Exploring blind spots in collaborative value creation in building design: A creativity perspective

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Defining, developing, and delivering value is critical in integrated design processes (IDP) in building design and its two core design disciplines, architectural design and engineering design. Even so, how values emerge—the creation part itself—is underexposed. Using the seminal four p model from creativity research (person, process, product, and press) as an analytical lens, the paper explores blind spots in two building design cases that we as architects and researchers in creativity and engineering design have been involved in. On this basis, the paper contributes a *four-leaf clover model* of potential blind spots in collaborative value creation in building design. The model is comprised of *value exploration, value negotiation, value formulation,* and *value manifestation*. Design researchers can use the model as a scaffold for new design value theory, and design practitioners can employ it as an instrument to better navigate collaborative building design processes with multiple stakeholders, whose individual value sets may not always be clearly articulated and hence may sometimes collide.

Keywords: value creation; building design; creativity; four p model; integrated design process (IDP); interdisciplinary

Introduction

Values can be defined as the '*principles, standards, and qualities that guide actions*' (Le Dantec and Do 2009, 122, orig. emphasis) and are essentially what we care about when making decisions (Keeney 1992). Creating value is critical in all design projects (Whitham, Moreton, Bowen, Speed, and Durrant, 2019), and value has even been called a 'unifying concept for design' (Cockton 2006, 165). The importance of value is especially relevant in building design, whose outcomes form an inseparable part of human life. A severe challenge, however, is building design's multifaceted value profile with heterogeneous stakeholders, whose values must be aligned both before and during the design process.

In our role as architects and researchers in creativity and engineering design, we have been involved in several building design projects, and as we unfold below, we have seen how obscurity and inconsistency in the perception of value creation have troubled architects, engineers, and other stakeholders. In hindsight, many issues that we were not fully aware of during these projects seem to converge in one overarching theme—the dominance of the value of the *final* building design. This unilateral pre-understanding is problematic because it ignores that value per se must be created before it can be interpreted. All values emerge in complex, collaborative creative processes that dictate the final design value. Underestimating the importance of the value *creation* part—how values are *defined*, *developed*, and *delivered*—can be a severe *blind spot*, which causes misunderstandings and conflicting stakeholder expectations that often lead to problems such as exceeding of budgets and timelines in complex building design collaborations. A well-known example of this is the Berlin Brandenburg Airport. Originally planned to open in 2011, it remains unfinished and is approx. €2,5B over budget (Nieto-Rodriguez 2017).

The importance of value in collaborative processes is recognized by several disciplines within or pertinent to design, e.g., participatory design (Iversen, Halskov, and Leong 2012), user experience (UX) (Gray and Kou 2019), the liberal arts (Kemal and Gaskell 2010), academic design programs (Lújan Escalante 2019), management and marketing (Prahalad and Ramaswamy 2004), business design, e.g., as value proposition (Osterwalder et al. 2015), Human-Computer Interaction (HCI), e.g., as value built into the software systems (Suchman 1993) or as Value Sensitive Design (VSD) (Friedman 1996; Le Dantec, Poole, and Wyche 2009), urban design (Chiaradia, Sieh, and Plimmer 2017), and project management (Laursen and Svejvig 2016), to name but a few.

Not many studies have focused on values in building design. Luck and McDonnell (2006) analyzed colloquial conversations between an architect and building users and, by classifying the information exchanged, discerned four representational elements of design—functional, perceptual, phenomenological, and symbolic—based on Medway (2000). McDonnell (2009) showed how a design process progresses naturally through conversational moves, turn taking, and collaborative negotiation of information and values. Le Dantec and Do (2009) found that thirty percent of the events of two architectural design meetings concerned design values and ten percent human values, and using the same data set, Lloyd (2009) showed how values in such building design meetings are always imbued with ethical concerns.

This paper complements the non-participant perspective of these studies by examining two building design projects that we have taken part in. In our experience, the creation part of collaborative value generation is often overlooked in complex building design processes. We therefore adopt a *creativity perspective*, since creativity research is the discipline specialized in studying creative processes. By distinguishing between *person*, *product*, *process*, and *press* (from the milieu), the seminal *four p* model of creativity (Rhodes 1961) has proven relevant for identifying critical aspects of how ideas, including conceptions of value, emerge in a creative process. Since the four p model has significant explanatory power in design theory (Biskjaer, Dalsgaard, and Halskov 2017), we deploy the model as an analytical lens to explore blind spots in collaborative value creation in building design. We advocate a contingency perspective 'that explicates how value is created from the vantage point or perspective of a particular source' as opposed to 'a single universal conceptualization' (Lepak, Smith, and Taylor 2007, 183).

The paper is structured as follows. First, we outline interdependent values in integrated design processes (IDP) in building design and in its two core design disciplines, architectural design and engineering design, and we point to *general* blind spots in these two disciplines. We then apply the four p model to two building design cases that we have been involved in as a way to illustrate *specific* blind spots that we have observed in these collaborative value creation processes. This enables us to propose a *four-leaf clover model* of potential blind spots in collaborative value creation processes in building design. Finally, we discuss the model's relevance for examining innovation as a central value in building design processes.

