

Emergent Collaborations Outside of Organizational Frameworks: Exploring Relevant Concepts

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ABSTRACT

The broad notion of communities required a fine-grained vocabulary to investigate how communities interact with digital technologies. We can identify various constructs in the literature, such as temporary groups, coalitions, movements, communities of practice, place, and interest, that can describe different collaborative configurations. Despite the diversity of concepts describing the formation of “collectives”, we still need to understand how the formation of collectives and communities emerges through collaboration. We propose a vocabulary to analyze emergent forms of collaboration and the appropriation of technologies over time. This paper focuses on emergent, spontaneous, or unplanned collaborations facilitated by digital technologies in response to changing circumstances or problems. To frame different types of emergent collaboration, we borrow three concepts from activity theory, urban planning, and educational psychology: knotworking, self-organization, and the formation of publics. The paper examines these concepts in detail and describes their history and how they relate to each other, highlighting their qualities, similarities, and differences. Using these concepts, the paper aims to increase awareness of the complexity of emergent collaboration and its challenges and help designers operate with a more dynamic understanding of collaborative work outside established organizational settings.

CCS CONCEPTS

• Human-centered computing • ~Collaborative and social computing • ~Collaborative and social computing theory, concepts and paradigms

Additional Keywords and Phrases:

Emergent collaboration, Knotworking, Self-organization, Publics

ACM Reference Format:

First Author’s Name, Initials, and Last Name, Second Author’s Name, Initials, and Last Name, and Third Author’s Name, Initials, and Last Name. 2018. The Title of the Paper: ACM Conference Proceedings Manuscript Submission Template:

This is the subtitle of the paper, this document both explains and embodies the submission format for authors using Word. In Woodstock ’18: ACM Symposium on Neural Gaze Detection, June 03–05, 2018, Woodstock, NY. ACM, New York, NY, USA, 10 pages. NOTE: This block will be automatically generated when manuscripts are processed after acceptance.

1 Introduction

The Communities and Technologies (C&T) 2023 conference call identifies the notion of communities “as people who share something in common; this common element may be geography, needs, goals, interests, practices, organizations, enemies, or other bases for social connection.” However, this notion of community remains broad. This is positive because it is inclusive; at the same time, a more fine-grained vocabulary might allow a more thorough investigation of how communities interact and relate to digital technologies. Literature provides us with many constructs referring to various formations of people, such as temporary groups [1], coalitions [2], movements [3], and communities of practice [4], [5], place [6], or interest [7] to describe various collaborative configurations. These constructs are in active use in the C&T community (see, e.g., [8]–[11]). In their theoretical work, Korsgaard et al. [12] also propose the concept of “collectives” grounded in activity theory. There is a need, they claim, for a concept that is more than the ones mentioned above and usually used in fields exploring computer-supported collaborative work, “Collectives” refers to “the social constellations of people who pick up, learn, use, share, recommend, reject, modify and appropriate the many tools that come to play in and around their activities” [12] - in other words, who shape their artifact ecologies. Korsgaard et al.’s collectives are a complementary theoretical construct to artifact ecologies, thus allowing us to understand “how multiple people in various constellations and contexts appropriate a wide range of interactive technologies, devices, services, and platforms to cooperate and collaborate toward shared commitments” [12]. In this paper, we aim to focus specifically on emergent collaboration, which might occur as collectives and communities are forming or might take place inside them, but in different configurations. We propose a set of concepts and vocabulary that help us untangle the relationship between formations of people and their use and adaptations of technologies during the moments when

collaboration between people is emergent. As such, our contribution highlights the importance of understanding how the formation of collectives and communities emerges through collaboration. Thus, we propose a finer-grained vocabulary to analyze emergent forms of collaboration and suggest how such emergent collaborations appropriate existing tools and shape them into artifact ecologies to suit their temporary needs.

In emergent collaborations, participants engage in spontaneous or unplanned ways in response to changing circumstances, often facilitated by digital technologies. These collaborations are not pre-planned or structured but organically emerge as people adapt to changing conditions or problems. They may involve individuals or groups not previously working together and may lead to creating new knowledge, solutions, or innovations where actors come. Literature from C&T and related fields referring – though not always explicitly – to emergent collaborations include research on situations of change, such as emergencies [13], [14], routine tasks, for example, within healthcare but where some of the participating actors are always new and not part of the formal healthcare system [15], or the disruption of usual services due to the Covid-19 pandemic [16], ways in which the self-employed organize [17], as well as volunteer work in other contexts (e.g., [18], [19]).

This paper aims to highlight the main characteristics of emergent collaboration and the challenges that supporting emergent collaboration imposes on designers. To do so, we borrow three concepts from the domains of activity theory, urban planning, and educational psychology. The three concepts – knotworking, self-organization, and the formation of publics – frame different types of emergent collaboration. They have been used in fields like HCI and CSCW (see, e.g., [20]–[22]) but have not been brought together in the way that we propose: we have chosen these concepts and use them together because they allow us to cover a continuum where the emergent collaboration can happen on a small scale like in knots, a small to mid-size scale like in self-organization, and mid-size to large scale like in publics.

