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Going Beyond Transactions: Frameworks for collaborating in systemic settings

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Going Beyond Transactions: Frameworks for collaborating in systemic settings

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Interdisciplinary collaboration is critical to addressing the extraordinary challenges that are of concern to the systemic design community. Given the importance of such collaboration, especially for ill-defined and unbounded problems, there is surprisingly little training or support to guide designers, academics, and practitioners in framing interdisciplinary collaboration. This lack of scaffolding means that collaborations more often resemble a contractual exchange than shared intellectual work. This paper presents and explores several illustrative examples and articulates two distinct modes of interdisciplinary collaboration: relational interdisciplinary collaboration and transactional interdisciplinary collaboration. A mode can be defined as a way of thinking, doing, communicating, and managing a collaboration. Analysis of these modes is approached through six attributes: the collaborative foundation, power relationships, language and means of expression, approaches to risk, products of the collaboration, and the potential for transformative outcomes. These attributes help distinguish between the two modes and serve to guide organisations in ways to construct and support more effective cultures of collaboration.

KEYWORDS: interdisciplinary collaboration, complex systems, interdisciplinarity, transformative research

RSD TOPIC(S): Learning & Education, Methods & Methodology

Introduction

Systemic design is inherently interdisciplinary. Our challenges span social sectors, disciplines, and cultures. Effective systemic designers must be skilled at working in an interdisciplinary way, yet too often, interdisciplinary collaborations are simply taken for granted, and little attention has been given to the ways one might diagnose the types of collaborations that are needed in various settings (Manzini, 2015). This paper introduces frameworks for interdisciplinary collaboration that are often overlooked when exploring ways to approach this ubiquitous topic. Our initial research began within a National Science Foundation research project that was concerned with transformation in engineering graduate studies. Although our exploration began in the engineering context, the frameworks we will discuss can be applied to any manner of collaborative work. We'll now shift from the theoretical to the concrete.

Example 1: *An engineer is working to design and prototype a new hand-held device. It becomes clear that she will need assistance from an industrial designer to improve the usability of the product. She meets with several potential designers, discusses the project, and describes what she needs from them. After selecting an industrial designer, they agree upon the terms and conditions of the partnership, including relevant ASME and NIST standards for documenting the work. Although she relies heavily on their opinion and expertise, the final decision on design choices rests with her.*

Example 2: *A faculty member in the materials engineering department sees an announcement for a research talk being given by a member of the chemistry department. Although the work is not directly related to his research, he wonders if the underlying techniques might give him a new way of thinking about his approach. At the lecture, he is struck by the intellectual curiosity, creativity, and enthusiasm of the chemist, concluding, "I have to work with him." The two begin an extended collaboration that improves the work they were previously doing and opens substantial new areas of inquiry.*

While both examples could be characterised as interdisciplinary collaboration, they represent two distinct *modes* of this type of work. A mode can be defined as a way of thinking, doing, communicating, and managing a collaboration. In this paper, we explore two modes, *relational interdisciplinary collaboration and transactional interdisciplinary*

collaboration. To guide us, we introduce six attributes that help characterise how people and organisations work together. These are:

- collaborative foundation
- power relationships
- language and means of expression
- approaches to risk
- products of the collaboration
- potential for transformative outcomes

After a short discussion of our motivation and a very brief literature review, we describe and explore these attributes and see how they can represent a spectrum of collaborative activities with relational interdisciplinary collaboration and transactional interdisciplinary collaboration on opposite endpoints. Finally, we open a conversation on how we might introduce and support these two modes of collaboration in a way that helps create a stronger culture of collaboration.

Defining interdisciplinary collaboration—a peek at the literature

To this point, we have been using the term interdisciplinary collaboration as if it is part of a consistent and well-understood vocabulary. At the conversational level, when we speak of interdisciplinary collaboration, most of us have an idea of what we mean—an ability to work with, communicate ideas with, or perhaps simply value the intellectual contributions of persons from various other disciplinary environments. To go further, and especially to develop tools and models that support interdisciplinary collaboration, however, it is useful to dig a bit deeper. There are more formal expressions of what constitutes interdisciplinarity in academic environments, especially in research. A committee appointed by the National Academy of Science, for example, offered the following definition:

> Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialised knowledge to advance fundamental understanding or to solve problems whose solutions are

> beyond the scope of a single discipline or area of research practice. (Committee on Facilitating Interdisciplinary Research, 2004)

This definition highlights that interdisciplinary collaboration is generally driven by the scope of the problems and the limits of any single discipline. The definition, precisely because of its intended wide usage, does not pick up the many possible types of collaborations. It is descriptive rather than prescriptive and, therefore, cannot offer much insight into how and when such collaborations might occur or the conditions in which they might thrive.