Understanding value in integrated design processes (IDP) in building design

In contemporary building design, an *integrated design process* (IDP) is an architectural-oriented, holistic design management method that through an interdisciplinary approach supports close collaboration and dialogue between architects and engineers. An IDP is based on five iterative phases. Full participation of all members of the design and delivery team ensures the best results (WBDG 2016). An IDP includes different aspects of the profession such as control of all the parameters that must be integrated to create better sustainable solutions (Keeler and Vaidya 2016). Building design projects are marked by both qualitative and quantitative values (Nygaard 2002), which are generally referred to as "softer" or "harder" values (Madsen, Beim, and Reitz 2015, 39). Harder values are marked by an epistemology that presumes a reality that can be described and measured objectively. Softer values express that such objectivity is not possible (Groat and Wang 2013, 76-78). Some sub-disciplines in building design deal with harder, quantifiable values, e.g., energy consumption, construction cost, and indoor climate, while others address qualitative aspects related to social and cultural values, e.g., experience of the built environment (Spencer and Winch 2002, 8, 33-36). These softer and harder values are strongly interdependent (see *Figure 1*), which is mirrored in the heterogeneity of stakeholders in a typical building project (Wandahl 2005), ranging from end-users over consultants to contractors and local authorities. Due to dissimilar knowledge, goals, and context, different stakeholders uphold different values (Lepak, Smith and Taylor 2007, 185), so collaborative value creation should be conceived holistically (Madsen, Beim, and Reitz, 2015, 44) based on its core design disciplines.

INSERT FIGURE 1 HERE

Figure 1. Interdependent values in IDP-driven building design.

Understanding value in building design's two core design disciplines

Architectural design

By "architectural design" we refer to the design of physical environments in building scale where the design task is undertaken by a trained architect in collaboration with other stakeholders. Since the term "quality" dominates architectural design (Rönn 2011, 8), we focus on *architectural quality* when examining value. In Antiquity, architect and architectural theorist, Vitruvius (1914), stated that a building should possess "utilitas," "venutas," and "firmitas" (commodity/functionality, delight, and firmness), and that its quality arises in the meaningful interplay of these three. The Vitruvian triad's view on quality thus entails both harder and softer values. In *An Essay on Architecture,* Laugier (1753) advanced this idea of architectural quality: '[t]he parts that are essential are the cause of beauty, the parts introduced by necessity cause every license, the parts added for caprice cause every fault' (12).

These historical examples show how the quality of architecture is based on an objective evaluation of facts as well as how we perceive it sensorily (Rönn 2011, 4;

Pallasma 2005). Recently, the conception of the role of the architect and architectural quality has changed. This can be traced back to the Beaux Arts movement in Paris that favored an artistic approach over technical reasoning (Lauring 2010, 3). Architects are now mainly trained to adopt an artistic approach and ‘as generalists to provide an overview of often very complex projects’ (Knudstrup 2010, 63), indicating a shift toward less quantifiable values. This shift may improve communication between architects and non-specialist users of a building, but it has also caused a *general blind spot* in architectural design in terms of collaborating with very tech-savvy, specialist stakeholders. One example is the post-WWII era’s many rectilinear-shaped buildings with full single-glazed façades. Projecting prestige, confidence, and prosperity to the public, this style was preferred by prominent corporations and clients. Many of these baronial buildings had dark-tinted glazing for purely aesthetic reasons and a low, visible light transmittance value. Since little light could actually penetrate the building, the imposing glass façades ironically caused a need for more artificial lighting (Oldfield, Trabucco, and Wood 2009).

Engineering design

Engineering design lies at the intersection of two cultural and technical streams (Penny 1970) (see *Figure 2*). As the principal goal, value can be defined as synthesized solutions in the form of products, processes, or systems satisfying perceived needs (Pahl and Beitz 2013). These needs are articulated by mapping functional requirements (FRs) in the functional domain and design parameters (DPs) in the physical domain so that DPs satisfying FRs are selected (Suh 1990).

INSERT FIGURE 2 HERE

Figure 2. Engineering design’s central activity (adapted from Pahl and Beitz 2013, 2).

A major challenge is how engineering design's many sub-disciplines consider value. They tend to focus on harder values based on assessment of benefits versus the resources needed to achieve it (Dallas 2006). This may be expressed as a ratio between a particular function and its whole-life cost, so that improved function or reduced whole-life cost will increase value. The design aspect of engineering design deals with issues such as safety, usability, and quality. The aim is to get the best value for a project by establishing and delivering the value-defined functions at least whole-life cost consistent with the required quality and performance (Hammersley 2002). This makes measuring and quantifying value critical.

A *general blind spot* is the multi-disciplinarity of building design given its reliance on multiple specialist stakeholders. In our professional experience, engineers are highly aware of values in their design processes, but given their advanced level of technical expertise, they might find it challenging to clearly express the effects of their design within a bigger picture. One example is Hopkins Architects' *Velodrome* for the 2012 London Olympics (Pallister 2011) where functional, structural, and environmental values should all be integrated. From competition stage to final form, the engineering designers managed to eliminate 35,000 m^3 of internal volume from the building, reducing the amount of air to be conditioned (76). The Velodrome's structural system thus had to be redesigned—a controversial decision that needed to be communicated clearly in terms of the (softer) values gained. The alteration eventually improved the experiential quality of the Velodrome and reduced the amount of steel by twenty-seven percent, shortening the construction program by three months.

