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Article — Published Version

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Creativity and Innovation Management

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Suggested Citation: Vogelgsang, Lukas (2020) : Transition rather than balance: Organizing constraints for collective creativity in pharmaceutical development, Creativity and Innovation Management, ISSN 1467-8691, Wiley, Hoboken, NJ, Vol. 29, Iss. 3, pp. 413-423, <https://doi.org/10.1111/caim.12391>

This Version is available at:

<https://hdl.handle.net/10419/230242>

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REGULAR ARTICLE

Transition rather than balance: Organizing constraints for collective creativity in pharmaceutical development

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Award Number: FOR 2161

When it comes to organizing for collective creativity, management scholars typically advise balancing between constraint and freedom. However, this suggestion to balance is often too enigmatic in practice, neglects the dynamics inherent in creative processes, and predominantly highlights the inhibiting aspects of constraints. Thus, the present article aims to rethink this balancing proposition by asking how constraints unfold during collective creative processes. Based on four cases of pharmaceutical development, it illustrates how collective creativity is enabled by constraints from two distinct sources, namely restraint and contingency. The article further shows how and why these constraint sources alternate along the development trajectory. While constraints can enable collective creativity, phases of constraint transition are eventually necessary to revitalize the development process. Building upon these findings, the article concludes that organizing constraints for collective creativity is a matter of transition rather than balance.

KEYWORDS

collective creativity, constraint, process

1 | INTRODUCTION

Creativity, the production of novel and valuable ideas (Amabile, 1988; Sternberg, 2006), is a crucial asset for organizations relying on innovative products and technologies, for instance pharmaceutical and biotechnological companies (Johnstone, Pairaudeau, & Pettersson, 2011). However, in these high-tech industries, multiple specialists with diverse backgrounds need to combine knowledge to generate valuable novelty (Lapierre & Giroux, 2003). To address this issue of *collective creativity*, organizational and management studies increasingly scrutinize how novel and valuable ideas emerge from the interaction of interdependent agents (Thompson, 2018, p. 245; see also Garud, Simpson, Langley, & Tsoukas, 2015; Hargadon & Bechky, 2006; Sawyer & DeZutter, 2009).

Still, organizing for collective creativity remains puzzling to scholars, especially concerning the role of constraint (Caniëls & Rietzschel, 2015). On the one hand, limitations and restrictions can provide inspiration as well as structure for creativity (Arrighi, Le

Masson, & Weil, 2015a, 2015b; Lampel, Honig, & Drori, 2014). On the other hand, creativity also relies on exploration, emergence, and improvisation (Austin, Devin, & Sullivan, 2012; Brattström, Löfsten, & Richtné, 2012). Especially in pharmaceutical development, collective creativity depends on tight control and clear objectives as well as experimentation, surprise, and uncertainty (Dougherty, 2015; Dunne & Dougherty, 2015; Styhre & Sundgren, 2011; Sundgren & Styhre, 2003). Accordingly, the relation between creativity and constraint is typically conceptualized as an inverted U-shape: too much as well as too little constraint hinders collective creativity (Acar, Tarakci, & van Knippenberg, 2018; Cirella, 2016; Rosso, 2014). Therefore, management scholars suggest balancing constraints, meaning to establish an optimized and middle ground “sweet spot” of constraints, in order to organize for creative output (Chen, 2012; Cirella, 2016; Davis & Scase, 2000; Gilson, Mathieu, Shalley, & Ruddy, 2005; Lampel et al., 2014; Rosso, 2014; Shalley & Gilson, 2017).

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Yet, this notion of balancing constraint is often too enigmatic to help organize collective creativity in practice (Caniëls & Rietzschel, 2015; Ortmann & Sydow, 2018; Rosso, 2014). For instance, it remains unclear if and how management should balance between distinct types of constraints (Acar et al., 2018). Furthermore, balance suggestions discount the continuous constraint handling involved with creative processes (Joas, 1996; Lombardo & Kvålshaugen, 2014; Ortmann & Sydow, 2018). Finally, recommendations to balance between constraint and freedom highlight the inhibiting aspects of constraint and severely disregards its enabling characteristics (see Lampel et al., 2014; Ortmann & Sydow, 2018; Rosso, 2014). Thus, the present study aims to rethink the prevalent suggestion to balance constraints for collective creativity in management theory.