Questions surrounding how to define interdisciplinary collaboration are summarised very well in Aboelela et al. (2007). They reviewed more than 500 journal articles in which the research is characterised as interdisciplinary, of which some 14 papers offered a "definitional component" of interdisciplinary work. Ultimately, Aboelela and her colleagues drew specific attention to the definitions proposed by Klein (1996), Rosenfeld (1992), and Lattuca (2001). These authors set out several typologies of Interdisciplinary research, distinguishing between the least, moderate, and greatest degree of synthesis.

Klein distinguishes between:

- Instrumental interdisciplinarity (such as "bridge building between fields" to solve problems without seeking a fusion of perspectives)
- Epistemological interdisciplinarity in which a former approach is restructured to define a new field
- Transdisciplinarity "a movement toward coherence, unity, and simplicity of knowledge"

Rosenfeld proposes an approach which is immediately useful for describing behaviour, drawing a distinction between:

- Multidisciplinary research, where teams work in parallel or sequentially from their specific disciplinary base to address a common problem,
- Interdisciplinary research, in which teams work jointly but still from a discipline-specific base to address a common problem
- Transdisciplinary research involves teams using a shared conceptual framework, drawing together discipline-specific theories, concepts, and approaches to address a common concern.

Lattuca's approach is particularly useful in setting out the range and type of interdisciplinary activity in research and teaching. She posits four types of interdisciplinary research.

Informed disciplinarity, in which disciplinary-specific questions can be informed by concepts from another discipline, usually because of the intellectual curiosity of the disciplinary researcher. This might include the analogical use of situations or insights from another discipline to clarify the original discipline. Lattuca suggests that while potentially useful both in terms of knowledge production and teaching, this approach is only marginally interdisciplinary.

Synthetic interdisciplinarity occurs when the subject of the research inquiry links knowledge or methods from two or more disciplines, usually at the boundary between them. This can either take the form of overlaps or gaps in both disciplines. Examples she uses include the exploration of historical and legal approaches to public education and the biological and psychological study of human communication.

Transdisciplinarity, in which the subjects of research or material for courses cross disciplinary boundaries, with "the application of theories, concepts, or methods across disciplines with the intent of developing an overarching synthesis." In this case, "these theories, concepts, or methods are not borrowed from one discipline and applied to another, but rather transcend disciplines and are therefore applicable in many fields." Importantly, the disciplines serve as settings in which the overarching approaches can be applied rather than the foundation for the theories themselves. Examples might include systems approaches in fields such as biology or across the various engineering disciplines.

Conceptual interdisciplinarity, in which the subjects of research or teaching do not come from any of the disciplines specifically, but rather from an understanding or critique of knowledge and insight. Lattuca suggests that this type of scholarship may be "either interdisciplinary or predisciplinary", representing a fundamental critique of disciplinary understanding of issues or questions, with examples such as postmodernism and cultural studies. In addition to the critique, this model of interdisciplinary research presents an opportunity to integrate discipline-specific knowledge into deeper and broader understanding.

These sorts of categorisations are useful for evaluating whether an activity can be characterised as a form of interdisciplinary research and the extent to which the collaboration may lead to the sort of new insights discussed by the National Academy committee. As behavioural models, however, they are still very abstract and generally are focused on how the disciplines interact as much as how the people themselves do. Unfortunately, these models offer us only a limited pathway into how we might educate and train people in collaborative work.

Myra Strober, in her book *Interdisciplinary Conversations*, discusses the behaviours and attitudes that are needed to foster successful interdisciplinary collaboration within academia (Strober, 2011). These include leadership, earned respect for participants, and building appropriate cultures to support the collaboration. She notes that, sadly, there is seldom training for faculty in these areas. It is, therefore, not at all surprising that students and practitioners are similarly unaware of how one might collaborate effectively across disciplines. This lack of understanding has dire implications for all interdisciplinary endeavours, specifically systemic design. Yet, to explore the nuances of collaborative activities, we need to examine the constituent elements of this way of working.