As building design's two core design disciplines, architectural design and engineering design are equally important, but have no clear terminology for identifying, articulating, and analyzing the value *creation* part of a collaborative IDP to avoid potential blind spots. This suggests looking toward *creativity research* as the discipline specialized in examining how ideas and thus values emerge.

Introducing the four p model from creativity research

As an early contributor to modern creativity research, Rhodes (1961) offered a basic taxonomy, the *four p model*, to take ‘some of the fuzz off the concept of creativity’ (305). His analytical framework of *person*, *process*, *product*, and *press* (from the milieu), which must always be seen in conjunction, has since become seminal. We describe the four ps before applying them as an analytical lens to two IDP-based cases of collaborative value creation in a building design.

Person

Person concerns ‘personality, intellect, temperament, physique, traits, habits, attitudes, self-concept, value systems, defense mechanisms, and behavior’ (307). This is different from stakeholder mapping (Newcombe 2003), since person concerns how individuals in a creative process contribute to the process and product and impart a specific *value system* that affects the final design.

Process

The creative *process* applies to ‘motivation, perception, learning, thinking, and communicating’ (Rhodes 1961, 308). Many process models have been offered (Sawyer 2012, 89). Rather than employ one particular model, we wish to underline that it is general process awareness of the emergence of values that can illuminate some of the specific, potential blind spots in collaborative value creation in building design.

Product

Product concerns the outcome of the creative process: ‘When an idea becomes embodied into tangible form it is called a *product* […] Products are artifacts of thought’ (Rhodes 1961, 309, orig. emphasis). All products and the values they express are always judged by a social group. This points to the social context of value creation. *Whose values* are represented by the *product*? On *what grounds* are these values chosen? At *what costs* are they implemented in terms of reduced influence of other participants?

Press

Press refers to ‘the relationship between human beings and their environment’ and ‘studies of press attempt to measure congruence and dissonance in a person’s ecology’ (308), i.e., the impact of the sociocultural context in which creativity takes place. The sociocultural context may remain unaltered in a building design project, but values change, dissipate, and disappear. This makes it relevant to study the creation of values, and to this end Rhodes’ (1961) four p model lends itself well as demonstrated by five decades of analytical use in creativity research.

Analysis: The *four p* model applied to two building design cases

We use the four p model as an analytical lens to explore specific blind spots in two building design cases we have taken part in. In accordance with the UN’s Sustainable Development Goals (SDGs), we include the value of *sustainability* (Krygiel and Nies 2008) where appropriate for explanatory purposes. The first case is the design of a school, *Vestmyra Skole*, in Fauske, Norway (AART Architects 2015). Built in 2017, it spans 9,350 m^2. Situated on a plateau, the two-story school features wooden façades with windows of various sizes to ensure that its functional interior blends in naturally with the surrounding mountains and fjords. The second case concerns a competition entry in relation to *energy renovation of a 1960s prefab, concrete residential block* in a housing project in Gellerup, Denmark, undergoing complete renovation. The project was put out to tender as a turn-key contract with an integrated architectural competition (Aarhus Kommune 2007). The tender has been settled, but renovations are not finished.

Architectural design

Person

Architects often join the early conceptual design phases where creative freedom is high while knowledge about the project in its entirety is limited (Zeiler, Savanovic, and Quanjel 2007). Decisions here often have a relatively big impact on the final design (Bragança, Vieira, and Andrade 2014), underlining the importance of each architect's ability to collaborate with experts from other disciplines. In the case of Vestmyra Skole, the client and their advisors established more ambitious goals for indoor climate than what the national building regulations prescribed. As an example, a daylight factor of five percent was set as a requirement in all primary educational spaces to secure evenly lit spaces. This prompted a higher level of early-stage interdisciplinary collaboration than in similar IDP projects. The architects realized that referring to experience from previous projects could be a blind spot when attempting to fulfill the new ambitions to literally go "above and beyond." Therefore, they tried to broaden their understanding of the quantitative aspects of daylight and used simulation tools alongside conventional tools to be able to enter into a dialogue about the quantity and quality of daylight (Jensen and Kirkegaard 2015).

Process

An architectural design process is considered iterative (Lawson 2006), and several maps for describing the architectural design process have been proposed, e.g., the Danish

Association of Architectural Firms distinguishes between initial consultancy (including design specification), design phase, construction phase, and operational phase. In Denmark, the conventional way of building entails that

> the architect shares or hands the project over to the engineer when he or she has pretty much finished the schematic design of the building. This means that the engineer assumes a reactive role in the design process instead of the proactive role, which is required in an interdisciplinary approach to design (Knudstrup 2010, 63).

This reactive-proactive dichotomy between engineer and architect is problematic. A sustainable architectural design process requires an integrated approach among architects and engineering designers. Ignoring the unheeded appropriation of these dichotomous roles in collaborative value creation can therefore be a blind spot that works against implementation of the IDP philosophy.

In the case of the competition entry for renovation of a residential block in Gellerup, we tried to overcome this dichotomy through an iterative process. We tested concepts by drawing them in 2D and 3D, discussing them internally in the architectural studio and weekly with the interdisciplinary project team, and on two occasions with the client. This was a more time-consuming process for the architects. Unnoticeably assuming said division of roles to help accelerate the process was a constant risk that required a constant focus so it would, quite literally, not become a blind spot. We estimate that this challenge can be reduced in future projects if architects make more active use of early-stage simulation tools. Fortunately, in the present project, the extensive experience of both contractor and engineers in the field of energy renovation of social housing meant that they could easily assume a very proactive role.

