rapid digital transformation in many economies. Austria and Germany witnessed a significant real-world application of fully digital work experiences during this period, representing a large-scale implementation. In contrast, countries such as Sweden, Denmark, and Estonia had already gained extensive experience with digital transformation on a broad scale. These varied experiences underscore the need for support in navigating digital shifts and the lack of simple, effective frameworks for understanding the effects of digital transformation on cognition and social interaction.

This paper builds on Böhm's [1] contribution at the 2022 eKNOW conference held in Porto, Portugal, making several valuable contributions extending the original content: 1) an expanded time-frame including 2023 promotes a shift of focus to post-pandemic conditions reflecting the current movement of organizations to use digitally supported communication; 2) an increased depth and breadth of theoretical foundations, as the SOAC concept is embedded within the theory of social energy, providing new insights and understanding of

relationships between these two concepts; 3) an extension of potential applications of the SOAC concept in three areas.

In terms of knowledge management, the pandemic situation offers a unique context for the use of information technology in developing knowledge intensive businesses and activities. Much can be gained by reflecting on experiences during the pandemic from the perspective of knowledge management considering the interactions among human users (mostly) using digital channels.

Initially, during early stages of the pandemic the technical challenges dominating the agendas of businesses, organizations and academia included improvement of infrastructure, availability of software systems and the development of necessary skills. Yet surprisingly, the challenges that were at first considered major barriers to technology adoption within the knowledge management community were resolved rather quickly. For example, collaboration challenges in the digital world were solved with new tools and strategies, which gained almost immediate acceptance, becoming the "new normal" of online interaction. As the duration of the pandemic extended into the second year, it became increasingly apparent that the new mode of digital interaction had unique properties resulting in both advantages and disadvantages. Advantages included the ability to establish immediate connections between colleagues and peers; communication and collaboration between individuals and groups of all sizes was facilitated by a wide range of useful tools that were developed on demand as new needs, requirements and features were identified. Geographic distance and location were no longer impediments, meaning frustrations with travel times were non-existent. The transition from paper to digital in office settings became a reality, and its implementation lead to easier and more efficient ways of knowledge sharing among office staff. Disadvantages included the difficulties in differentiation between working time and free time as boundaries became much more blurred; the significant increase in frequency and duration of digital meetings; and the shrinking availability of time slots for concentrated work. Despite massive use of digital communication tools, the individual feelings of loneliness and isolation increased, as informal conversation or communication became more difficult or simply did not occur. This has hindered informal knowledge exchange and will

continue to have a negative impact on human health and well-being. The long-term negative effects led to a unique form of tiredness and exhaustion, which became known as “Zoom fatigue” [2]. Recent research has validated this effect in a study carried out in Germany [3].

Channel reduction theory (from the German “Kanalreduktionstheorie”) [4] assumes that remote communication generally has deficits. Recent studies identify a shift in relationships between communication partners. At the same time, new phenomenon starts to emerge: 1) Intimacy between communication partners can be even higher in an online setting, because the situation leads to a higher readiness of self-revelation (phenomenon: “talking to a stranger”); and 2) digital settings often focus only on the factual level. These new developments are positively received as communication is more efficient and less status oriented, referring to the disentrainment hyperpersonal model of computer mediated communication [5].

Based on the situation described above, “this rapid and large-scale switch from in-person to remote interactions”, had already been identified in the literature as remote living or “Telelife” [6], which emphasizes that people will collaborate more remotely. Given these observations, it is clear that the massive application of technology mediated communication and collaboration does not only have benefits and positive effects, but also drawbacks – which is to be expected in massive use of any technology. Therefore, the right balance between digital interaction and direct interaction of human actors is of critical importance and warrants more in-depth exploration and consideration.

Direct interaction between human and digital interaction, in which technical means are used for the communication (e.g., a phone call, a chat or a video conference call) are perceived differently in terms of richness and cognitive load, as well as towards trust building and perceived interactivity. As this might simply be due to the fact that the channels are less rich [7], [8], both channels will be included in this current analysis. In essence, most users perceive direct interactions as more attractive and easier to use than digital interactions. This became increasingly clear during the COVID19-pandemic with the switch to solely digital interaction for an extended period of time. With this understanding in mind, it is important to address the questions of when and how: When to use each channel? How to more effectively interweave the two channels?

This paper introduces the concept of the Social Accumulator (SOAC) as an explanation model for the digital interaction of human actors, focusing on both positive and negative effects of computer supported collaborative work (CSCW). By emphasizing different factors in a simple conceptual model, the SOAC supports the interweaving of digital and in-person channels during communication and collaboration activities.

The paper is structured as follows: Section II provides an overview of the concepts of social energy; Section III introduces the concept of SOAC; Section IV provides an

illustration of positive and negative characteristics effecting the SOAC of human actors; Section V presents application areas of the model, including challenges for implementation. The paper concludes in Section VI with a summary and an outlook for future research.