Attributes of interdisciplinary collaborations

It is helpful to recognise several key attributes that are useful in understanding and differentiating between modes of interdisciplinary collaboration, where, as noted, a mode represents a way of thinking, doing, communicating, and managing the joint endeavour. In addition to helping us establish two modes of these partnerships, these attributes offer a potential framework for teaching us how to approach interdisciplinary collaborations. In the following section, we describe each of these attributes, illustrating them using the examples at the beginning of the paper. For ease of presentation, we refer to the first example, the engineer and industrial designer, as transactional and the second example, the materials engineer and the chemist, as relational. We then generalise these illustrations to clarify two polar modes of interdisciplinary collaboration.

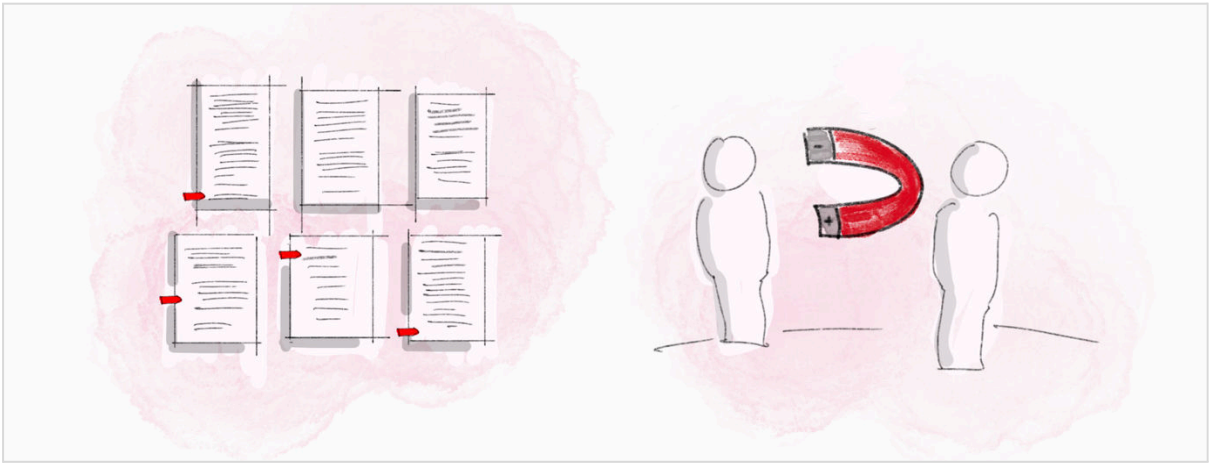

Figure 1: An illustration of two types of collaborative foundations.

Collaborative foundation—This is the bedrock of any collaborative effort, the fundamental principle that defines who will collaborate, what motivates their collaboration, and how they will characterise the nature and success of their work. The motivations, goals and reward structures for specific collaborations vary, but any framework for describing interdisciplinary collaboration will have such a foundation, even if it is not explicitly stated by the participants. Clarifying the collaborative foundation helps to align participants and their actions toward the overall goal. Elements of the collaborative foundation might include compensation, the ability to learn, develop, or apply new techniques, or the opportunity to work in a fulfilling environment. Put into behavioural terms, a potential participant may think of the collaborative foundation in this way, "No situation will be perfect, but if I don't have (blank), it's not going to be worth it."

In a systems context, the number and range of relationships make more transactional foundations impossible. Some stakeholders may not be able to accept funds or compensation for legal reasons, and financial transactions usually come with oversight and stipulations that make them far too rigid for more emergent challenges. Of course, contracts, funding and traditional reward structures can help drive projects forward, but if we over-index on those foundations, we will privilege collaborations that are deemed safe enough to fund.