Product

Recent years have seen an increase in international assessment methodologies for evaluating sustainability in collaborative building design proposals. Although some are process-oriented and others are certification tools, there is a tendency to favor quantitative over qualitative values (Madsen, Beim and Reitz 2015). This makes it challenging to attain a shared language, since, for example, a tenant and a contractor rarely subscribe to the exact same values. Not prioritizing a shared value-based terminology makes it harder to support an IDP and often represents a blind spot. In the case of Vestmyra Skole, the requirement of a five-percent daylight factor in the main educational spaces was an attempt to express a qualitative value (improving the students' potential for learning by optimizing lighting) through quantitative measures to avoid terminological blind spots. The proposed design of the classrooms included windows starting 450 mm above floor level. This did not contribute to a high daylight factor. Norwegian building regulations state the daylight factor be calculated 800 mm above floor level, so the low sill height did not give any "value for money." On the other hand, the low sill height allowed for views toward the outside playground and sports facilities and for the students to use the windows as niches for studying. A consensus was thus reached, leading to additional, non-quantifiable value for the users of the window zones (Jensen and Kirkegaard 2015).

Press

Expectations, values, and norms within the sociocultural context affect the architect's design space, which may be conceived as comprised of constraints (Biskjaer, Dalsgaard and Halskov 2014), including internal and external constraints (Lawson 2006). Internal constraints are factors 'under the designer's control' (97) whereas external constraints include location, budget, etc. Requests by stakeholders such as users, clients, and legislators constitute additional constraints that constrain collaborative value creation.

The Gellerup residential block renovation was located in a somewhat socially deprived suburban area, so grasping the full complexity of the sociocultural context was not straightforward. Although the value of sustainability often simply means “green” or “environmentally friendly” (Krygiel and Nies 2008), it was evident that sustainability in this case had further connotations specifically pertaining to the challenging life situation of the people living there. The value creation process was also affected by trends. The client and advisor highlighted reference projects with values they felt could be adopted, and the project was influenced by the current debate about whether such Modernist housing blocks have any value worth preserving. Within the project group, this caused lively discussions about the level of preservation versus alteration to pursue. Eventually, the group decided to propose a design emphasizing “the grid” in the façade to preserve a typical Modernist style and, conversely, to ignore thermal bridges through alterations to the existing construction in the separation between apartments. This case shows how prevalent sociocultural values and trends must always be redefined and reinterpreted by architects and stakeholders in a building design project. Failing to do so causes a severe blind spot that is detrimental to the potential success of the entire project.

Engineering design

Person

Person in engineering design may refer to many different specializations, including civil, mechanical, electrical, and structural engineers. How much experience such diverse engineering teams have with sustainability-related values such as energy and water efficiency and material cycles will greatly affect the building design process, especially in the construction phase. Just as architects, engineering designers must carefully articulate and align all value propositions.

In the Gellerup case, the project proposal team consisted of engineers, architects, and contractors with various competencies. The engineers focused on energy optimization, indoor climate, and structure, etc., while the contractors prioritized production, costs, and minimization of annoyances for the residents. Through a holistic approach, architects worked to synthesize the above and improve "quality of living." As opposed to the engineers and contractors, the architects were less trained in social housing renovation. While this uneven distribution of domain experience could represent a severe blind spot, it was embraced by the project team and indeed seen as a "breath of fresh air," pushing everyone to be more innovative by enabling new ideas. The engineers and contractors became even more aware of the softer values related to the residents' "quality of living" while meeting the technical requirements of the project. Here, acting upon uneven levels of domain experience led to stimulating discussions about the creation of the project value goals.

Process

Process in engineering design usually refers to values emerging through commissioning, consultation, construction planning, and dealing with the construction site itself. Engineers prioritize iterative design processes, but when the goal value is extremely complex, such as when designing a "sustainable building," engineers may resort to a simpler strategy to limit the profusion of interpretations of the desired goal value. Engineering teams tend to identify a single goal value under sustainability based on their expertise (Kamari, Corrao, and Kirkegaard 2017). Although expedient for the progression of the project, simplification of a complex goal value may be a blind spot that complicates engagement with the (often softer) values of the involved architects.

In the Vestmyra Skole case, we found it inadequate to reduce daylight to a mere quantitative matter. Still, setting an ambitious goal of a five-percent daylight factor was a simple and efficient way to articulate the importance of the value it represented in the interdisciplinary team. Advanced daylight simulations became a tool in the iterative IDP alongside graphical representations of the envisioned design and its requested values.

Product

The result of IDP-driven building design is a multi-task engineering production, either as the outcome of the building design process or as the erected building itself. As all engineers optimize their workflows to meet deadlines and budgets, two value streams must be conjoined—functional requirements (FRs) and whole-life cost. FRs in sustainability concern energy consumption, material types, waste management, pollution, transport issues, and system lifespan, etc. The derived values are all harder and quantifiable, but achieving a sustainable building design requires a design process with many softer, subjective values as well. All stakeholders must stay involved throughout the process to ensure that everyone experiences co-ownership of the collaborative value creation (Busby Perkins+Will Stantec Consulting 2007).