II. SOCIAL ENERGY

The concept of energy is a crucial element in understanding psychological well-being, yet there is no standard definition of energy in the body of relevant literature. According to Lavrusheva [9] it is often linked with vitality, vigor, and overall well-being. Lavrusheva has identified five characteristics of vitality, which are also applicable to the energy concept. First, vitality is subjective, reflecting the feeling of aliveness and energy of an individual. Therefore, assessing energetic or vital states depends on self-reported evaluations, resulting in various interpretations. Second, vitality is deeply tied to positivity, involving a positive sensation of energy [10]. This means that energy is frequently associated with positive experiences. Third, vitality is in an ongoing state of fluctuation, as it becomes depleted and replenished, which encourages comparison to a renewable resource [11], [12]. Fourth, vitality can be regulated and managed by individuals, which can assist in dealing effectively with life's challenges and improving performance at work [13]. Fifth, vitality includes both physical and psychological aspects, underscoring its comprehensive nature [9].

Klijn and colleagues [14] have also outlined four dimensions of “personal energy”, namely physical, emotional, mental and spiritual. The *physical* dimension pertains to nutrition, exercise, sleep, and overall physical health. *Emotional* energy involves positive emotions and the avoidance of negative emotions, contributing to feeling “energized”. The *mental* energy dimension emphasizes cognitive focus and maintaining a peaceful mind, similar to Csikszentmihalyi's flow [15]. Lastly, *spiritual* energy relates to beliefs and personal values, where feelings of meaningfulness lead to an energized state.

Among the various theoretical frameworks that have been applied to the study of vitality, self-determination theory (SDT) is one that is most commonly [9]. Developed by Deci and Ryan in the early 1970s [10], SDT argues that individuals have inherent psychological needs for autonomy, competence, and relatedness. As explained by Ryan and Frederick [10], when these needs are fulfilled, individuals experience an increase in vitality. Autonomy involves a sense of self-directed behavior and volition, leading to greater satisfaction, intrinsic motivation, and authenticity. Competence refers to the desire for skill development, aligning with personal values and interests, fostering a sense of achievement and self-efficacy. And finally, relatedness emphasizes the importance of social connections and a sense of belonging, fulfilling the inherent need for meaningful relationships and emotional support.

In conclusion, the exploration of “energy” and “vitality” in psychological well-being reveals the multi-dimensional nature of these constructs and their interplay with individual and social factors. An aspect that is particularly interesting from the standpoint of social energy is the need for relatedness.

Social interactions have long been recognized as energy-consuming processes, as posited in the communicate bond, belong (CBB) theory, which is based on human energy management (HEM) [16]. HEM is guided by two principles: energy conservation (where individuals seek to minimize energy expenditure) and energy investment (where individuals invest energy to achieve valued goals, often with the intention of conserving energy in the long run) [17]. One of the valued goals in energy investment is the “need to belong” [18], which drives individuals to invest social energy in interactions to fulfill the desire for connection and avoid disconnection, ultimately resulting in feeling energized.

One current definition of *social energy*, is put forward by Hall and Merolla who define it “as the behavioral, perceptual, emotional, and cognitive tasks required for engaging in social interactions” [19], where the level of social energy plays a significant role in determining the outcomes of these interactions. Both connecting and disconnecting socially demand substantial energy expenditures [20]. Interestingly, research has shown that individuals who feel more connected after a social interaction are more likely to seek solitude later in the same day, suggesting a need for energy recovery [20]. It has also been shown that repeated social interactions lead to the investment of more energy in relationships, resulting in reduced energy requirements during future interactions [21]. These findings support the CBB model as it maintains that energy recovery takes place during periods of solitude.

Various factors influence the level of social energy expended during interactions. Topics of communication, personal interests, and characteristics of conversation partners all play a crucial role [20]. Interaction length also affects energy expenditure.

In a separate study, Hall et al. investigated which communication media is most suitable to satisfy the need to belong [22]. Face-to-face interactions were found to have a primacy for promoting connection and avoiding disconnection. However, the results for video-calls were inconclusive, with mixed evidence for their ability to foster connecting and avoid disconnecting.

In conclusion, the SOAC model, especially its focus on the need for relatedness, provides valuable insights into human energy management during social interactions. Understanding the dynamics of energy expenditure and recovery in social settings contributes to a deeper understanding of human behavior and well-being.