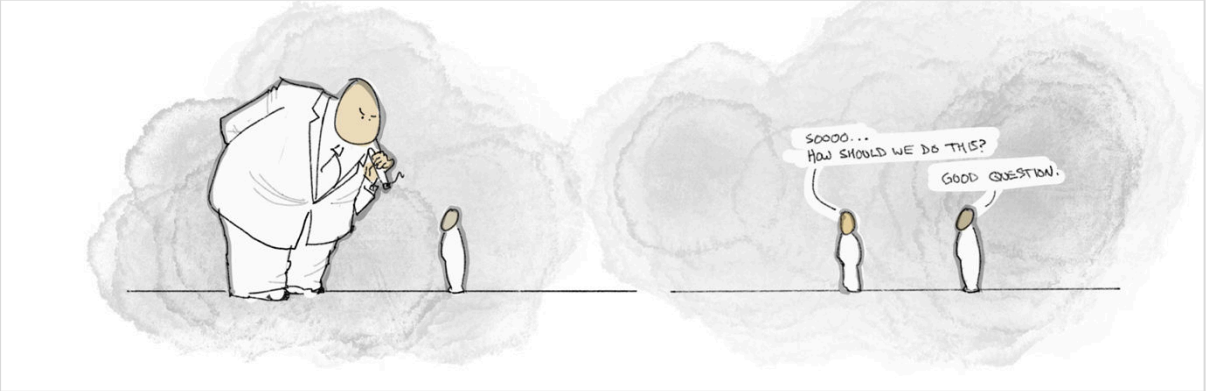

Figure 2: An illustration depicting the spectrum from transactional (left) to relational on the right.

Power relationships—Although the role of power has an enormous influence on the nature of a collaborative endeavour, the topic is often not made explicit. As we consider examples of interdisciplinary collaboration, it is helpful to explore power relationships through questions such as: Who within the collaboration has the authority to define a question, assign a task, or evaluate a result? Who allocates what work is done by each participant? What methods of control over the activity are available to the collaborators? In the transactional example, power resides primarily with the issuer of the contract rather than with the contractor. The contractor may have considerable leverage based on the importance of the work product to be delivered and the uniqueness of their expertise, but as noted in the example, the final decision-making authority rests with the engineer who created the device.

In the relational example, power is distributed among the collaborators. Because of the voluntary and relatively unrestricted nature of the collaborative foundation, decision-making seems to be shared and will often shift as the nature of the project changes over time.

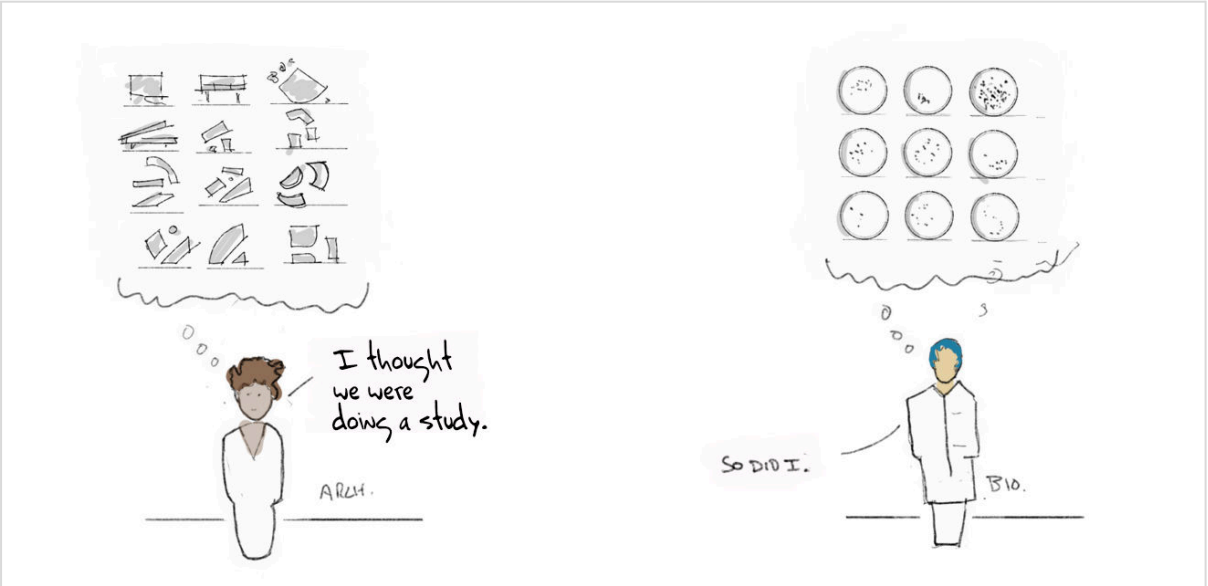

Figure 3: Domain-specific language can cause confusion or open up new modes of inquiry.