The Gellerup case shows how reaching a sense of a shared goal value and co-ownership can be very difficult once the building design project reaches a certain scale and complexity. Acknowledging this correlation between a project's magnitude and the risk of blind spots in the (seemingly) shared understanding of values is critical. The work prior to the competition phase to define the limits of the project proposal in collaboration with authorities and users was thus prioritized highly by the client and their team of consulting architects and engineers. Attention to how to best manage and engage users in the construction phase was not only a central democratic value, but an integral part of the assessment criteria of the building design project competition.

Press

Engineering design focusing on sustainability represents a very complex design process performed in a specialized work place where tools and materials affect the final design (Kamari, Corrao, and Kirkegaard 2017). Often, engineering designers rely on advanced software, typically for quantitative analysis. Working with such advanced creativity support tools (Frich et al. 2019), which it takes extensive experience to master, impacts not only the design process, but also the final design by potentially prompting a more conformist mindset. At least eighty percent of users of advanced, customizable software technology work within default settings due to user passivity and the ‘process of institutionalization of the technology’ (Palen 1999, 22). In addition to the press from stakeholders, who will often want certain materials used, reliance on advanced digital tools that almost imperceptibly nudge users toward a more conformist work mode can be a blind spot in engineering design.

In the Vestmyra Skole case, the daylight factor (DF) was used as an indicator throughout the project simply because it was the concept introduced in the building program. Although Norwegian building regulations accept DF as a way to document daylight in buildings, this default indicator, for which the relevant digital tools are usually set up, is not ideal and may prompt a conformist way of thinking. Indeed, Useful Daylight Illuminance (UDI) could substitute DF as a way to say more about the quality of the daylight (Nabil and Mardaljevic 2006). A default applied indicator and the pertaining support tools can thus define and delimit a collaborative value creation process. Failing to realize this can become a blind spot that influences the potential success of the entire building design project.

Discussion

Applying the four p model to the two building design cases has revealed a number of more specific blind spots (see *Table 1*) as important challenges to be mindful of in interdisciplinary, collaborative value creation in building design.

INSERT TABLE 1 HERE

Table 1. Blind spots in architectural design and engineering design as explored through analytical application of Rhodes' (1961) four p model to two building design cases.

Value-based blind spots in building design's two core design disciplines

As Table 1 conveys, the discerned blind spots in architectural design and engineering design cannot be seen in isolation, since the two disciplines share many challenges. Their intrinsic values are interdependent (see Figure 1), mirroring the interwovenness in the four p model. Still, some of the four ps are more closely connected than others.

This can be observed in what we call *value exploration*. Architectural design is marked by a shift toward softer, more qualitative values, and this affects the role and motivation of the person—the architect—as a stakeholder. Given engineering design's many sub-disciplines, it covers equally many value sets that must be merged. When an interdisciplinary team explores values in a building design process, this intrinsic value complexity may inadvertently push the team toward inexpedient management and reactive-proactive roles and hierarchies. In the Gellerup case, we tried to avert this inopportune situation through an iterative process with many touch-base meetings across the team.

Initial blind blind spots due to cursory value exploration will affect the subsequent *value negotiation* among all project participants. This is central, since the negotiation of the value of design insights underpins the ensuing design actions (Gray and Kou 2019). Here, an undeserved conformism can arise among engineers in response to default indicators in the building program and standard (software) tools, triggering a less flexible “best-practice” mindset. Conversely, architects must manoeuvre under the press of changing, diffuse sociocultural values. Architects must constantly redefine and negotiate these values in order to integrate them into the design, and comply with as many stakeholder expectations and constraints as possible. This was the case in the social housing renovation project, which was marked by disentanglement of complex sociocultural value sets and more ideological debate about the (controversial) legacy of architectural Modernism.

This begs the question of how to achieve a consensual *value formulation* that abides by this value-based press. In our experience, meticulously listing all values and how they should be interpreted is not common in building design. Assessments of the building design product tend to favor quantitative, measurable values. This may become a severe blind spot, since architects often adopt the role of liaison between contractor and engineers who each specialize in dissimilar value sets. Agreeing on how to best define and reconcile all discipline-specific value sets thus becomes challenging. In the Vestmyra Skole case, using advanced daylight simulations based on quantitative data helped to convey the qualitative value of evenly lit educational spaces (to enable better learning) in a concrete and easily accesible format.

Value-based discrepancies are to be expected in building design, and so the team must find a way to reach a clear, shared *value manifestation* that reflects the multifaceted value profile of building design. A critical blind spot when the building design product emerges in a collaborative value creation process is the risk of a limited sense of co-ownership. This is undesirable because it correlates with the experienced quality of the final building design (Busby Perkins+Will Stantec Consulting 2007). In the Gellerup case, we experienced how sustaining a sense of co-ownership across the team became increasingly difficult as the building design project grew in magnitude and complexity.

Collaborative value creation in building design can therefore be understood as a highly complex process with (at least) four main aspects—value exploration, value negotiation, value formulation, and value manifestation—informed by Rhodes' (1961) four p model from creativity research. These four aspects are interdependent and the collaborative process iterative and unique to each IDP-driven building design process. In sum, we refer to this as *the four-leaf clover model* (see *Figure 3*) of some of the most critical, potential blind spots in collaborative value creation in building design.

INSERT FIGURE 3 HERE

Figure 3. The four-leaf clover model of potential, critical blind spots in collaborative value creation in IDP-driven building design.