As noted, the medium in which interaction occurs plays a significant role in determining the amount of social energy that must be expended to satisfy the need to belong (CBB) or the need for relatedness (SDT). The COVID-19 pandemic has popularized videoconferencing in unprecedented ways (both in terms of frequency of use and length of use). At the same

time, there are indications that videoconferencing can be exhausting and often results in the opposite of feeling energized, culminating in the phenomenon of “Zoom fatigue”. Shockley et al. [23] determined that one major cause of fatigue lies in the way individuals present themselves through the camera. Self-presentation is fundamental to any form of interaction [24] as individuals strive to appear in a positive light. Self-presentation requires a high level of self-regulation and monitoring. Thus, it is an activity that consumes energy. When a person sees their own image on the screen, it leads to an increased use of self-evaluation [25]. Simultaneously, uncertainty grows, as only a small video clip is visible. Users continuously receive non-verbal cues that are incomprehensible due to the limited video frame. Perception of the images is only possible in 2D, and the other three senses are not directly engaged. Furthermore, reciprocal eye contact is not possible, affecting perception [26]. This results in uncertainty along with further increased use of self-monitoring [27]. The use of the camera is tiring, but Bennett et al. [28] describe various ways to reduce this fatigue or even reverse it. Indeed, their research asserts that video conferencing can be a good way to satisfy the need to belong. Bennett and colleagues identified seven recommendations for reducing fatigue and increasing energy:

1. Holding meetings earlier in the day can help to reduce fatigue, since they would be scheduled when employees are generally less tired, according to Hülshager et al. [29]. Consequently, meetings as emotionally charged events [30] could even have a positive impact on the energy curve of the day [30].
2. Enhancing group cohesion helps to reduce fatigue by making participants feel more connected with each other and increasing interest in participating in meetings, thereby minimizing attention-demanding efforts and associated fatigue, as shown by Kaplan and Berman [31].
3. Muting the microphone during a meeting when not speaking can help to reduce attention and thereby fatigue, as proposed by Kaplan [32], since it minimizes distractions from background noise, lowering the mental effort required to maintain a quiet environment during the meeting.
4. Turning the video camera on during a meeting can affect the sense of group belonging, as it helps a person to feel more connected with the other participants, which could reduce fatigue.
5. Turning the video camera off during a meeting helps to reduce the number of visual stimuli on the screen, which could decrease fatigue. With the video camera turned off it helps a person to spend less time worrying about their appearance or what is happening in the background while enhancing the sense of group belonging.
6. Breaks during and between video conferences are an effective way to reduce fatigue, according to Kaplan

[32]. These breaks provide participants with the opportunity to mentally disengage and switch off, which is of critical importance when there are no natural breaks occurring between meetings.

7. Establishing group norms can reduce fatigue, as they eliminate uncertainties about acceptable behavior, thereby reducing the mental effort required by participants [32], [33]. Additionally, strong norms could enhance the sense of group belonging, helping to increase interest and participation in meetings, which could further reduce fatigue.

To summarize, it can be concluded that the concept of social energy is a broadly researched topic that has gained new attention within the context of the pandemic situation and the massive use of digital communication channels, and has had a lasting impact on the way people communicate and collaborate with each other in both enterprise settings and educational settings. The ideas presented in this paper provide insight into the current evolution of the workplace of the future (often referred to as “New Work”) that is only just beginning. This evolution will be driven by (positive) social energy as it achieves an interactive and long-lasting change process [34]. An explanation model that makes the changes brought about by social energy more visible, would be a valuable contribution to this context of evolution and change.

III. THE CONCEPT OF THE SOCIAL ACCUMULATOR

The main contribution of this paper is the concept of the SOAC, which serves as an *explanation model for the characteristics of (intensified) digital interaction*. The authors perceive a need for deeper understanding of the positive and negative effects of digital interaction in a simplified form in order to plan, facilitate and execute digital communication and other forms of direct communication in the most effective way, without needing to be an expert in that research field. The concept of the SOAC provides insight and guidance in achieving the right balance between traditional and digital communication and interaction in an increasingly digital world. The SOAC concept is also very relevant, offering valuable contributions in the discussion about the future workplace [35] and post pandemic education models [36].

The SOAC builds on the analogy of an electric accumulator that stores electric energy, transformed to the aspect of interaction between human actors. Recharging activities are providing an energizing element and feel good for the humans interacting with each other. However, there are also draining activities which are perceived by the human actors as taking energy from them. These positive/negative or charging/draining aspects with the perceived social or personal energy have also been identified by other models, as elaborated in Section II, but the SOAC incorporates those observations and bundles them together by using a metaphor that is easy to understand for non-experts, as it draws from our everyday experiences with rechargeable batteries. This approach of connecting to everyday experience is also supported by [37] who

investigated the appropriateness of a battery shaped icon scales to represent energy levels. Figure 1 illustrates the concept of a SOAC.

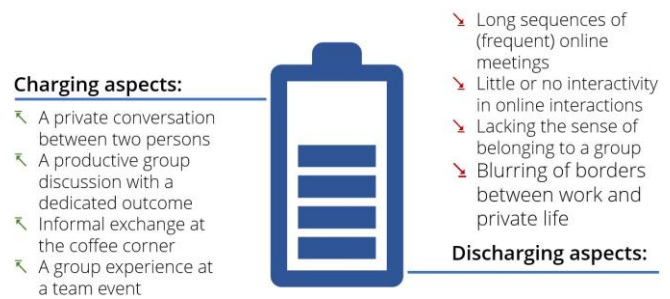


Figure 1. The social accumulator (SOAC) concept with examples of charging and discharging aspects.