In the context of systems, asymmetrical power relationships are not bad. They are often necessary to create change in an efficient manner. But all too often, the transactional mode of interdisciplinary collaboration is the only model we have for getting things done. It is problematic in a systems context where the context is in flux and even those with power have limited control over the landscape. In this context, a power structure that has the ability to adapt to changing stresses will prove more resilient than more traditional top-down power structures (Beckman and Barry)

Language/means of expression—The way we communicate offers an insight into the relationships and underlying values of a collaboration. Looking at the role of language and means of expression helps highlight the norms and expectations for a collaborative effort. To this end, we might ask: Is there a specific language that is used when members from different disciplines participate in a research activity? Are translation tools needed, and are they available? Whose translation is considered canonical, if anyone's? Is the team actively looking for emergent languages to better describe their work?

Figure 4: Two different ways of conceptualising risk.

In the transactional example, terms and conditions, and notably specifications and standards (both technical and legal) would likely be the primary language and means of expression. Indeed, standards and specifications exist precisely to control and define communications among participants. Mechanisms such as change orders are used to document variance from the terms and conditions of the contract.

Shared intellectual and research interests may act as a sort of "Rosetta Stone" for bridging communications gaps. If the disciplines were less tightly linked, we might even expect the use of literary linguistic devices such as metaphor or dependence on paradigmatic examples when seeking a common understanding. Ultimately, some mixture of terminology may develop, and participants may even develop new languages. The use of illustrations in this section is an example of introducing a non-traditional language into an academic paper.

Approach to risk—Risk is an inherent part of any endeavour, and this is especially true for interdisciplinary activity. As such, it is very useful to articulate both the apparent elements of risk (i.e., what might "go wrong"), and the posture of the participants toward risk. How do participants evaluate and consider the risks of a failed collaboration?

Figure 5: Products of the Collaboration. The outputs of a transactional collaboration can be categorised as a what (a thing that's created). relational interdisciplinary collaborations may also result in things, but they may also produce hows (processes, cultures or ways of being together.)

In the transactional example, the intent of all parties is generally to manage, reduce, or retire risk to both the undertaking and the undertaker. This may have the effect of relying heavily on "proven" approaches or technologies. In doing so, they reduce risk to a successful outcome, but that often comes at the price of reduced creativity and innovation.

In the relational example, risk is tolerated and may even be welcomed as a necessary part of working outside traditional boundaries. Participants may also see open-ended collaborations as putting scarce and valued resources, such as limited time or funding, at risk, which must be weighed against the potential payoffs.

When working on a systemic intervention, the unknowns are simply too large to address and retire risk the way one might in a more bounded setting. Systems designers can benefit from the ambiguity that comes with a relational interdisciplinary collaboration.

Products of the collaboration—We can consider the products of the collaboration narrowly in terms of specific work products or deliverables (e.g., drawings, prototypes, new insights, reports, etc.) or, more broadly, to include the value attached to the processes, activities, and efforts associated with the interdisciplinary collaboration. Considering the products of the collaboration clarifies how participants think about the outcome of collaboration and what is valued. Participants may have very different

notions of what is considered a success, and mismatched expectations related to output can cause unproductive friction during a collaboration.

In the transactional example, the work products are referred to as deliverables, which are the realisation of the contract. A successful collaboration, in this case, might be defined in terms of whether the work product meets the terms, conditions, and specifications as given in the language of the contract. The means by which the products are realised is generally less significant than the product itself. Products may also be thought of as “works for hire”, that is, an output that is owned by the issuer of the contract.

In the relational example, the participants enter the collaboration without necessarily having any specific work product in mind. This approach seems particularly well suited to collaboration in an environment of exploration and discovery, hopefully leading to new insights and ways of thinking about, understanding, and solving problems.

Potential for transformational outcomes—This is perhaps the most difficult to evaluate of the attributes. The first of these is to distinguish between transformations that occur because of the process of collaboration versus those from the products of it.

The potential for transformational outcomes from cases like the relational example depends on there being important (and unknown) insights that can come from sharing knowledge and extending across disciplinary boundaries. The shared interests, goals, and values may create opportunities that cannot be realised without stepping outside the disciplines into unknown intellectual domains. While Pasteur famously noted that “chance favors only the prepared mind,” there is perhaps a corollary that, in modern research, that chance favours the interdisciplinary mind.

