Towards a Theory of Collaborative Systems

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Abstract. High failure rates often observed in practice suggest that collaborative relationships are still not well understood. In this paper we investigate the nature of these relationships from second-order Cybernetics and Social Systems Theory perspectives. Thereby we develop a novel theoretical framework, the Collaborative System, which explains: 1. the organizational function of collaboration; 2. the system's elementary operation; 3. its coupling mechanism; 4. the system autonomy and; 5. its 'value' creation mechanism. The proposed framework is innovative and has far reaching consequences for the understanding of different forms of collaborative relationships. Nevertheless, it raises a whole new set of questions yet to be explored.

Keywords: Collaborative System, Interorganizational Relationships, Collaborative Networks, Cybernetics, Social Systems.

1 Introduction

In different forms, Collaborative Networks have been recognized as 'the societal structure of the 21st. century' [16]. At the heart of these networks is the interaction among organizations, the collaborative relationship, which we broadly define as *a voluntary interaction among autonomous organizations that is not strictly based on economic transactions*.

Collaborative relationships are not a new phenomenon. They have been studied for almost 50 years, mainly under the labels 'Hybrid Governance Forms', 'Supply Chain Management', 'Strategic Alliances' and 'Networks', culminating with the recently proposed discipline 'Collaborative Networks' [4]. Although different benefits have been associated with interorganizational collaboration, high failure rates are

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commonly recognized in practice[1]. This suggests that our understanding of collaborative relationships is still incomplete.

Abstracting from specific forms of relationships, we set ourselves to investigate their nature. Therefore, we propose a novel explanatory theory: the Collaborative System. Our theory is mainly derived from the work of the great German sociologist Niklas Luhmann[2] and is innovative in different ways. First, it is a new theory about interorganizational relationships. Second, it extends Social Systems Theory by suggesting that another type of system emerges from the relationship among organizations. Third, it constitutes a new *unit of study*, the Collaborative System, which is capable of observing and distinguishing itself from everything else. Fourth, it enables a completely new understanding of collaborative relationships, from which emerges great explanatory potential but also many questions.

In section 2 we briefly present the main concepts of Social Systems Theory and Organizations. The Collaborative System is discussed in section 3. Two implications of our work, namely autonomy and value creation in Collaborative Systems, are discussed in section 4. Finally, section 5 concludes with some important questions that our theory raises.

2 Social Systems and Organizations

Recognizing communication at the heart of everything social, the theory of Social Systems addresses: i) how communication comes about and; ii) how complex societal structures emerge from different forms of communication. Composed of three selections: information, utterance and understanding [9, pp. 137-175], communication is an instantaneous event that refers itself to past communications and generates further communications: they are autopoietic[3]. Furthermore, a nexus of communications can only be maintained through selective relations among its elements. These selective relations are structured by *expectations* that constrain further operations. Such an *'organized complexity' can come about only through the system formation* [9, p. 24]. Thus, social systems are boundary reproducing, operationally closed, self-referential and autopoietic systems, whose basal operation is communication [9]. Everything else besides communication belongs to the environment of these systems, for cells, people, thoughts and stones do not take part in the autopoietic (re-)production of communication. As Luhmann puts it: *'only communication communicates'*, (re-)producing the system's boundaries, i.e. the difference between system and environment [9, p. 137-175]. Thereby social systems are autonomous and construct their own reality through internally developed structures.

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[1] For interesting remarks about benefits and problems of collaboration in different forms, please see [7, 8, 6, 15] and the references therein.

[2] In a life of work, Niklas Luhmann elaborated a coherent but intricate theory of society based on Parsons' Social Systems, Second-Order Cybernetics, the concept of autopoietic Systems and evolutionary theory. For details see [9, 10].

[3] As proposed by Varela, Maturana and Uribe in [18, p. 188], '*the autopoietic organization is defined as a unity by a network of productions of components which (i) participate recursively in the same network of productions of components which produced these components, and (ii) realize the network of productions as a unity in the space in which the components exist*'.