To do so, constraints are not examined as static parameters that can enhance or hinder creativity (Caniëls & Rietzschel, 2015), but as dynamic variables themselves, that change and develop during collective creative processes (Fortwengel, Schüßler, & Sydow, 2017; Ortmann & Sydow, 2018). The goal is hence to understand *how constraints unfold during collective creative processes*. To answer this question the paper uses *creativity biographies* (inspired by innovation biographies; Butzin, Rehfeld, & Wiedmaier, 2013) from collective processes of pharmaceutical development. Based on four cases, it shows that constraints differ not only in type (Acar et al., 2018), but also regarding their *source*. Thereupon, the paper illustrates how collective creative processes alternate between phases of *enablement* and *transition* regarding constraints. These findings lead to three theoretical contributions.

First, creativity research typically scrutinizes the types of constraints as external factors that hinder or enhance creativity (Acar et al., 2018; Caniëls & Rietzschel, 2015; Lampel et al., 2014; Rosso, 2014). This paper suggests that the *sources* of constraints illustrate vital aspects regarding the creative process not depicted by type alone. Second, some studies already point to the inextricable interweaving of constraint handling and creativity (Joas, 1996; Lombardo & Kvålshaugen, 2014), stating that transformation of constraints is part of creative processes (Ortmann & Sydow, 2018). Refining this notion, the present article illustrates that phases of collective creativity and phases of constraint transition are distinctly separate. Collective creativity thrives when constraints are taken seriously and are hence sustained by the involved participants. Only after creative insight has been created, do participants try to alter the (now obstructing) constraints. Third, building upon these insights, and upon the notion that constraints enable *and* restrict creativity (Giddens, 1984; Ortmann & Sydow, 2018; Rosso, 2014; Sonenshein, 2016), this article concludes that *constraint transition* rather than *constraint balance* is beneficial to organize for collective creativity.

2 | THEORETICAL BACKGROUND

2.1 | Collective creativity

In most of the organizational and management literature, the study of creativity, as the production of novel and valuable ideas, is based on a

social-psychological ontology, which examines individual creativity in social context (Amabile, 1988; Amabile & Pillemer, 2012; Woodman, Sawyer, & Griffin, 1993). In contrast, a relational ontology aims to understand the collective origins of valuable novelty (Thompson, 2018, p. 245). There, creativity is conceptualized as an emerging property of ongoing collective processes, which cannot be attributed to specific individual parts and variables (Hargadon & Bechky, 2006; Sawyer, 1999; Sawyer & DeZutter, 2009). Following this relational ontology, collective creativity, as understood in this article, is not about individual creativity within collectives (Kurtzberg & Amabile, 2001), but rather about the emergence of creativity from networks and its embeddedness in social groups (Sawyer & DeZutter, 2009, p. 81). Thereby, the focus of analysis lies on interactions, which “*yield creative insight, but cannot be attributed to particular individuals*” (Hargadon & Bechky, 2006, p. 484), that is, on the “*processual and interactional mechanisms whereby creativity emerges*” (Sawyer, 2015, p. 181).

Applying a relational ontology means to investigate how valuable novelty emerges through the interaction of interdependent agents (Dunne & Dougherty, 2015, p. 157; Sawyer & DeZutter, 2009, p. 83). For example, Sarah Harvey (2014, p. 325) argues that group creativity emerges during efforts to integrate contradictory perspectives into a unique and shared understanding (see also Drazin, Glynn, & Kazanjian, 1999). Hence, collective creativity makes another aspect of the complex phenomenon creativity salient. It neither negates nor denies individual creativity, but is instead interested in collective aspects of the generation of valuable novelty (Hargadon & Bechky, 2006, p. 498). In fact, individual and collective creativity coexist and even stimulate one another (Cirella, 2016).