The potential for transformative results in the transactional example presents us with an interesting paradox—the product of the collaboration might radically change the body of knowledge or the social context, but transformation is generally a result of the product rather than the process by which it was achieved. For example, a device that permits the safe storage, transport, and delivery of vaccines might be highly transformative, regardless of the nature of the collaboration that led to its invention.

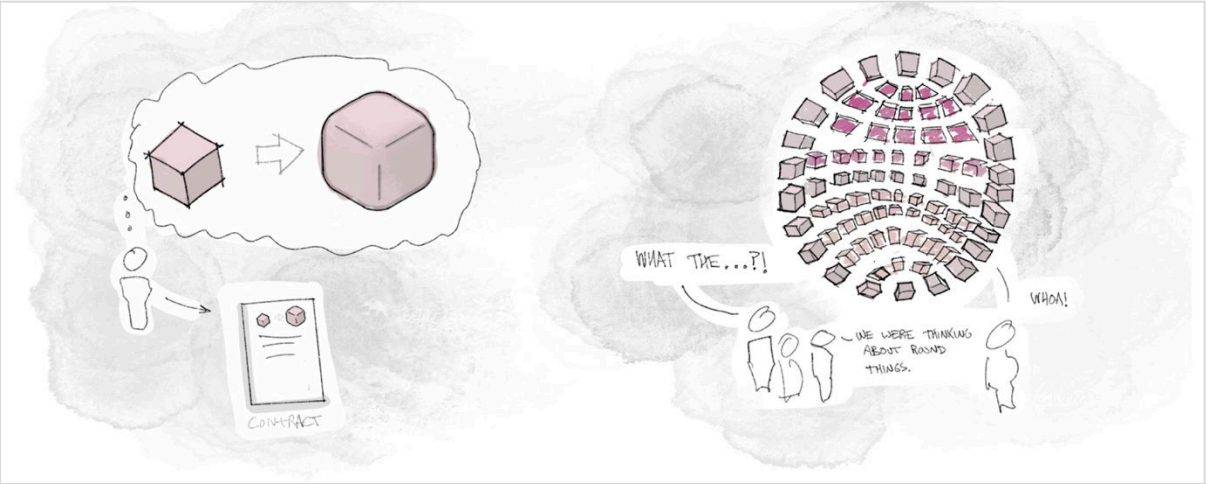

Figure 5: how participants think about the outcome of collaboration and what is valued.

This capacity for transformation rests primarily on the thing that is produced rather than insights from its development. There is very little inherent in the process itself that elevates the potential for transformation. Table 1 summarises the attributes related to relational and transaction interdisciplinary collaboration.

Thus far, we examined six attributes of interdisciplinary collaboration, and explored them through a relational mode; where the collaboration was built primarily on establishing and developing a culture based on mutual respect and a set of shared interests, values, or goals. In a transactional mode, the collaborative foundation is built upon a set of commitments that are defined in terms of contracts and agreements.

The examples we have used thus far might be considered endpoints of a spectrum of interdisciplinary collaborations. It would be unusual for anyone to spend their entire career only at these endpoints. Far more likely is that successful systemic interventions will reside somewhere along a continuum between relational and transactional and will evolve over the life of the collaboration. In the next section, we consider this movement and the reframing of interdisciplinary collaborations, raising important questions about how these two modes might play a role in systemic design.

Table 1: Attributes of Relational and transactional interdisciplinary collaboration

Attribute	**Relational interdisciplinary collaboration**	**Transactional interdisciplinary collaboration**
Collaborative Foundation—Basis for the collaboration	Common goals or values explored together, based in part on relationship between collaborators	Transactions and transmissions (contractor and client)
Power Relationships	Power and control are shared by collaborators	Client has authority over contractor
Language/Means of Communication	Language of disciplines used with translation, enhanced by literary and narrative devices	Standards and specifications formalise communications
Approach to Risk	Risk of the undertaking is accepted as an element of participating. Undertakers may incur risk by working outside disciplinary bounds	Risk is reduced whenever possible and is managed in the terms and conditions of the contract
Product of the Collaboration	Deeper insight into the participant's own and the other discipline. Possibly new languages, concepts, and products	Device, system, or result as specified in contract
Potential for Transformative Outcomes	Potential may exist because of the process itself as well as any specific work products. Openness to different perspectives may lead to outcomes that surprise collaborators	Potential resides primarily in the product itself rather than the process by which it was built Because collaborators seek to "retire" risk, unexpected outcomes may be much less likely