Interactions among people constitute the simplest social system [14, p. 93]. However, society also comprises other social systems, each one of them fulfilling one of society's major functions, e.g. religion, science, politics, economy, arts, etc. [10]. These function systems developed their own operations and structures, but they are not capable of acting[4]. Another type of social system is therefore necessary: organizations.

Organizations are social systems (re-)produced by the communication of decisions [11, pp. 45-56]. In a decision, a selection is communicated *as a selection* [1, p. 139]. Thus, decisions involve two selections: the (mostly implicitly communicated) set of alternatives and the selected one. By communicating these two selections, a decision absorbs uncertainty by: i) functioning as a unity, an instantaneous event that divides present time in past and future; ii) fixing the future, at least until further decisions change it, and; iii) enabling other decisions to refer to it as a decision premise [12, p. 396].

Because both the set of alternatives *and* the chosen one are contingent (i.e. they are neither necessary nor impossible), decisions are doubly improbable to become accepted [1, pp. 139-142], [11, pp. 123-151]. In order to overcome this problem, improving the probability of further (re-)production of decisions, organizations developed specific expectation structures called decision premises [11, pp. 222]. These premises are special types of decisions that, by constraining the set of possible decisions, reduce complexity [11, pp. 237]. There are nine types of decision premises: membership, communication pathways, decision programs, personnel, position, planning, culture, self-descriptions and cognitive routines[5]. Decision premises grant organizations the ability to observe and construct an individual reality, making sense of and giving sense to their environment [20]. Only thus they can recognize themselves as a dynamic boundary reproducing unity incapable of being divided, even though decisions are constantly being made and premises are constantly being changed. It is precisely the operational closure and its constructed reality that allow organizations to observe themselves as a 'self' in an environment [11]; only thus are organizations able to make sense of the environment and structure internal complexity to absorb uncertainty in very improbable ways.

3 Collaborative Systems

As a specific type of social system, organizations can communicate under their own identity. Therefore, organizations (alter[6]) situated in the organizational environment of ego are recognized as systems of the same type, as organizations, or alter-egos. Just

[4] As in a conversation, the conversation *per se* cannot act, only participants can.

[5] For example, by deciding about membership organizations are capable of recognizing which decisions belong to them. Moreover, membership improves decisions' acceptance, since contesting them might risk membership itself. A complete description of these premises can be found in [1, pp. 145-152] and [11].

[6] Coherently with the social systems theory, we consciously abuse from the terms 'ego' to denote the focal organization, 'alter' to denote other organizations in ego's environment and 'alter-ego' to express that ego recognizes other organizations (alter) as systems of the same type as ego is. Nonetheless we do *not* restrict ourselves to the dyad. Alter is understood as any number of organizations in ego's environment.

like ego himself, alter's decisions are neither impossible nor necessary [12]. Thus, as an alter-ego, alter is identified by ego as a special source of contingency.

This contingency is experienced by ego in two different ways. First, when organizations perceive external relations as resources, contingency is experienced as dependency. Second, if external relations are perceived as information, contingency is perceived as uncertainty [9, p. 184]. By deciding to interact with other organizations, ego interprets uncertainty and dependency as risks that derive from ego's own decisions and affect its capacity to secure future necessities [13]. These risks offer guidance to internal goal oriented decision making. Organizations can deal with such risks in three different ways.

First, they can improve the degree of internal ordered complexity deciding upon further decision premises. Such decisions create internal redundancies in the effort to reduce risks from environmental uncertainty and dependency[7] [9, p.184].

Second, if environmental conditions apply, organizations can decide to improve internal complexity through the integration of external ordered complexity. By acquiring other organizations, they 'internalize' sources of contingency, turning them into hostages of their own decision premises. However, by increasing quantity and variety of decision premises, either internally or through acquisition, organizational size and complexity also increase [11, pp. 307-311].

Third, recognizing alter-egos in their environments, organizations can decide to interact with them trying to influence them in such a way that ego's complexity and uncertainty are reduced. Thus, we propose:

Proposition 1: A collaborative relationship has the organizational function of absorbing uncertainty and reducing complexity.