The three chosen concepts may establish a discussion in the C & T community about how we approach and consider emergent and temporal collaboration and the terminology we use. This paper examines how these concepts have been used and their qualities, similarities, and differences. We want to unfold, explore, and further discuss how these concepts can refine the vocabulary associated with emergent collaboration in CSCW. We examine these concepts in detail and describe their history and how they relate. Our contribution is to shed light on the broad contexts in which emergent collaboration evolves. These concepts also increase our awareness of the dynamism of emergent collaboration.

Our exploration of the concepts mentioned above highlights their challenges. It increases the awareness of their complexity to help designers operate with a more dynamic understanding

of collaborative work outside established organizational settings.

2 The Diversity of Emergent Collaboration

As a field closely related to C&T, Computer Supported Cooperative Work has provided an extensive corpus of knowledge on understanding collaborative work, albeit from a more organizational perspective. CSCW researchers have used concepts derived from Activity Theory, for example, to analyze collaborative work [23] [24][25][26]. The field of CSCW has also developed theoretical concepts based on a large corpus of ethnographic studies. For instance, Blomberg and Karasti [27] conducted a literature review of ethnography in CSCW, in which they identified a broad and dynamic range of concepts of what may affect how we collaborate, such as situated action, situated awareness, articulation work, invisible work, and so on. All these concepts have shaped how CSCW researchers view the nature of collaborative work and thus shape the design of computer technologies that support cooperative activity. More recently, there have also been explorations targeting the boundaries between formal and informal collaborative work settings and emergent, sporadic, and opportunistic forms of collaboration, as listed in the previous section. As a result, more studies are exploring collaboration beyond the traditional workplace in contexts where the geographical situation, roles, relations, and motivation to collaborate are in continuous motion and development – thus resembling collaboration in communal and collective settings.

In this section, we present the concepts of knotworking, self-organization, and the formation of publics, which we have picked from related literature (see the introduction above). With the help of these three concepts, we aim to highlight common characteristics and differences related to emergent collaboration.

2.1 Knotworking

Knotworking is an Activity Theory concept introduced by Engeström and his colleagues, who analyzed cross-organizational collaboration in contrast to collaboration in a team [28], [29]. Knotworking relates to co-configuration models of production, where companies work with customers to deliver products tailored to their needs [30]. Engeström and his colleagues employed Victor and Boynton's concept of 'co-configuration' [31]. [32] describes a form of work organization that they call 'negotiated knotworking', defined as the 'rapidly pulsating, distributed, and partially improvised orchestration of collaborative performance between otherwise loosely connected actors and activity systems' [33, p. 972]. Knots are characterized by a 'pulsating movement of tying, untying, and retying otherwise separate threads of activity The locus of initiative changes from moment to moment in a knotworking sequence' [28, p. 346].

Several studies have used the concept of knotworking to describe the complexity of collaboration across the boundaries of activity systems, such as the interdisciplinary collaboration among healthcare professionals at a hospital [34] across multiple

healthcare settings [35], or among home healthcare professionals [36]. Knotworking has also been used to describe established work practices that take place outside the borders of classical teams, where work practices are situation-driven and involve various and fluid combinations of actors, for example, in work setting such as law courts [37], and flight crews [38]. In these work settings, the interaction among the actors is orchestrated according to their well-defined practices and individual roles, which allow complex work activities to be accomplished [39]. More recently, and in the field of CSCW, Bødker, Dindler, and Iversen's [40] work on participatory infrastructuring draw on the concepts of knotworking and networking to better understand the kinds of relationships and dynamics that emerge through the process of participatory design. The authors argue that participatory infrastructuring is about 'stimulating the emergence of new knotworks through participatory activities in which participants actively engage in defining the infrastructures to be and then sustain the networks of people and technologies that embrace the new artifact(s)' [40, p. 266]. In Abou Amsha and Lewkowicz's [17] study of collaboration among home healthcare actors with a private practice, they report a case of knot formation in which healthcare actors caring for the same patient at home must collaborate to preserve the patient's quality of life. In general, home healthcare actors work individually: their collaboration is opportunistic and depends mainly on the healthcare actors' willingness. However, when a patient's condition is complicated and involves multiple pathologies, the willing care actors come together in a knot to create a care plan in which they define the patient-care activities and communication. This knot will be the first of many as the patient improves or deteriorates. According to the authors, emergent problems that challenge the existing care plan (e.g., the patient had surgery) comprise the 'pulse' that prompts the formation of the knot that includes current healthcare actors and possible new healthcare actors. In [22], the authors use the concept of "complex knotworking" to analyze collaborative work, which involves a dynamic number of loosely connected actors that happens in episodes and involves constantly negotiated cooperative work arrangements.

Knotworking poses new challenges to work communities and researchers. Unlike traditional procedures of constant cooperative improvement of work, rapid negotiation and improvisation, with constantly changing configurations of participants, is central to the context of knotworking. However, these quick, pulsating negotiations must be embedded in a longer time limit (the entire path of the product or service). For example, the open-source software movement demonstrates this longitudinal perspective: this work creates new opportunities for initiative and innovation from below [41].