2.2 | Constraint and creativity

To remain neutral and inclusive, constraint is here defined as restrictions, limitations, or confinements within prescribed boundaries (Rosso, 2014, p. 553). There are numerous *types* of constraints in the literature, like structural, resource, and temporal constraints (Lampel et al., 2014); product and process constraints (Rosso, 2014); or capability and coupling constraints (Hägerstrand, 1970) to name a few prominent ones. This paper follows the convincing taxonomy from Acar et al. (2018), which synthesizes these diverse categories into three constraint types, namely *input constraint* (resource availability), *output constraint* (outcome requirements), and *process constraint* (procedural regulations).

Initial management studies regarding individual creativity theorize constraint as antithetical and harmful to creativity (Amabile, 1988). Instead, freedom and intrinsic motivation are conceived as propellants of creativity, which thrives under slack and freedom (Amabile, 1996). However, a total lack of constraints can also lead to creativity decrease: for instance, a lack of input constraints can make creators too comfortable (Csikszentmihalyi, 2014), while tight input constraints can stimulate innovation and stretch employees' imagination to find unique solutions (Shalley & Gilson, 2004). Hence, constraints do not

only obstruct creativity, but can also pose an obstacle that challenges participants to come up with novel solutions (Marguc, van Kleef, & Förster, 2015). They can inspire and challenge ingenuity by making things difficult, instead of making things easier (Honig, Karlsson, & Hägg, 2013; Lampel et al., 2014; Ortmann & Sydow, 2018).

A similar ambivalent role of constraint is depicted regarding collective creativity, which increases under careful planning of phases and deadlines, well-communicated tasks, and assignment of specific roles, whereas too rigid and formal structures are inhibiting as well (Cirella, 2016). Constraints limit group creativity, but they can also enable it, if contributors are able to accept and embrace them (Rosso, 2014): for instance, process constraints can guide and structure the collective creative process toward better results, as is the case with brainstorming sessions (Stroebe, Nijstad, & Rietzschel, 2010). Likewise, standardization (e.g. routine) and collective creativity are conceptualized as a complementary duality (Elsbach & Hargadon, 2006; Gilson et al., 2005; Sonenshein, 2016). Moreover, normative constraints can promote free expression of ideas and foster collective creativity as well (Goncalo, Chatman, Duguid, & Kennedy, 2014). Yet again, too tight constraints limit the creative possibilities. For instance, too rigid output constraints limit the possibilities and acceptance of creative surprises (Austin et al., 2012).

2.3 | Organizing collective creativity—Balancing constraints?

While these studies all provide very valuable insights on the influence of constraint on creativity, their practical advice for the management of creativity is basically to adjust for compromise: “*when constraint trumps freedom or freedom trumps constraint, creativity will suffer*” (Rosso, 2014, p. 579). Essentially, management must strike a balance between “*under- and over-organizing*” to foster creativity (Chen, 2012). However, this insight leads to an all too simple message concerning constraint management for creativity: “*tight enough, but not too tight; difficult enough, but not too difficult*” (Ortmann & Sydow, 2018, p. 915). In summary, the literature suggests balancing constraint, meaning to establish and keep an optimized middling amount of constraints to organize for collective creativity (see also Cirella, 2016; Lampel et al., 2014). This suggestion rests on the notion that constraints and freedom are mutually exclusive. Yet, balancing constraints raises three distinct issues.

First, balancing constraints entails practical issues for creativity management. Basically, implementing a constraint balance in practice is somewhat enigmatic (Caniëls & Rietzschel, 2015; Ortmann & Sydow, 2018; Rosso, 2014). It remains unclear how such a balance could be achieved, especially regarding different constraint types: through a limited amount of constraints or only partial enforcement? By leaving some aspects “free”, while heavily constraining others? While balancing constraints seems intuitive, these practical questions are still unresolved in detail.

Second, the balancing suggestion challenges the notion that change is inherent to creative processes. Ideas continually evolve as participants gain knowledge and produce failure (Brinks, Ibert, Müller, & Schmidt, 2018). Similarly, constraints constantly change during creative processes (Joas, 1996). For instance, Ortmann and Sydow (2018) illustrate constraint dynamics during creative processes using Nietzsche's notion of “dancing in chains”. During the creative process (dancing), participants put some constraints (old chains) down, while simultaneously establishing (forging) new ones (Ortmann & Sydow, 2018, p. 903). Consequently, creation is never *ad nihilum* and always results in new constraints. Similarly, Lombardo and Kvålshaugen (2014) illustrate how constraint handling is inextricably intertwined with all creative action and how constraints are shattered during creative action for novel problem solutions. However, such a dynamic perspective on constraints during creative processes conflicts with the standstill implications employed by the suggestion to balance.