Nevertheless only further decision premises can alleviate the pressure to select [1, pp. 143]. Hence, ego can only reduce its uncertainty, complexity and risks by adopting alter's decision premises as ego's own decision premises. This requires that alter communicates to ego about it's decision premises. In this context, we define:

Definition 1: Commitment: a decision to communicate a decision premise.

When alter commits to ego, alter communicates a decision (as a decision) to communicate about its decision premises to ego. If this commitment improves the probability of ego choosing some decisions among others, it reduces ego's necessity to select, thus structuring ego's decisions and reducing complexity. It is interesting to highlight that alter's commitment hence reduces *ego's* complexity. Three different forms of committing exist: a. *communicating the commitment* - e.g. the communication of the decision to disclose an internal process; b. *communicating the decision premise itself* - e.g., the partner's actual communication of an internal process (a decision premise), and; c. *acting* - e.g. the partner's investment in a relationship specific asset (e.g. buying a machine) for a collaborative process. This

[7] Examples of these decisions are building up stock, redundant suppliers, diversification and phantom orders. But by trying to reduce uncertainty through internal decision premises, the environment might also be affected, originating undesired 'side-effects', e.g. the Bullwhip Effect.

action communicates both the premise (the asset) and the commitment (the decision to communicate it).

Differently from creating redundancies through further internal decision premises or acquisitions, commitments allow ego's reduction of complexity through alter's premises. Consequently, we propose:

Proposition 2: In a collaborative relationship, partners' commitments are necessary and sufficient to reduce organizational complexity.

Less abstractly, this proposition implies, for example, that what is commonly known as 'collaborative synergy' (e.g. performance improvement) is only possible if (or, it is necessary that) each organization uses its partner's decisions (premises) to guide their own decisions (i.e. to make them 'better'). On the other hand, structuring internal decisions through partner's premises also comprises risks. As future remains unknown, further structuring decisions can become a hindrance (commonly known as lock-in effect or path dependence) if environmental and systemic conditions change; that is why proposition 2 states that commitments are necessary and sufficient *only* to reduce *complexity* (the pressure to select). Nonetheless, complexity reduction does *not* necessarily improve performance.

Being decisions, commitments always communicate along their parasite contingency. Differently stated, alter's commitment grants ego the possibility of reducing complexity, *even though alter could have decided otherwise*. Thus, a single commitment can be interpreted as an act of altruism. Yet, by committing to ego, alter also expresses an interest about ego's own commitment, since this is the only way in which ego can benefit from the interaction. Hence, each commitment generates an expectation about further commitments. Moreover, when ego commits himself too, past commitments constrain the set of possible further commitments, i.e. commitments always refer back to past ones. Ego commits back based on its expectations about alter's expectations for further commitments. In simple words: 'you gave me your forecasting plans, so I assume thereby you expect higher service levels!' Hence commitments structure themselves, self-referentially restricting the set of further possible commitments. Joining proposition 2, self-reference and expectation structures, commitments (re-)produce themselves in an operationally closed nexus: they are autopoietic operations and constitute a social system. This leads us to our third proposition:

Proposition 3: A collaborative system is a (self-referential, operationally closed and autopoietic) social system composed of commitments.

Commitments are the medium of communication by which collaborative systems couple organizations in a specific way: they become decision premises for the organizations involved. Thereby, collaborative systems are necessary and sufficient for collaborative relationships to fulfill their function. Furthermore, operational closure grants collaborative systems the possibility of constructing their own reality and identity, which can be interpreted as the semantic differentiation of *'us'* and *'our relationship'* from *'you'* and *'me'*. It also explains how and why different semantics and identities emerge among different collaborative relationships, even when the organizations involved are the same.

4 Implications

Different implications can be derived from collaborative systems, from which we briefly discuss 1. autonomy and 2. value creation[8].