To summarize, the concept of knotworking provides a framework for organizing collaborative work across boundaries (organizational and activity-system boundaries). Participants in a knot co-create the collaboration protocol: each knot is different. Knots that include related profiles (e.g., a patient, GP, and nurse) work differently, depending on the preferences of the participants and the kinds of problems/tasks they are addressing. Knot participants may bring their preferences, work practices, and tools

to the knot. In other words, the absence of protocols for collaboration or any pre-established form of collaboration allows the participants to create and, over time, re-create their collaboration process, tools, and rules. According to Bentley and Dourish [42], systems that support collaboration may be classified according to two categories: systems that provide 'mechanisms' to structure collaboration and systems that provide a 'medium' that the users may shape rather than the technology, in and through which the collaboration occurs. For example, the wiki for Wikipedia members is an example of the system being used as a medium; the wiki allows information structure to emerge as collaboration occurs among numerous actors working on a subject. In the process of knotworking, participants in the early knots may need a 'medium' that they can shape while shaping their collaborative practices. However, when a knotworking process becomes more stable, the tool should allow actors to preserve and enforce best practices learned by those actors who participated in multiple knots around an object. Such a system will be more like a mechanism that shapes the collaboration of future knot members.

2.2 Self-organization

The term 'self-organization' has been used only occasionally in CSCW. It is casually used by Schmidt and Bannon [43] to convey the opposite of the organization of more formalized work. In relation to studies of wikis [44], [45], self-organization is also used to describe bottom-up and self-organized ways of working versus a 'top-down strategy driven by a department manager' [45]. Rohde et al. [46] write about how a self-organized community of students builds communities with web-based systems.

The concept of self-organization is used in studies of complex adaptive systems in both the soft and hard sciences to refer to the way in which 'multiple agents (living or inanimate) interact, producing unintentional order without guidance from outside the system' [47, p. 20]. More recently, urban planning scholars, such as Boonstra and Boelens [48], have used the concept of self-organization to reconsider user and stakeholder participation in urban planning: they describe self-organization as referring to 'initiatives that originate in civil society itself, via autonomous community-based networks of citizens outside government control which participate in developing the "urban fabric"' [48, p. 99]. This foregrounds the idea of groups of people self-organizing around a concern but doing so outside the organizations that usually address such concerns. In Boonstra and Boelens' example, people self-organize outside the structures of government to influence government decision-making: 'we define self-organization in urban development as initiatives for spatial interventions that originate in civil society itself, via autonomous community-based networks of people, outside government control' [48, p. 100].

Bødker et al. [49] report on a self-organized, volunteer-based community that emerged and shaped itself around the desire to obtain locally-produced organic food. In this case, [49], no explanation of the term 'self-organization' is provided. However, an article on urban planning by one of the same authors uses the same case study of a self-organized organic food community [50]. There, the term 'self-organization' references Boonstra and

Boelens' concept of this as participation that is prompted by and takes place outside government or official structures [50].

Weise et al.'s article [51] on designing civic infrastructures also uses the term 'self-organization' in the context of a group of peoples' capacity to self-organize, and they also refer to Boonstra and Boelens' paper, to pinpoint the difference between participation that is prompted by governmental mechanisms, and those that emerge outside of it.

White et al. [52] use 'self-organization' to describe spontaneous disaster-response efforts. Starbird and Palin [53] also use 'self-organization' in the context of disaster response but define the term with reference to the concept of 'emergent organizations' from the field of the sociology of disaster. They refer to Dyne's definition of emergent organizations as "organizations that did not exist before a significant disruption of the social order"; in other words, these are 'groups of people that previously had no standing structure or defined tasks' [53, p. 1078]. The other organizational type – established, expanding, and extending – has varying degrees of pre-existing structure and task definition. These emergent organizations are generally self-organized and are shaped by the progressive manifestation of some key features, something Starbird and Palin [53] use to highlight the mechanisms of self-organization in their casework on Twitter volunteers during disasters.

The various understandings of self-organization, as referred to in, or linked to CSCW literature, seem to converge when referring to how people come together around a shared interest and the kind of collaborative work that is not formalized or takes place outside formal organizational frameworks. These examples foreground a certain sense of freedom in choosing how collaborative work is undertaken. Their bottom-up, loosely shaped formations enable people to come together and achieve concrete outcomes through their own efforts without waiting to operate within the existing structures for disaster response or food distribution, for example. This concept supports an emphasis on the work done to make things happen as a response to an external trigger, but if we take Boonstra and Boelens' interpretation and its application in the organic food community case, it also allows us to address participation in collaborative activities that originate outside the established organizations that usually address these concerns.

Bødker et al.'s [49] study of a local organic food community also demonstrates how in this instance, self-organization references the initial formation of a group of people that later became a community and a registered association: it started with the efforts of two women, and, six years later, became a community of 900 members. Referring to the organic food community as self-organized highlights the original mechanisms of its formation, as well as the community's ethos of pursuing self-organization in terms of doing things for themselves.