While we have used sustainability as an example of a complex, widely accepted value in building design, there is another that is equally important in this domain—*innovation.*

Implications for innovation in building design

The quest for innovation in building design pushes all stakeholders to pursue new ideas, materials, and techniques in very high-risk projects with some of the biggest budgets in design. As a prevalent value, innovation is hard to pin down. More than sixty definitions of innovation exist (Baregheh, Rowley, and Sambrook 2009) with "new" as the most sought-after value (Rindova 2007). To address this conceptual nebulousness, Baregheh et al. (2009) argued that the goal of all stakeholders in innovation is to 'transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace' (1334).

Although this unifying definition disentangles a very complex concept, it may have its own blind spot—the *threshold level* of "new/improved," or what Kolko (2007) called 'valuable newness' (225) in the final product. This is most relevant in value exploration and value negotiation in the four-leaf clover model above. Although innovation can be measured in economic impact (Smith 2004) pertaining to the transition from value formulation to value manifestation, it tends to ignore that building design stakeholders always ascribe various values (use, aesthetic, cost, technical, etc.) to any product—and perhaps particularly those that might not yield much economic impact. This is evident in arts- and culture-founded values, which are often elusive (Choi, Papandrea, and Bennett 2007) and may best be perceived in exactly a person perspective (Crossick and Kaszynska 2016) in value exploration and value negotiation. Such value discrepancies obfuscate the innovation process in terms of assessment methods for judging if the process has been executed "successfully" or not, which relates to value manifestation. Given the often grand budgets in building design, projects often catch the attention of policy-makers who must balance public spending, 'public engagement as a form of impact' (Watermeyer and Hedgecoe 2016, 662), and the need to show socio-political innovation. This is a constant press that all participants in a collaborative design value creation process must realize when dealing with value negotiation and value formulation.

This leads us to argue that the four-leaf clover model is also relevant as a means to explore potential, critical blind spots in innovation in building design. Although the model suggests twenty-seven themes that each merits even more attention as potential blind spots, we speculate that the challenge of *value relativity* in innovation in building design, i.e., "new/improved" and "successful" to what extent, to whom, and by what measures, may be the single most critical blind spot in collaborative value creation. Asking such questions means moving beyond outcome-based measurements of value, which further points to value emergence through contextualized negotiation (Agid and Chin 2019). Such a proposed reconceptualization of value itself seems particularly relevant to design-based disciplines where impact assessment tends to equate innovation and economic impact, thus ignoring the main causes behind this conceptual complexity, not least the complex interplay between the four ps in collaborative value creation.

Limitations

In accordance with Myers' (2009) guiding definition, we consider our work exploratory insofar as our 'primary motivation [has been] to discover and explore new phenomena' (258), including the 'relevant features, factors, or issues that might apply in other similar situations' (72). Even so, using the four p model as an analytical lens entails blind spots of its own. As the basis of our four-leaf clover model, Rhodes' (1961) four p model certainly does not capture the full complexity of a building design project given its complex value profile and many heterogeneous stakeholders (Wandahl 2005). Still, we argue that the model can serve as a useful, analytical perspective and reflection tool to supplement current stakeholder mapping models (Newcombe 2003). We also wish to underline that we appreciate that many engineers work with softer, qualitative values and vice versa for architects. Therefore, the presented value distinctions should be seen as general predilections, not as pigeonholing. The work presented is informed by two building design cases that we have taken part in. Future work should apply the four-leaf clover model more micro-analytically to an ongoing building design project to study its components, relevance, and explanatory power in a real-world collaborative value creation process.

Conclusion

Collaborative value creation processes are challenging, and many value maps have been offered. Our aim has been different. We have noticed a need for a more critical, theory-driven look at how values are in fact *created* in such processes. Informed by Rhodes' (1961) four p model from creativity research, our *main contribution* is the *four-leaf clover model* of potential blind spots in collaborative value creation in IDP-driven building design. We argue that the model's four aspects—*value exploration, value negotiation*, *value formulation,* and *value manifestation*—can serve as a simple, but appropriate instrument for analysis and reflection to help design practitioners and design researchers better identify, articulate, and navigate some of the (often latent) complexity of collaborative value creation in building design and, potentially, beyond.

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Tables

Table 1. Blind spots in architectural design and engineering design as explored through analytical application of Rhodes’ (1961) four p model to two building design cases.

	Building design	
Analytical focus	*Architectural design*	*Engineering design*
Person	Conflicting value systems, a shift from harder to softer values	A highly specialized discipline covering diverse sets of values
Process	Reactive-proactive dichotomy between engineer and architect	Prone to standard procedures to ensure efficiency and simplicity
Product	Prone to favor quantitative values in final assessment	Diverse value sets limit sense of co-ownership in final design
Press	Societal and cultural values are rarely continuously redefined	Constraining effect from using standard metrics, advanced tools