1. *Autonomy.* Operationally closed systems are autonomous [19]. In such systems, internal order emerges without centralized control. Consequently collaborative systems *cannot* be controlled; as neither alter, nor ego can control a conversation [9, pp. 404-436], organizations cannot control a collaborative system. They can only irritate, stimulate or destroy it. Furthermore, collaborative systems cannot be engineered, deployed, installed or achieved, since they are part of the organization's social dimension. This is a much more modest view of collaborative relationships than often encountered in literature. Moreover, it suggests that high failure rates can be the result of the misunderstanding of collaborative relationships as a sort of single-sided controllable input-output system.

Operational closure implies that collaboration can only come about through commitments. This apparently tautological expression hides the profound implication that social and network capitals are only 'useful' in a collaborative setting when they are translated into commitments embedded within a system. Organizations can only try to influence collaborative systems through further commitments and nothing more; everything else is external to the system, which autonomously observes and interprets through its own constructed reality or 'logic'. This closure explains why self-enforcing safe-guards contribute to relationships, while contracts and the extensive use of power do not [5]. While self-enforcing safe-guards are 'commitments par excellence', by using power ego communicates the unwillingness to commit himself, even though it is forcing alter to commit. The extensive use of power frustrates expectation structures and results in commonly related disadvantages for relationships.

2. *Value Creation.* Value is a common buzz word that draws, by itself, no clear distinction (see, for example, the definition offered in [3]). Examples of its possible meanings are utility, share holder value, societal values, etc. In spite of the lack of consensus about the its definition, 'value' always denotes a *form of observation*. By marking something as valuable, a system indicates something capable of improving the probability of continuation of a system. This probability of continuation can only be achieved through uncertainty absorption and the emergence of boundary setting structures [9, Chap. 3 and 5].

In a collaborative relationship, commitments are the *only* mechanism capable of absorbing uncertainty. Thereby commitments have the *potential* for improving viability (or creating 'value'), independently of the specific definition of value. By assuming partner's commitments as premises, organizations *can* improve decision making, because 1. only specific alternatives must be evaluated; 2. partner's behavior can be better predicted, and; 3. decisions can be adapted to partner's decisions. Nevertheless, even though this potential might be realized, such that resulting

[8] Unfortunately, space requirements restrict the exploration of the full potential of this theory. Nonetheless, it is important to highlight that it opens the possibility of applying established social systems techniques, as the ones described in [2], to the analysis of collaborative relationships, significantly augmenting the potential of knowledge generation.

decisions improve system's continuity (they are 'more valuable'), uncertainty and complexity reduction does not imply the creation of 'value' in a specific sense. For faster and to the partner better adapted decisions can still became worse decisions if environmental conditions change. Thus, the collaborative system is a *necessary but not sufficient* mechanism for value creation in the collaborative relationship. For sufficiency is a much more complex matter, which also depends on content and, therefore, belongs to a future discussion.

5 Conclusions and Future Work

Based on Systems Theory we developed the theoretical background of Collaborative Systems, whose main contributions are: 1. by recognizing collaborative relationships as boundary setting autopoietic systems, it is a new theory about interorganizational relationships; 2. it extends Social Systems Theory; 3. it explains the coupling mechanism between organizations; 4. it is not restricted to interfirm relationships, but it is equally valid to interorganizational ones; 5. it offers support to change the common view of collaboration as a strategy or an input-output system to a more realistic, social founded, but modest, view; 6. it opens a wide horizon for application of established social system techniques to collaborative relationships; 7. it suggests a new clear-cut unit of study: the collaborative system, and; 8. it offers a strong social systemic foundation that can support and inspire further developments of reference models, such as the 'value systems' described in [17, 3]. Together, these contributions can account to a whole new set of theoretical and practical insights about collaborative networks. For example, by analyzing how the flow of different types of commitments on time constitute the identity, expectations, past, present, future and 'success' of the system, new knowledge about the role of contracts, trust, governance, coordination processes, 'value' creation and organizational culture might be developed. Nonetheless, this work is only the first theoretical sketch that opens up a wide horizon of possibilities for further examination. Much research effort must still be invested in detailing it and in understanding how this theory relates to other commonly cited theories of collaborative relationships (e.g. Institutional Economics, Resource-Based View, Game Theory, etc.).

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