The challenges of designing for self-organization have been reported in relation to the scarcity of resources usually available to self-organized communities because these are often volunteer-based groups and operate outside established organizational settings. Bødker et al. [49] report the local organic food community's difficulties in finding financial and labor resources to create their website. Also, even if official bodies such as local

governments or municipalities are sympathetic or collaborate with self-organized communities, they are not yet equipped to provide them with the technological support of any kind. Self-organized communities end up relying on widely accessible and often free technologies provided by global giants with unclear terms, such as Google or Facebook, and sometimes on wiki-based technologies if they have the technical know-how to operate them [54]. Self-organized groups sometimes creatively adapt certain existing features (e.g., the use of the Facebook group's photo albums to follow up on and organize pet rescue during major disasters [52]) but do not have the means to shape the technology more directly they use, unless they find ways to design their own, and develop or pay for it themselves [19].

2.3 Formation of Publics

The modern concept of publics was developed by Dewey [55] in the context of educational psychology. In "The Public and its Problem", Dewey enters the political debate and discusses the nature of democracy. He argues that the public forms as a reaction to a negative influence that must be combatted [55]. The public emerges only in such situations where people feel they must come together to resolve a serious enough issue.

Although the idea of a public is ancient – the word stems from Latin – Dewey conceptualized it in a form that would later become a tool for understanding and designing collaborative work. Le Dantec and DiSalvo [20] use Dewey's concept of publics in their work on the formation of publics. They present the idea of the publics as the coalescing of groups of people around a shared concern and emphasize the role of attachments in the formation of the publics. People become part of the public through their attachment to a problem or concern. There is not one public, but many, representing a multitude of voices and concerns. Le Dantec also defined publics as 'the combination of identifying a shared issue, one that crosses multiple stakeholder boundaries, and then in working toward a common end to overcome or resolve that issue' [56, p. 2]. He also highlights that, as noted in Dewey's work, publics emerge as a response to a concern and not a priori the concern has been raised [ibid.]. Publics are highly dynamic and responsive by nature and may benefit from collaborative technology support, including information exchange, support for connecting and maintaining contact among peers, and onboarding new actors. Over time, some publics may stabilize and transform into organizations or other formal structures that work towards a specific goal, whereas others come and go. Some publics involve actors that usually collaborate or have collaborated before a public was formed. The concept of publics and its use in collaborative design challenge designers and systems design. In collaborative design work, we usually know for whom we design, and we may even have previously designed with the particular, existing, and predefined group in question, using Participatory Design, for example. We often design together with the intended users, or at least with these users in mind. When designing for collaborative work to define publics, we cannot design for an existing group of users until the group has formed. That said, the notion of publics could help designers to understand and design for social

movements before they take shape. Then, as a public is formed, design may be a tool that actively supports the now-existing public and its needs.

Recent examples of large-scale publics include those that emerged in response to political and global events, such as the many refugees coming to northern Europe a few years back and environmental concerns like microplastics and CO2 emissions. Regardless of your views on these examples – for example, whether we must decrease our environmental footprint to save our earth for future generations or not – both sides may be described as publics. As with the refugee example, there are two or more sides, and each side constitutes a public. Many people have worked with the pro and con sides of these or similar concerns for a long time, some as individuals, whereas others have organized (to various degrees) to raise awareness and work to implement favorable (from their perspective) changes (e.g., to prevent refugees from coming to Europe or to help people arriving in these countries, welcoming them, and providing food and shelter when needed). When these examples appeared on the broader public agenda, for example, through media news and political debates, publics emerged. Sometimes, the actors in these publics may work with existing groups of people and already active individuals, and sometimes independently, and although differences may exist among some of the actors, they are all part of the same movement. Publics may also be small and address a local concern, for example, a city community. Le Dantec and DiSalvo and Le Dantec et al. [57], [58] present and discuss such publics, here, two publics formed around a shelter for homeless people (one being the homeless visitors and the other being the staff) and supported by a technological intervention called ‘Community Resource Messenger’. They discuss not only the technological platform that supports the two publics over time but also how the new tool changed things, such as the division of labor at the shelter. Ludwig et al. [59] have applied ICT as a tool to study the formation of publics, rather than to shape or form them. A public may be perceived as ‘A locus in which material resources and discourses are appropriated and exchanged’ [60, p. 127]. Chay-Nemeth [60] describes resources as crucial to publics, but resources are seldom discussed in detail when we consider CSCW-related literature on publics.

DiSalvo [61] has discussed how publics are designed, and when studying how publics are constructed, an understanding of the role of technologies in supporting their construction is relevant. Our point of departure is slightly different than DiSalvo’s [61], as we are interested in the technology that publics appropriate and use during their formation and lifespan rather than in how to design and construct publics. The challenges of supporting publics through technology reside in having unknown parameters; for example, when actors do not know about each other, it becomes difficult to identify and implement technical support tools. Indeed, it is challenging to design tools for a community before it exists, and hence does not know its needs. Once a public is created, the tools must become available to individuals that may not meet physically or that are not even aware of one another.