The term social accumulator is not a common term, although it is briefly mentioned over ten years ago in [38], albeit within a very different context, namely the social status of youth.

A related concept to the SOAC is the term “social battery”, which is not a medical concept, but rather a “metaphor for explaining how much energy a person has for socializing” [39]. This metaphor relates to the SOAC in terms of conceptualizing the limited capacity that each individual has for engaging with others (“socializing”). This limited capacity depends on individual aspects, such as personality (e.g., being more introverted or more extroverted), as well as social interaction (which can lead to feeling either drained or recharged, depending on one’s personality) [39], [40]. In addition, a number of aspects have been identified that deplete the social battery (for instance, a person’s social network, the type of interaction, the size of the group, to name a few), but there is no mention of the digital channel or digital tools as a potential cause for depletion. Therefore, the social battery concept differs from the concept of the SOAC, which has a special focus on digital channels and the use of digital tools, in order to effectively balance draining and charging aspects. The concept of a social battery is mostly used by youth in the generation Z, and is often related to social media settings [40]. Research is still lacking on the term and concept, but it is interesting to note that there is an awareness about limited capacity, including charging and discharging aspects of social interaction, especially in younger generations that might even lead to consequences like social burnout [41]. Relating to the observations of social energy in Section II, there are similar characteristics found in a number of models. The authors interpret these similarities to mean that the existence of social energy can be viewed as a valuable and finite resource, a viewpoint common in younger generations who are intuitively aware of both benefits and limitations as they monitor their interactions more or less closely. Digital technologies (especially in the domain of social media) may amplify these

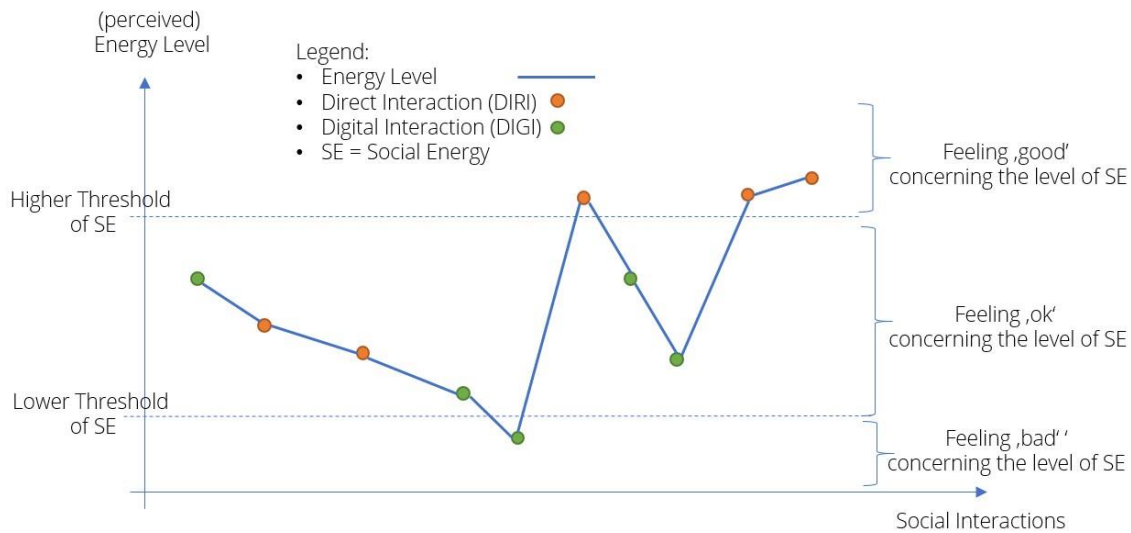


Figure 2. Changes in the SOAC charging stage influenced by direct interactions and digital interactions over time.

effects, which contributes to the awareness and the potential negative effects (e.g., affecting the “need to belong” [18], both in a positive or a negative way).

For the sake of completeness, it should be noted, that the term social battery is misleading in terms of the analogy to the technical concept of a battery: an ordinary battery cannot be recharged without damaging it, whereas an accumulator can be recharged multiple times. The authors therefore prefer to use the term *accumulator*.

Furthermore, the authors are convinced that the metaphor of a battery charging or discharging enables the intuitive perception of comparison with communication or cooperation activities. In terms of digital interaction, it is important to consider the general observation that a direct conversation between human actors (“face to face”) is perceived as richer and more satisfying than a digital interaction. Therefore, the SOAC concept identifies in-person types of interactions as positive (charging) activities, while extensive digital interactions are identified as negative (discharging) activities, in line with the concept of zoom fatigue.