Third, arguing for a balance between constraint and freedom discounts the enabling aspects of constraints. The notion to balance constraints falls back to a simplistic understanding that constraint restricts creativity, while freedom enables it (see Amabile, 1996). It rests on the assumption that constraints are necessary for control, but unwanted for creativity, making them a “necessary evil”, that should only be employed in the minimal required dosage (Arrighi et al., 2015a; Gilson et al., 2005). However, constraints restrict *and* enable creativity (Giddens, 1984; Ortmann & Sydow, 2018; Rosso, 2014). Their enabling aspects, though, are mostly neglected in balance suggestions.

Motivated by these three issues, the present article aims to revisit the notion of balancing constraints to foster collective creativity by looking at the unfolding of constraints during collective creative processes of pharmaceutical development.

3 | METHODOLOGY

This study is conducted by means of a multiple-case design of pharmaceutical developments (Eisenhardt, 1989; Yin, 2014). Every case illustrates the development of a novel and valuable pharmaceutical compound ex-post as a collective process with a tangible creative outcome in a longitudinal account (Brinks et al., 2018, p. 1749). This was realized by constructing *creativity biographies*, thick narrations on the development of a pharmaceutical compound from idea to patent, which were reconstructed from multiple retrospective interviews with essential participants. These *creativity biographies* follow the methodology of *innovation biographies* (Butzin et al., 2013), yet they end inquiry at patenting, instead of market implementation. This change was made to focus on the development period (and thus creativity) of the innovation process.

Cases were drawn from pharmaceutical developments, because first, they are large-scale, highly expensive, long-time projects; second, they involve multidisciplinary and complex collaboration spanning wide ecologies; and third, they are characterized by tight control as well as experimentation (Dougherty & Dunne, 2011; Drazin

et al., 1999; Sundgren & Styhre, 2003). Therefore, pharmaceutical development cases suitably represent collective creative processes involved with constraint.

3.1 | Data collection

To start, suitable cases of *creative* pharmaceutical development needed to be identified. This was accomplished by selecting tangible creative outcomes in the form of *novel* and *valuable* pharmaceutical patents. The *novelty* of these patents was acknowledged based on recognition (e.g. awards, citations) by the professional field. In turn, the *value* was verified by comparatively exceptional investments in the development and commercialization of these patents. A list of possible cases was set up through extensive desktop research, thoroughly scanning patent applications, highly ranked scientific publications, industry newsletters, and results of innovation competitions for patents that match the criteria of novelty and value. This search was limited to patents from Germany to support comparability. Another aim was to select cases originating from diverse forms of collaboration, including public research, startups, joint ventures, and international pharmaceutical companies as to achieve a higher level of generalizability (Langley, 1999, p. 706). The resulting list of cases was then presented to an industry expert for confirmation.

Next, the scientists listed on the patent application of the selected cases were contacted. In case of a positive response, narrative interviews about the development process were conducted. Thereby, the goal was to let the interviewee narrate the development process as freely as possible, by using an open introductory question about the history of the development. Follow-up questions inquired more specifically about decision making, imposed limitations, and aspects of governance (e.g. how collaboration was organized). At the end of every interview, the story was retold by the interviewer to verify or correct the understanding of the process trajectory. Afterwards, further contributors were approached for additional interviews to complete the initial narration. This process was repeated until a clear description of the respective case was established. In addition, four industry insiders from different organizational backgrounds were interviewed about the process of commercial pharmaceutical development in general to supply context information.

A total of 28 interviews were conducted altogether. Initial interviews typically took about 120 minutes, follow-up interviews about 70 minutes. All but two interviews were recorded and transcribed verbatim. Due to the sensitive information present in pharmaceutical development, names of persons, products, and procedures were rendered anonymous. As the interviews were conducted in German, all quotes cited in the findings have been translated into English.