Regarding the three concepts or modes of collaboration presented above, there are notable similarities and differences.

Also, at a general level, many systems and situations may be studied by using one or more of the presented concepts. We will now analyze these three concepts with the aim of making them and the relationships between them clearer.

3 Analysis

We have seen how the three concepts presented separately in the previous section allude to emergent collaboration. This section examines the three concepts together and identifies some of their characteristics. These characteristics – similarities or differences – provide a way to refine our understanding of emergent collaboration in different scales. The literature does not provide explicit recommendations for the number of participants in emergent collaboration, but we can see from the examples in section 2.1 that Knots are typically small, though the number of participants varies based on the problem’s complexity. For example, [17] provide an example of a Knot with three actors. Self-organized entities can vary significantly in size without emphasizing size as a defining characteristic. For example, the self-organized organic food community discussed by Bødker et al. [49] started with two people and expanded to a core group of about twenty members. Over time, a larger community grew around the core group and comprised 900 members in 2016. The size of a public can range from a small group to a much larger entity at local or global levels. In their example of a shelter for homeless mothers, [57] loosely refer to the twenty-five residents as one public and ‘staff’ (without any indicated size) as another, as we saw in section 2.3, the public may also be much larger entities and exist at local and global levels.

Accounting for the emergent collaboration at different scales leads to a better understanding of the dynamism of emergent collaboration, which we will represent in two scenarios combining the concepts mentioned in the paper.

3.1 Characteristics of Emergent Collaboration

Table 1 summarizes some of the main characteristics that shape emergent collaboration in knotworking, self-organization, and the formation of publics, presented in the literature overview in the previous section. These characteristics are based on directly mapping the work presented in section 2.

Table 1: Main characteristics of emergent collaboration.

Emergent collaboration	Knotworking (Typically, small)	Self-organization (Typically, small to mid-size)	The formation of publics (Typically, mid-size to large)
Aim	Collaboration to resolve an emergent concern associated with everyday activities.	Acts on a shared concern, through engagement.	Comes together around a shared concern, possibly with a political undertone, and works to resolve this concern.
Motivation	Solving a problem or accomplishing work that requires boundary-crossing collaboration.	Achieving concrete outcomes through exploratory, collaborative efforts.	Personal attachment to a concern, or matter of concern shared by the public.
Participation	Contingent, not formalized, dependent on the problem at hand.	Occurs outside formal organizations, with different degrees of involvement.	Loosely-coupled, and participants do not need to know each other.
Resources	Uses resources 'ready at hand'.	Uses the (usually scarce) resources at hand, and seeks new ones.	Fundamental but non-prescriptive.
Boundaries	Fluid, cross organizational or activity-system boundaries, but remain outside the borders of classical teams.	Emphasis on the distinction between inside (of formal, top-down organizations) and outside (where autonomous networks grow).	A public may define, cross, or dissolve boundaries.
Temporality	Knots are ephemeral, whereas the process of knotworking may extend over time.	Emergent, and may become stable over time.	Both short and long-time frames. The rhythms of engagement may vary, if the public is considered as a whole or as a local division or section.

In our three concepts, collaboration emerges as something that achieves a common aim shared by a group of people. The generic aim of knotworking is to resolve a particular and emergent problem associated with the participants' everyday activities [34]–[36]. Self-organized communities act on a shared concern, working towards active engagement that is sustained over shorter or longer periods [19], [49], [52], [53]. Publics, similarly to self-organized groups, also come together around a shared concern, here called an attachment [58]. An attachment, and the related public, may be political, as it emphasizes a move towards change, locally or more broadly in society.

Motivation relates to the 'why', as in, why do people individually wish to initiate a certain change, to achieve a particular aim, in each situation or context; what is the driving force for each participant? The motivation to engage in knotworking stems from an individual and contextualized desire to intervene in an emergent situation that must be handled here and now. With self-organization, the motivation is to collectively achieve concrete outcomes by coming together around a shared interest and finding ways to achieve these outcomes. Regarding publics, people may have different motives for being affiliated with one; they may be spread across the globe and be more or less active, but they are all part of a

public, as they all have an attachment (that may be individual) to a public and its cause.

Participation describes who participates in a collaboration and their level of engagement and activity. In knotworking, the actors' participation is contingent and relies on their willingness and active participation; participants in knots have a direct stake in either an emergent problem or a resource that may help solve that problem. In self-organization, participation is first understood as occurring outside of established organizations [48], through loosely-established formations of people. Additionally, self-organized entities display a high degree of active participation, but this is often limited to the founding and core group members. The larger the entity becomes, the more room there is for less active people to be part of it [49]. When compared to the other two concepts, publics may demonstrate much looser connections between people, making participation open-ended and less dependent on specific actors. In general, anyone can claim to be part of a public, but as we have seen in the example of the city shelter described in section 2.3, participation can also depend on belonging or having access to a defined physical space.