Relational and transactional interdisciplinary collaboration in systemic contexts

Example 3: *A mathematician, an oncologist, and a tissue engineer from several different research institutions find they have a shared interest in models of tumour growth and methods to treat them. They determine that their balance of skills and common concerns could lead to better understanding of how tumors spread and the effectiveness of certain types of treatments. After working together on several papers, they are awarded a large NIH grant that allows them to build a team to do cutting-edge research.*

This example represents a certain "scaling up" of the earlier examples, and the collaboration moves along the spectrum of interdisciplinary collaboration modes. This team shows many of the same elements as the materials science/chemistry example. The collaboration may yield more relational outputs, such as new ways of thinking about, modelling, and acting on tumours, but the researchers will also want to develop to achieve measurable outcomes for patients. The more focused and goal-directed their collaboration, the more likely they are to reduce the risk to the deliverables. At some stage, the collaboration will look more like transactional interdisciplinary collaboration than the original relational interdisciplinary collaboration approach.

Because this middle ground often becomes familiar terrain to interdisciplinary collaborators, several interesting and important questions arise:

- What skills underlie successful interdisciplinary collaborations?
- Where do participants learn relational interdisciplinary collaboration and transactional interdisciplinary collaboration skills and techniques?
- What support or scaffolding might organisations provide to assist both modes of interdisciplinary collaboration?

Many of the skills for successful collaboration have been well documented in the literature (see, for example, Lattuca, 2001 and Strober, 2011). Transactional interdisciplinary collaboration requires classic project management skills, formal design frameworks, and command and control approaches to discipline. Transactional interdisciplinary collaboration projects are typically organised in terms of scope, spending, and scheduling. Aspects of transactional interdisciplinary collaboration are taught in almost every project management and engineering cornerstone and capstone

course. The list of skills described above can be found in the table of contents of any text for these classes. Transactional interdisciplinary collaboration is the *lingua franca* of engineering education and practice.

Relational interdisciplinary collaboration skills, attitudes, and behaviours, on the other hand, are often learned by happenstance. This form of collaboration necessitates a capacity to listen, question, and translate information into and out of one's own domain-specific vocabulary. Relational interdisciplinary collaboration relies upon either rapid language acquisition skills, an ability to explain domain knowledge to an "outsider", or a high degree of trust. An important tool for communicating domain-specific knowledge to a fellow collaborator may be the use of metaphor and other linguistic tools. In addition, a high degree of curiosity beyond one's own discipline, patience with the progress of others, and a tolerance for ambiguity may be valuable attitudes and behaviours and may be key to risk tolerance. The ability to cede control over a part of the research endeavour to an outsider with very different expertise may be a more valuable skill for relational interdisciplinary collaboration than any tool found in a project management system.

This sharp distinction between *transactional* and *relational* skills development is not because of a shortcoming in traditional education. The open issue here is the ability of systems designers to participate in large, open-ended problems. To the extent that we wish to participate in the collaborations that will be needed to address those challenges, skills that support relational interdisciplinary collaboration will need to be added to the systems designer's toolbox.

What support or scaffolding might systems design education and research organisations provide to assist both modes of interdisciplinary collaboration? Creating a climate that provides mentoring, financial support, access to graduate assistants, and creative processes for evaluation of intellectual work product is needed if relational interdisciplinary collaboration is accepted as a valid option rather than a heroic choice.

In this paper, we have used examples to illustrate ideas, highlight issues, and provoke the reader. We close with two examples drawn from contemporary practice. While each is outside the traditional American academy, they demonstrate that providing

scaffolding for collaborative environments is not only an aspiration but an achievable goal.

Remarks

The field of systemic design includes scholars and practitioners from a range of varied disciplines. The complexity and dynamic aspects of systemic challenges will require collaborations that morph and evolve to meet emergent and unforeseen needs. Effective cross-disciplinary work will necessitate fluency with the different modes of interdisciplinary collaboration. By introducing these frameworks, we hope to create a greater awareness of the ways we understand, conduct, and teach interdisciplinary collaboration.

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