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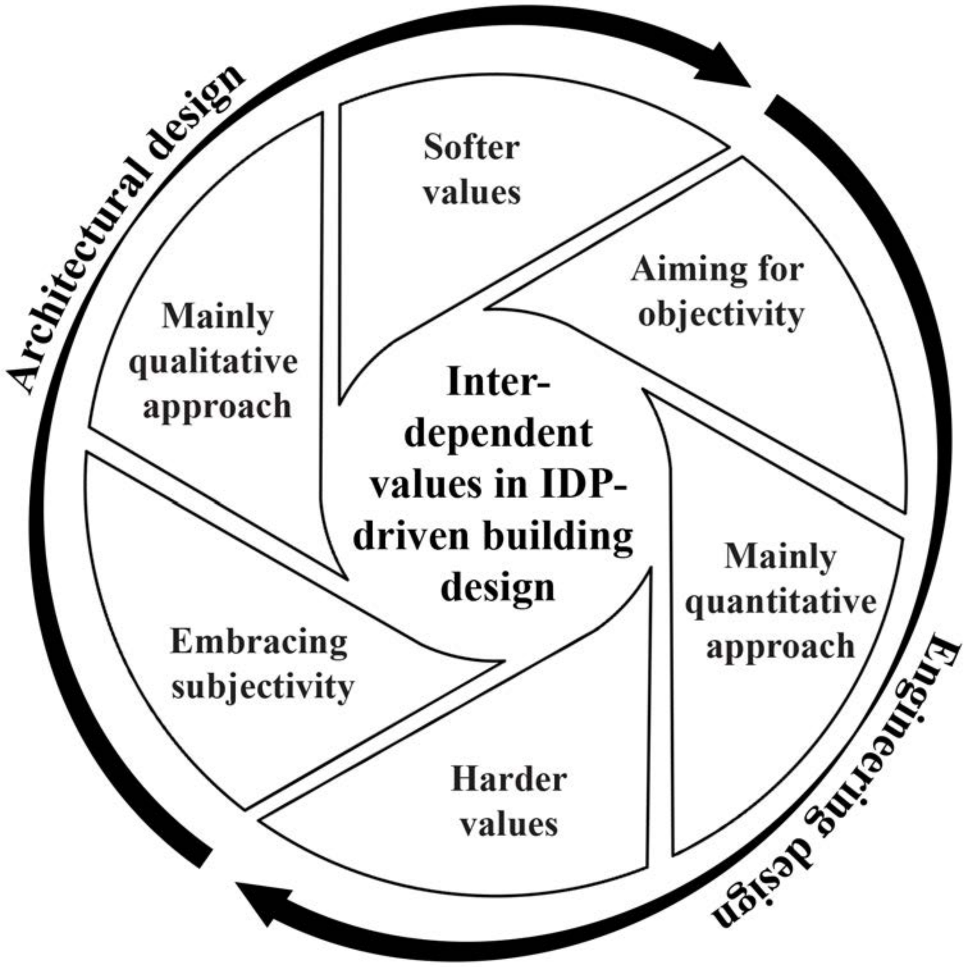
Figure 1. Interdependent values in IDP-driven building design.

Figure 2. Engineering design's central activity (adapted from Pahl and Beitz 2013, 2).

Figure 3. The four-leaf clover model of potential, critical blind spots in collaborative value creation in IDP-driven building design.



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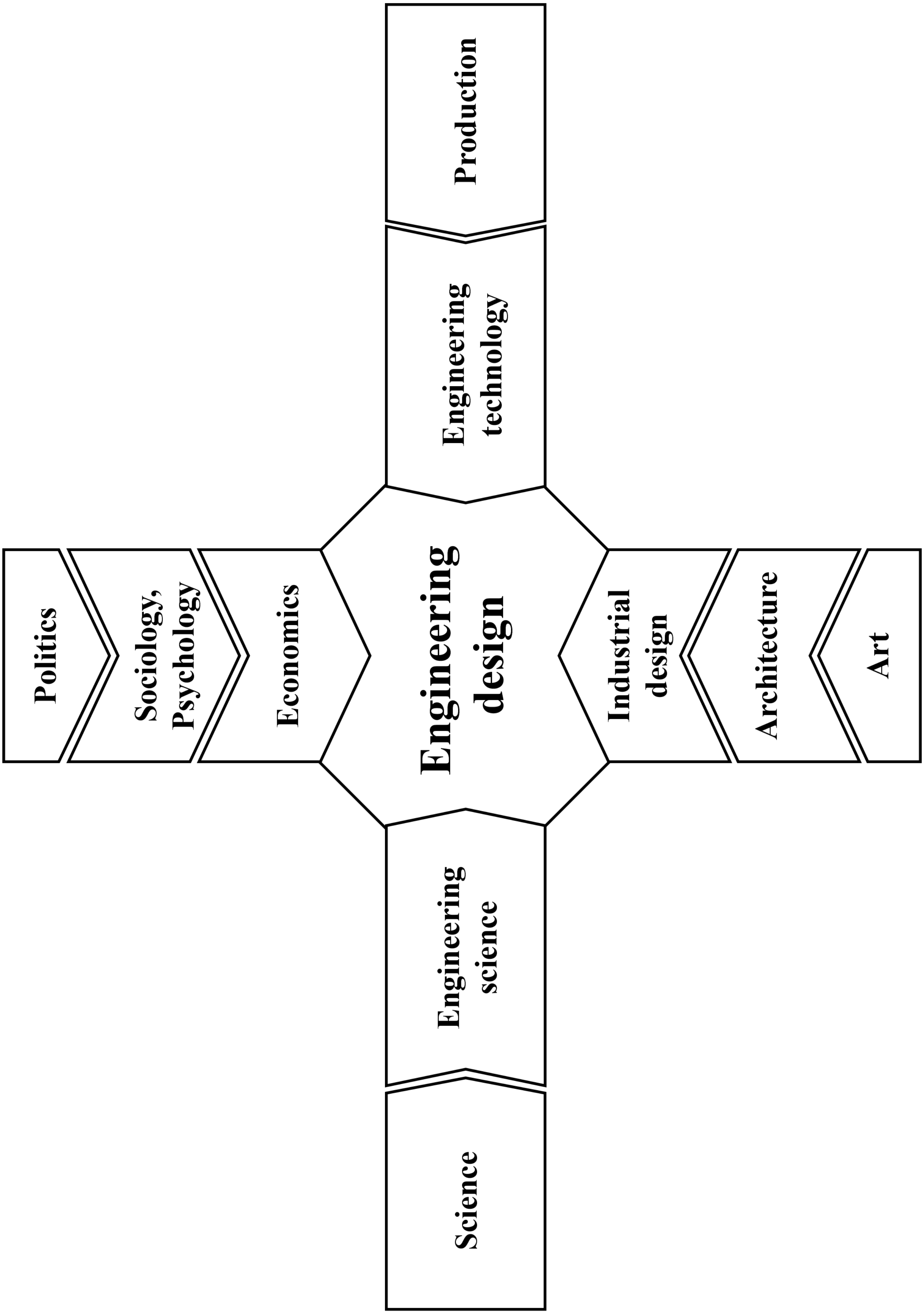