Resources, such as people, money, tools, know-how, and dedicated available time, differ among the three concepts. Both knotworking and self-organization rely on resources being ready at

hand, resources that are available at the moment(s) of action, and contributed by the participants or members. Self-organized entities often must contend with a scarcity of material and temporal resources. However, self-organized groups may also manage and collect resources (e.g., crowdsourcing, as discussed by [50]), something that may also be done by publics, but seldom in knotworking.

Resources accumulated by publics range from individual efforts to raise awareness about questions of public concern to more collective efforts to raise money and organize events (e.g., welcoming refugees or lobbying for or against current policies, as exemplified in section 2.3). However, it is difficult to analyze the question of resources held by publics, as in the literature, they have been discussed mainly from a limited set of perspectives (e.g., gathering available resources to support the work needed, as discussed in DiSalvo's work, presented in section 2.3).

Boundaries are referred to differently in the literature on the three topics. In knotworking, boundaries are defined by the scope of the problem that the involved actors want to solve. Thus, a knot might transcend organizational or activity systems boundaries to solve a problem. Knotworking involves crossing boundaries, normally separating communities of practice within an established organization or between organizations. When it comes to self-organization, the focus is on the boundaries between the formal (e.g., government) and informal (e.g., civic): self-organization happens outside the boundaries of formal, established organizations. With the formation of publics, stakeholder boundaries are crossed in order to shape a bounded entity around the shared concern; as such, existing boundaries may be dissolved, or new ones may be created.

Temporality differs among the three concepts. Knots may be rapidly created and allow for intensive collaboration, depending on the complexity of the problem at hand; knots take either a long or short time to dissolve. Knotworking, or the process of creating and dissolving knots, develops over time and hence has a longitudinal dimension compared to the short-lived, isolated knot. Self-organization may be short-lived or persist for a long time. Its creation is emergent, and it may be rapidly created or come into being over a longer period of time. Similarly, a self-organized entity may be rapidly dissolved or slowly fade away as its members lose interest, or its goal is reached. A self-organized entity may also transform into a more established, formal organization over time. Publics may also blossom rapidly or slowly materialize over a longer time span, as in section 2.3, the literature mentioned mainly the formation of publics and the role of attachments. An interesting feature of publics is how they allow various stakeholders to collaborate on shared concerns, and through the loosely coupled nature of publics, these stakeholders may engage with a public at different times and with different levels of effort.

There are strong similarities among the three concepts discussed here, such as the centrality of an issue of interest that motivates the formation of a collaborative group. However, differences appear when we consider the detailed characteristics listed in [Table 1](#), with some of the characteristics indicating only subtle differences, whereas others are more pronounced. The latter allows for what we

may interpret as defining characteristics of each concept, especially as they relate to collaboration. As analytical lenses, choosing one concept over the other will allow particular differences to stand out, whereas others will not. Knotworking emphasizes how collaboration takes place: spontaneously, often at a small scale, and in a pulsating and loose fashion, to resolve a specific problem. Self-organization emphasizes where collaborative work occurs, focusing particularly on its occurrence outside the boundaries of formal, established organizations. The formation of publics most strongly emphasizes the “why” of coming together – and, by extension, the mode of collaboration – through attachments. Publics often have a political agenda and are based on a notion of collaboration that is less rigid than the other two concepts. For example, do we collaborate when we express opinions by clicking ‘Like’ on a social media post?

3.2 The Dynamism of Emergent Collaborations

As we have examined the foregoing concepts individually, now it is essential to present their potential complementarity. Below we propose scenarios for emergent collaborative work grounded in literature or in real situations, where the three concepts are used in different combinations to explore and highlight the dynamism of emergent collaboration.

3.2.1 Scenario 1 – Organic and locally sourced food

The work of Bødker et al. inspires the first example. [19], [49], and [50], as reported in section 2.2 concerning self-organization around locally-sourced organic food. In this example, the authors reported how two women got together to start working on getting organic food directly from local farmers. A similar scenario inspired by the previous example might start with people who live in a town where the supermarkets do not provide any real options for buying locally-produced food. A group of colleagues with a shared interest in food come together to determine how they can start to consume more locally-sourced food. They research where they can source food locally regularly and contact farmers. This is an example of a knot and of knotworking. Our scenario could end here. However, the people in the knot and two farmers they contacted might join forces to start providing local agricultural products to interested residents in a neighborhood. They create advertisements, establish online visibility on social media, and, as they gather other interested people, start to jointly determine how to establish an order and payment system while at the same time using several freely available tools, such as a Facebook group and the Google Drive suite to self-organize. Some people like the idea and start to offer to transport the farm products to the town in exchange for some of the products. The knot has now transformed into a self-organized entity. Teaming up with similar initiatives across the country, they raise awareness about local organic food production, sustainability, and the impact of food production and consumption on climate change. They create a Facebook public page parallel to their existing private group (see, e.g. [54] and start using a catchy hashtag. In doing so, they influence the creation of a new public, or the sustaining of an existing one with an attachment to supporting locally-sourced food. The self-organized unit still exists but is now

also situated within a larger public that shares a partially overlapping goal.