Based on these observations the concept of a SOAC is “charged” in (most) direct face-to-face interactions of human users and “discharged” in (many) digital interactions. Recent research [42] has found that a low level of interaction between participants in a digital domain might also lead to the perception of fatigue. However, the involvement of all stakeholders in a digital communication is important, which can be easily overlooked in this context. When balanced correctly a viable amount of social energy is available for the human user, and the interaction is perceived as sufficient. If the level drops below a certain level, this becomes a (perceived) problem, affecting the well-being of the user, especially if the situation continues over a longer timeframe (which explains observations from the longer COVID19 periods). If the level substantially exceeds the average energy

level, then the interaction is perceived as a valuable interaction (e.g., users refer to a good chat as being inspirational). If this excessive level situation occurs more often, then the context of the interaction is positively perceived (e.g., an inspirational workplace or motivating group). Figure 2 illustrates the process on a schematic level.

It is important to note that neither digital nor direct interaction are inherently negative (discharging) or positive (charging), but that with the right balance or orchestration, both charging and discharging effects are important for a functioning communication relationship between the participants. In the context of active management of social energy of individuals and groups, it is important to monitor and influence the levels in such a way that they remain above the lower threshold and at times exceed the higher threshold in order to achieve “inspirational peaks” in individual or group collaboration. Due to the greater importance of digital interaction and the limitations of digital channels in terms of richness for all senses, social energy management in this area is even more important. In this case, awareness of the SOAC charging level for individuals or groups can be used as a management objective.

The level of social energy available to human actors has a strong influence on the ability to create and share knowledge, and could also affect levels of creativity and innovation [40], thereby resulting in a strong impact on knowledge intensive activities (e.g., in companies or in educational institutions).

The relationship between social energy and communication is not adequately defined and described only informally in the literature [43]. In the context of this paper, social energy is defined as the individual and subjectively perceived energy level of a human actor in terms of their capability or willingness to participate in or contribute to a physical or digital conversation.

As discussed in Section II, the concept of social energy has multiple dimensions, leading to many different effects. Figure 3 presents the most important dimensions of social energy, personal energy, and the effects of digital communication. A special emphasis is placed upon digital communication, which is influenced by the other two dimensions. For example, the level of personal energy at a specific time of day may impact the perceived energy level of the SOAC (which might not relate to the digital communication channel, but rather to personal circumstances). An assessment of the individual SOAC level should also consider other dimensions as contextual parameters.

As an immediate result of the charging and discharging effects, social energy has a strong impact on knowledge related activities, such as knowledge creation, knowledge sharing, knowledge use and knowledge transfer. Social energy changes over time and even during a conversation. Parallel to this, the management of social energy is not usually the main focus of the interacting users, and consequently, may not be noticed early enough to intervene before the primary activity is harmed or influenced.

The *awareness* created by the SOAC model enables reflection on a person's communication and collaboration situation, making it possible for the actor to take appropriate and effective action.

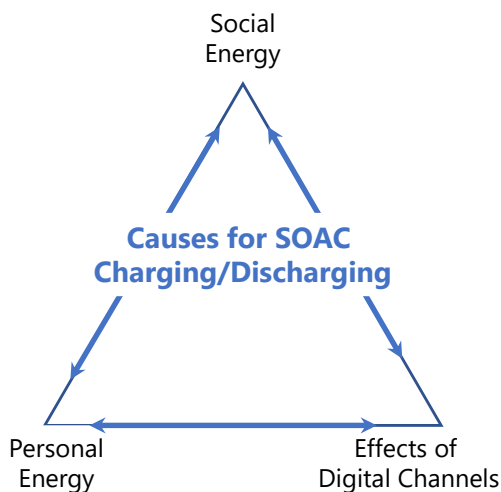


Figure 3. The different influences on charging and discharging effects of SOAC, with an emphasis on the effects of digital channels

Assessing the current situation provides a starting point in becoming more aware of the SOAC charging state, and with reflection can lead to a change of the communication mode (e.g., from digital interaction to direct interaction). Possible next steps taken by a human actor could involve tracking social energy over time to learn more about positive and negative aspects on digital interaction from their individual perspective.

The intent of the authors is to use this model to explain the dichotomy of direct vs. digital communication. The focus is

placed on the channel and its methods and characteristics. It is clear that human interaction is also largely influenced by the topic of the communication, along with the opinions and general feelings of human actors. These aspects have positive and negative aspects, requiring specific and appropriate responses (e.g., conflict resolution). However, these responses are not dealt with in detail within this paper.

IV. CHARGING AND DISCHARGING THE SOAC

The aspects and characteristics of both digital and direct communication channels can be considered in terms of their charging effects (adding social energy to the SOAC) and the discharging effects (taking social energy from the SOAC), which will also be a subject for detailed future research. Some general observations regarding “Zoom fatigue” have already been illustrated in Section II. In order to examine the effects on digital channels and direct interaction in greater detail, some examples of both categories will be described in the following subsections.