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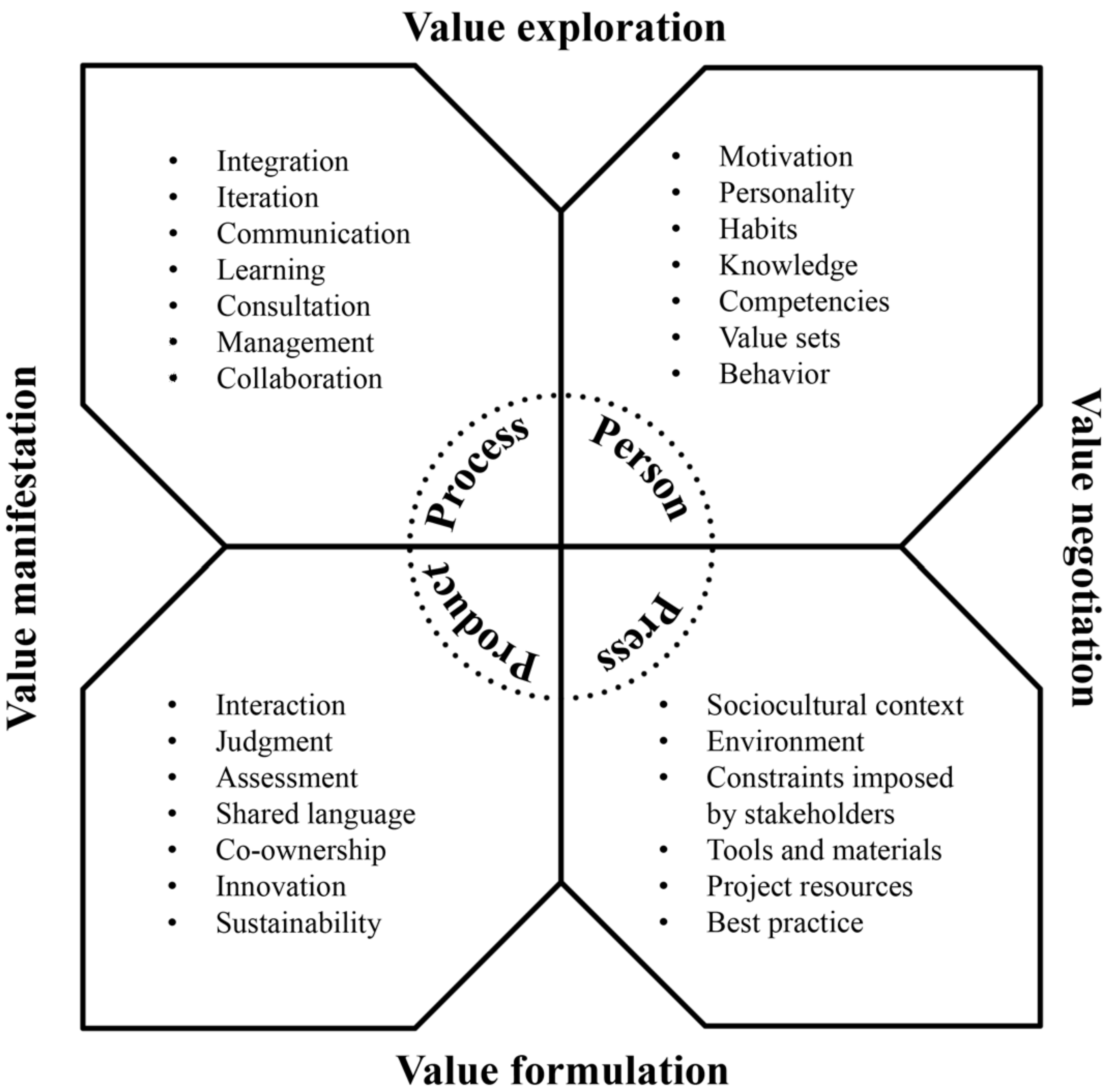

Figure 3. The four-leaf clover model