3.2.2 Scenario 2 – Open-source development

The second scenario highlights the collaboration that emerges around open-source projects. Here, the use of tools such as GitHub plays an important role, as it offers a place where a group of programmers may work together on a project. Using our three concepts as analytical lenses shows how collaboration emerges and evolves within this kind of project. As an example, a group of programmers starts a new project to develop an open AI platform for research. At this early stage, we could describe the work as knotworking, where the project participants organize their work around solving problems and enhancing the developed codebase. Project participants use the GitHub platform to put together their code to achieve their goals. Their efforts result in the creation of various versions of a program that they start to promote through forums and social networks. The application becomes popular, and the initial programmers who started the project (i.e., the project owners) receive contributions from other programmers scattered around the globe. The project now has many so-called forks (i.e., branches of the code that develops in different directions), and the owner of the project needs to treat these requests before adding the proposed code to their project. The project owners have to change the way they organize their work. They started funding the project on a crowdfunding site (e.g., GitFund) to sustain the AI platform’s development. The owners are moving towards becoming a more self-organized entity where the actors involved have different roles. As the project continues, more supporters and contributors promote the developing AI platform through social networks (e.g., Facebook and Twitter). At this stage, a public form around the use and the contributions to this project. Taking the three lenses together shows us how emergent collaboration around open-source development might transform from one type of collaboration to another. This scenario also demonstrates how we can have multiple forms of emergent collaboration coexisting, for example, a self-organized group leading the development and a public that supports, promotes, and use the developed AI framework. Furthermore, the self-organized entity created by the project owners might still contain instances of knots to face particular challenges. In our scenario, having public support for the project might lead to creating knots to answer public inspiration, like adopting a specific copyright license. Thus, considering the collaboration described in this example as knotworking influenced by a public or a self-organized entity that uses knotworking to face challenges will modify our understanding of the situation.

To summarize, the three concepts that we have examined showcase three different lenses through which we may study and understand how people come together around a shared issue and allow emergent collaboration to take place.

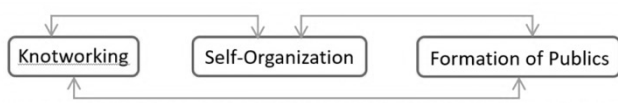


Figure 1: Various possible relationships among the three concepts.

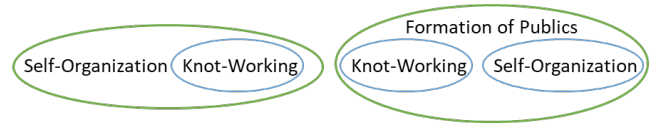


Figure 2: The coexistence of multiple forms of emergent collaboration.

Each concept highlights a particular take on emergent collaboration, but these concepts may also be considered together as three complementary lenses that demonstrate how emergent collaboration may transform (Figure 1), but also how multiple forms of emergent collaboration may coexist (Figure 2). A knot may give way to the formation of a self-organized entity (scenario 1) or a public (Figure 1). Moreover, a self-organized entity may include instances of knots to face particular challenges (Figure 2). Having a public supporting a project may lead to the creation of knots to respond to ideas picked up from, or suggested by, a public, such as creating versions of the application under a more open copyright license in scenario 2 (Figure 2).

4 THE TECHNOLOGICAL SIDE OF EMERGENT COLLABORATIONS

We now turn to the technological side of emergent collaborations and how it may be supported.

4.1 Establishing collaborations

Emergent collaborations rely heavily on the various technological tools with which the participants are familiar and which they bring with them to the group [19], [49]. Any technology that supports the formation of an emergent collaboration should allow easy and effortless onboarding. To support knotworking that will last only for a few hours, one cannot expect too large of an investment in time and resources from any participant. For a public or a self-organized group, there may be a greater willingness to invest resources in technology support, but usually not in the initial stages. Knotworking may also require less support, as these types of collaborations are less stable and often have only a short lifespan.

Looking at existing and everyday examples of emergent collaboration, we can say that the WhatsApp messenger application or an e-mail discussion best suit knotworking, as they allow for quick and ephemeral discussion and resource gathering around an issue that needs to be addressed [62] – and often among a limited set of participants. Facebook groups and email mailing lists have been shown to support the needs of self-organization, as they are easily and freely available, with low barriers to set up and use [54]. They also support documentation and archiving, though, in the case of Facebook groups, this is not yet optimal [54]. Finally, hashtags (#), as used on various social media platforms like, for example Twitter, support the formation of publics, as may have been most clearly witnessed lately during the Arab Spring [63] or the #metoo movement (studied for example by [64]).

In the examples above, we see that self-organized groups are most likely to maintain a Facebook group and/or page. For the other types of collaboration, a WhatsApp group or a hashtag may be the most effective tool. However, all the cases emphasize the use of familiar, mundane, and everyday technologies. As Bødker et al. [19] emphasize in their work on self-organized communities, intrinsic design decisions are made by participants in these formations in order to shape working artifact ecologies that combine various tools [19].