A. Positive aspects charging the SOAC

To illustrate the positive (charging) aspects that increase social energy some examples are described below in more detail:

1. *A fruitful conversation*: between two human actors that evolves into interesting and sometimes unexpected results is a good example of a charging activity. Very often it is not only the exchange of information, but the overall situation, including gestures and mutual empathy that makes a positive impact. As an important side effect psychological safety is created in such situations.
2. *An informal talk*: at a coffee corner or similar place is a form of latent communication that happens as a by-product of another activity (e.g., taking a coffee). This often leads to the exchange of interesting information, knowledge sharing and even the creation of new knowledge stimulated by the situation. The main characteristic is spontaneity that it is unplanned, but not unlikely. These events happen less frequently in digital interactions. A possible explanation for this could be that interactions in digital environments are less frequent and less original.
3. *A team experience*: almost always requires a presence setting to allow for the emergence of team spirit while working on a common goal or being submerged in a joint activity. Very often these activities serve as trust building entities for new groups or are reassessing mutual trust levels for an existing team charging the SOACs of the participants. Such settings can create transparency within the group as an important side-effect that fuels the positive perception of the group-members.

4. *A collaborative activity*: working together within the same time and space toward a common aim can contribute to the sense of belonging and might even stimulate a mutual learning from the observations and activities of the people involved. The joint goal and making contributions to it provides opportunities for charging effects for the SOAC. When working together on the same physical object (e.g., a shared physical whiteboard or similar collaboration space) the perception of joint work might also be intensified.

B. Negative aspects discharging the SOAC

To illustrate the negative (discharging) aspects that decrease social energy some examples are described below in more detail:

1. *A high frequency and/or long duration of digital interactions*: might be considered as tiring to the human actors. This fact has been reported in a number of studies and it is important to clarify that this could also occur in situations in which only one of the human actors is under such a high load of digital interaction leading to a communication setting which is perceived very different by the participants (e.g., a team lead that is connecting to its peers in a 1:1 session).
2. *Few interactions during a digital interaction*: are another impact factor that is adding cognitive load to the human user, especially if the video setting is static, which requires additional effort for the human brain to remain focused. When presentation settings are transferred 1:1 from an in-person setting, they are often perceived as more demanding in the digital communication and take more time or include more interactions to retain the attention of the audience.
3. *The perception of constant availability*: for human actors also adds to the perceived stress level. The lowered barrier of getting in contact with the other participants in a synchronous interaction might impact the current working process. The cultural assumption within the organization that everyone is expected to be almost always available and instantly can lead to less efficiency in the working tasks and a high level of engagement at the same time.
4. *An imbalance of the presence for different users*: When different means of participating in the digital communication are used with different levels of channel richness (e.g., video on/off, different audio quality) the perception of direct engagement and involvement might vary among the users, leading to a discharging effect on human users, independent of their role in the setting (active/passive). It is a challenging situation for presenters if they cannot “perceive” their audience because the cameras are turned off and the level of interaction is limited.

V. POTENTIAL APPLICATION AREAS OF SOAC

In this section potential application areas for the SOAC will be explained in detail. It is interesting to note that the SOAC can serve different purposes in diverse application areas. From a knowledge management perspective, the charging and discharging aspects of the SOAC are helpful to identify barriers in the related fields of knowledge (co)-creation, knowledge sharing and knowledge use among the different actors in the application settings that are described below. The concept of the SOAC can also contribute to achieving the right balance of in-person activities and online activities in the post-pandemic era, in which almost all sectors are reconfiguring their mode of operation in order to anticipate the experience from the past two years, along with the challenges and expectations for the future of the new work(place) [44].

A. The context of higher education

The effects of the COVID19 pandemic and the intensified use of distant teaching has transformed how higher education of the future is seen by students and lecturers alike. Initial studies after the pandemic show that the fast transition to distant teaching had a massive impact, as [43] reported for the medical domain. Although focused on a specific sector, the results could be similar in other areas, especially those where more intensive communication and collaboration is as important as experience and applicable knowledge for (complex and diverse) problems. Learning from these experiences is important not only to be better prepared for similar situations in the future, but also to strike a balance between face-to-face and distance learning (sometimes referred to as hybrid learning) in academic institutions.

Due to those experiences higher education institutions (HEI) will have to reflect on how to modernize the education in post-pandemic age with a mixture of in-person and distance teaching activities. It is very likely that even education programs that in the past have relied solely on in-person teaching will (have to) include some form of distance learning elements into their curricula, also due to expectations of Generation Z [45]. Even hybrid settings where in-person teaching and distance teaching occur simultaneously might be a valid scenario for the future.