4.2 Maintaining collaborations

There is an inherent fragility of commitment in collaborative practices and how it develops over time [65] and emergent collaborations may develop in various ways over time. A knot may develop into a self-organized group or a public, but knotworking may also be a one-off, ephemeral phenomenon requiring no maintenance. Participants in knotworking may create new knots in the future, and technology may support this continuity. Self-organization involves a longer time limit and could benefit from technologies that may be adapted to its specific needs over time. With publics, particularly those more widely distributed geographically, the introduction of new tools is problematic. Instead, publics rely on widely available technologies to extend their reach. Smaller-scale publics such as those that grew around the local shelter reported by Le Dantec and DiSalvo [58] are closer in long-term technology requirements to those of self-organized groups.

We may consider efforts of maintaining collaboration as articulation work [66], [67]. Schmidt and Bannon, for example, refer to articulation work as the work “to make the cooperative mechanisms developed to support different aspects of work in complex environments fit together and fit local circumstances” - [43, p. 22]. However, we argue that in the case of emergent collaboration, the articulation work becomes more explicit and visible, compared to what occurs in a traditional workplace, owing to the constant change in participants, and in the form and context of emergent collaboration. Although this section has been about maintaining collaboration, the aspect of maintaining the technology that supports the collaboration should also be considered. Maintaining collaborative technologies may be challenging, especially if the groups themselves undertake it, for example, in cases of self-organization where the groups rely on their own collaborative technologies, but may lack the resources and expertise to maintain them [49]. From a research project perspective, it may also be challenging to develop collaborative technologies that should function and be used by a group after the research project and its funding has ended [68].

4.3 Fluid collaborations

We have discussed different types of collaboration that are seldom stable and do not exist in isolation. A self-organized group may complete tasks through knotworking and overtime may form a public. Similarly, a public may generate self-organized units or knots. The fluidity and blurred boundaries of these concepts make it essential not to consider these concepts in isolation during, for

example, the design and implementation phases of digital technologies. Instead, one could argue that various technological artifacts can support more than one kind of collaboration, and the transitions among these types may better support its users over time.

With their concept of collective artifact ecologies, Korsgaard et al. [12] highlight the need for understanding the connections between multiple people and the multiple technological artifacts they use, adapt, or discard. Collective artifact ecologies emerge and evolve through continuous dynamic processes, supporting the collectives’ activities, mediating personal relations, and bringing forward the identity of the collective to the wider world. The time of the establishment of collaborations that potentially gives rise to the formation of collectives and the time of maintaining these collaborations are important in the formation of the artifact ecologies. Additionally, it is also important to keep in mind that emergent collaborations are often fluid, thus in need of artefact ecologies that can emerge dynamically and organically.

When we recognize emergent collaboration as being fluid, it may thus be more relevant to consider the dynamic artifact ecologies that take shape to support the collaboration.

5 CONCLUSIONS

The rapid pace of technology development affects the nature of collaborative work. Also, recent decades have witnessed experiments with new forms of labor outside the traditional framework of waged work. It is no longer enough to rely on the vocabulary of collaborative work, which is grounded in waged, organization-based work. We need a richer and more fine-grained vocabulary – a larger ‘semantic space’ of sorts – to address emergent collaboration as a type of collaborative work that occurs beyond organizational framings. In this paper, we present an initial attempt to clarify three existing concepts that we believe can support the broader C&T community to better identify and articulate collaborative work as it emerges. That said, we are well aware that our suggestions merely scratch the surface. Further research would include explorations of an even broader vocabulary of concepts and terminology. For example, “Commoning” describes collaboration in settings where a commons-based approach to sharing resources takes place, challenging current capitalist-based approaches to production and consumption [69], [70]. The concept of Institutioning sheds light on the shaping of collaborations with institutions, such as municipalities or government bodies [71]. Furthermore, Infrastructuring is a concept that allows for further temporal explorations of collaboration across long-term temporal horizons [72]. Furthermore, we acknowledge that the examples we relay here are mostly taken from Western contexts. There is a need to explore technologically mediated emergent collaboration as it also takes place in other parts of the world [73], [74]. We see our work, especially what we present in [Table 1](#), as an early effort to create a relational map of concepts of emergent collaboration and the relationships between existing and future concepts of emergent collaboration. Such mapping is important to guide designers and researchers in their study and design of technology for emergent collaboration outside

organizational structures. When studying emergent collaborations, challenges arise; as such, collaborations have their inherent dynamics, move beyond boundaries, display changing temporality, and may be inherently sporadic. Also, such collaborations seldom occur in isolation but instead form a continuum where knots, self-organized groups, and publics intertwine and migrate from one of the concepts to another over time, making it both difficult and important to study, understand, and design for such types of collaborations.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Troyes University of Technology for providing a mobility grant (OPE-2018-0188) which allowed the first author to visit the IT University of Copenhagen in Denmark as part of writing this paper. We also like to thank ITU for supporting us in writing this paper.

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