It is obvious, that some topics are more suitable for distance teaching than others (e.g., labs and exercises), yet some students will favor digital interactions, while others will prefer a more direct interaction. Balancing those two forms of interaction between lecturer and students in the right way (in terms of didactic requirements and individual preferences), will retain a competitive advantage for an HEI in a market that is constantly becoming more competitive and globalized, due to extension into the digital domain by market participants (e.g., Coursera, Udacity and others). Additionally, a generation issue is currently felt in this area as the behavior and expectations of lecturers (often members of Generation X or Y) and students (often members of Generation Z) differ substantially, as [46] reported.

From a post-pandemic perspective, it is interesting to recognize the initial movement away from online teaching and the return to in-person teaching, on the student side as well as on the lecturers/HEI side. With the model of the SOAC in mind, this shift can be explained by a reaction on the number of discharging effects given the massive use of digital channels that needed to be compensated by social interactions (charging the SOAC). For some groups this effect has already been mitigated, since the positive aspects of distance learning, such as time and location independence gained focus again, which has led to requesting more digital channels. From a SOAC perspective, this development can be explained in a fully recharged state (by direct interaction) that provides enough energy for a set of digital interactions. In the long-term, it will be important for HEI to understand the duality of in-person and online teaching, and to *use both modes in a systematic and planned ways* that helps lecturers and learners to plan the different activities in the most efficient way. The SOAC model might support this development of understanding in this context as a balancing device. Otherwise important experiences and knowledge gains within the HEI are in danger to be lost as initiatives of individuals may not be valued and recognized, and investments in technology might not be used as planned, which will prevent their maintenance and iterative development.

The SOAC helps instructors to derive a measurement system during planning and execution of their teaching to find the right mix of direct and digital interaction. For students SOAC can function as a tool for self-reflection on individual learning preferences, in terms of their preferred form of communication, helping them to adapt accordingly by becoming aware of the advantages and drawbacks of digital interaction.

B. *The context of professional trainings*

For professional training in workplace settings and as part of lifelong learning, the results of the COVID19 pandemic revealed to companies and trainers that digital training can be effective and efficient. The requirement of traveling to a training became less of a demand and the integration into everyday work schedules was much easier for digital training, leading to a higher acceptance rate for training in general and budget saving aspects (no travel and accommodation costs). However, the focus on the training itself in an in-person training, along with the direct and valuable exchange between participants and towards the trainer, had been assigned a new value due to the drawbacks of digital trainings. Overall, it can be expected that the market for professional trainings will change, due to the results of the pandemic. Yet it still remains to be seen what exactly the long-term effects will be.

The SOAC can be helpful in two distinct ways. First, in many organizations, training is still understood as mostly a passive transmission of knowledge, with the focus primarily on content. Aspects of relationship building and interaction are often neglected in this approach. In this context, the SOAC can assist by creating an awareness of the social aspects of

learning, emphasizing the importance of collaboration, communication, and engagement in the learning process.

Second, the SOAC can help trainers design interaction with the participants more effectively by mixing direct and digital interactions so that participants receive optimal benefit from the training. Being aware of the characteristics of the charging and discharging effects helps to establish a level of social interaction that is common in a direct training, and also in a digital setting. The SOAC is not merely another plea for the well-known concept of blended learning, but rather goes a level deeper. It recognizes that the different mix of various learning formats, such as online training, peer-learning, classroom training, self-study, and more, serves not only the design of the content level of the learning process, but also the social energy levels. Unlike traditional models that primarily focus on content, the SOAC emphasizes a more holistic approach. In the SOAC model, content learning objectives are supplemented by "social energy objectives." This shift recognizes the importance of human interaction, collaboration, and engagement as essential elements of the learning experience. Rather than simply transferring information, the emphasis is on creating a dynamic and interactive learning environment where participants can energize and motivate each other.

SOAC helps to incorporate education in professional job settings, achieving a match to the individual requirements, thereby providing a framework for the trainer to derive and monitor the charging state of the participants. The concepts of SOAC can also be combined with more agile approaches in delivering the teaching practices. By emphasizing the human and interactive dimensions of training, the SOAC framework enables a more effective, responsive, and learner-centered approach, which is essential in the ever-evolving landscape of professional learning

C. *The context of companies and digital business*

The third application area highlighting the benefits of SOAC is the digitization process within companies, which have also been accelerated by the pandemic situation. Here, the concept of "New Work" [46][47] became a reality through the perception and evolving work models of many organizations, who had previously resisted such changes. This significant and ongoing change in the organization of companies often leads to more distributed or even virtualized companies, especially in the IT-domain. While it is a common pattern in northern European countries, this is relatively new in the DACH area.

In the post-pandemic context in 2023 a re-evaluation of the office and mobile work (home office) environment is being carried out in many organizations, often moving towards one of the extremes: either (fully) back to the office or (fully) remote work. Some initial studies, such as [49] [35] indicate that there are different perspectives, including the organization, the employer, and also the regulatory side with laws and rules that create a framework. Apart from setting up the rules [49] this perspective emphasizes the need to

communicate an organizational decision to move back to the office, which represents at least one aspect where the SOAC model can be useful as an explanation model (e.g., to (re)build a team spirit within an otherwise distributed team).

The influence of the pandemic can also have future impacts on the workplace based on the experiences and expectations of the new workforce (Generation Z), who demand more remote work possibilities wherever possible, addressing their need for autonomy and freedom. This means the attractiveness of the workplace will also be measured in the dimension of flexibility between working remotely and on-site, which directly relates to direct and digital communication channels and the effects on the SOAC. Some sectors will be more affected by this movement than others; the IT-sector might be a good example as it is an employee-market in the DACH-region (there is more demand than supply for employees) and since the work context is already digital and predominantly digitized.

From a managerial point of view this change creates new challenges for managing teams and projects due to the fact of (perceived) fewer social interactions. From the perspective of digital leadership, these aspects were already being discussed even before the pandemic. Digital leadership refers to both the restructuring of organizational and infrastructural frameworks, as well as the design of new working methods and styles that positively embrace digital transformation. Consequently, it affects both corporate management (including both strategic and operational levels), and personnel leadership. Similar to professional trainings, the focus in many organizations has been less on social aspects and more on technical, strategic, and organizational factors.

Many studies have found that only a few leaders possess the competencies of a digital leader. In a rapidly changing digital landscape, leadership must go beyond merely understanding technology; it requires a blend of strategic insight, adaptability, and a keen awareness of the human factors that drive innovation and change.

In this context, the SOAC can create an easily understandable framework to shift the awareness towards the social aspects of interaction. By placing an emphasis on the relational and interactive elements of leadership, it complements the technical and strategic components. The SOAC underscores the importance of empathy, collaboration, and social engagement in leading a modern organization, particularly in an era where digital transformation is paramount.

The SOAC as a managerial concept will help managers and team leaders to better understand the needs of their colleagues and team mates, and to act according to their (individual) needs, since they are able to sense and classify the charging and discharging activities during the digital and direct interactions. For employees the SOAC functions as a model that helps them to become aware and to voice their needs in terms of communication and interaction over the various channels.

Monitoring the social energy of the members of a group has always been an important task for leaders. However, in a hybrid working environment with a large amount of digital interaction it will be more important to monitor the social energy of the team members and to recharge their SOACs early enough to prevent “outages” that might affect team motivation and performance. The concept of SOAC can help to manage team social energy more actively.

D. Challenges for the application of SOAC

Applying the mental model of a SOAC has its challenges, which are a subject for future research. Some of the foreseen challenges are briefly mentioned in order to provide some hints for the application in the settings described above.

It will be important to retain the simplicity of the concept and to stay as close to the accumulator metaphor as possible in order to make application simple and intuitive for the human actors in the communication process. The notion of the social battery that is familiar to the younger generation might help to introduce the concept.

Likewise, it will be important and challenging to make the current social energy visible for the individual and for the group in order to *create awareness* and the opportunity to appropriately *act on critical states* of the SOAC. A promising approach for teams could be the use of retrospectives as a method from the agile software development for groups [50]. An adapted and simplified version might even work for the individual as a form of self-retrospective that can be mapped to the communication events in the recent period to plot the social energy levels over time. Integration in already established routines will be a key factor in this context, and feedback activities of all sorts might be a promising candidate for integrating SOAC.

Finally, charging and discharging factors will overlay each other and communication setting (in-person or digital) might not be directly related to the social energy level or being conscious for the human users in every situation. Therefore, the identification of relevant communication events and their contribution to the social energy level in a precise way is going to be another challenge. As indicated in Figure 3, personal energy and social energy may also influence the SOAC concept as it focusses on digital versus direct communication and collaboration; therefore, these aspects should be considered as contextual factors. Furthermore, the capacity and the loading/unloading events are highly individual and subjective by nature, which makes a comparison of SOACs of different persons challenging, the observation of an individual SOAC charging state over time might be more promising.

VI. CONCLUSIONS & FUTURE RESEARCH

The main contribution of this paper is the introduction of the SOAC as a mental concept that serves as a simple explanation model depicting the social energy level of an individual or a group, along with the perceived differences of direct and digital interactions. The SOAC concept supports understanding and the interplay between the different forms of interaction and thus enables the improvement of the overall interaction between human users, as both forms are and

continue to be present in our daily professional life. In addition, the paper helps to identify various individual aspects that need to be considered when planning and orchestrating the various forms of interaction. This is exemplified by using application examples from three different fields. The embedding of the concept in the field of social energy clarifies the current state of the art in this domain and explains the contribution of the SOAC concept with its focus on the alternation between direct and digital communication and collaboration.

A limitation of the research is the current focus on the conceptual level. There is a lack of empirical data, the collection of which is the subject of further research in the various usage scenarios mentioned above. This next step will also serve to gather responses from the human actors in the interaction process regarding the understanding and usefulness of the mental model of a SOAC.

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