3.2 | Data analysis

All interviews from one case were “bundled” into a single *creativity biography*, a thick narration comprised of overlapping subjective

process descriptions (Butzin et al., 2013). Thereupon four “in-depth” cases and three “supplementary” cases were built. A case was classified as “in-depth” when detailed empirical material (at least three interviews), a clear understanding of the development process, and an accountable narration were available. Interviews from supplementary cases as well as those with industry insiders on more general aspects of development were used as context material (a detailed summary of interviews and cases can be found in Table 1). The reconstructed creativity biographies from the in-depth cases were then used as data themselves (Vaara, Sonenshein, & Boje, 2016) to conceptualize phases and detect patterns (Langley, 1999, p. 692).

Initially, the idea of analysis was to understand how different constraint types alternate along the development trajectories. Due to this deductive approach analysis was conducted using *qualitative content analysis* (Mayring, 2015). Following Acar et al. (2018), the three *constraint types*—input, output, and process constraint—were used as a coding heuristic to identify when certain aspects of development were constrained. However, it became apparent in coding that all types of constraints pervade every development process, but through different “implementations”. For instance, every development process is continuously characterized by input constraints, alternating between constraint resulting from budgeting of resources and constraint from scarcity of resources. These differences could not be fully grasped by a deductive analysis based solely on constraint types.

Subsequently, the aim of the analysis shifted to find an inductive dimension that depicts this notion of “implementation”. The ensuing data aggregation was based on grounded theorizing in order to construct analytical dimensions from the collected data (see Gioia, Corley, & Hamilton, 2013). Shifting from data to analysis to theory, it appeared that *constraint source* is a useful notion to sort and aggregate the data. Source denotes *how constraints are implemented and enforced*, rather than what aspect of development is constrained, and can be divided into constraint from *restraint* and constraint from *contingency* (see Figure 1). The term source as well as the notions of restraint and contingency were established based on the data. In fact, source (or origin) of constraints is little examined in the literature (Acar et al., 2018).

Restraint denotes constraints that derive from control (input constraint), guidelines (process constraint), and objectives (output constraint). During phases of restraint the collective creative process is characterized by conscious contracts and self-made formalized structures, like standard operating procedures (SOPs), non-disclosure agreements, management plans, and budgeting. These restraints result from hierarchical (pharmaceutical company, public research facility) or strictly regulated market (joint venture, contract research) governance and impose a definite collaborative structure of prescribed objectives, procedures, resources, and contributors. Participation is limited to selected members (employees, contractors), who are confronted with fixed budgets and deadlines as well as strong enforcement of procedures and contracts from legal regimes. Accordingly, constraints based on restraint are typically self-imposed.

TABLE 1 Cases and interviews

Cases	Description	Primarily developed at	Interviews
LungTreat	Novel approach to cure a specific lung disease	International pharmaceutical company	Lead Scientist [LungTreat-1] Lead Scientist [LungTreat-2] Project Manager [LungTreat-3] Lead Scientist [LungTreat-4]
HeartComp	Compound to replace invasive therapy	Joint-venture	Lead Scientist [HeartComp-1] Lead Scientist [HeartComp-2] Procurator/CEO [HeartComp-3]
NatureComp	Synthetic replication of a natural substance useful to prevent heart disease	Startup	Lead Scientist [NatureComp-1] Contract Researcher [NatureComp-2] Lead Scientist [NatureComp-3] Legal Director [NatureComp-4] Lead Scientist [NatureComp-5]
CancerStop	Bio-chemical alteration of substances to prevent metastasizing of tumor cells	Public Research Facility	Lead Scientist/CEO [CancerStop-1] Lead Scientist [CancerStop-2] Post-Graduate [CancerStop-3] Lead Scientist [CancerStop-4] Legal Operations [CancerStop-5] Project Management [CancerStop-6]
Context Material	Interviews with industry insider and supplementary cases		Medical Director [Context-1] Regulatory Agency [Context-2] Cluster Management [Context-3] Freelancer [Context-4] Supplementary Case [Context-5;-10]

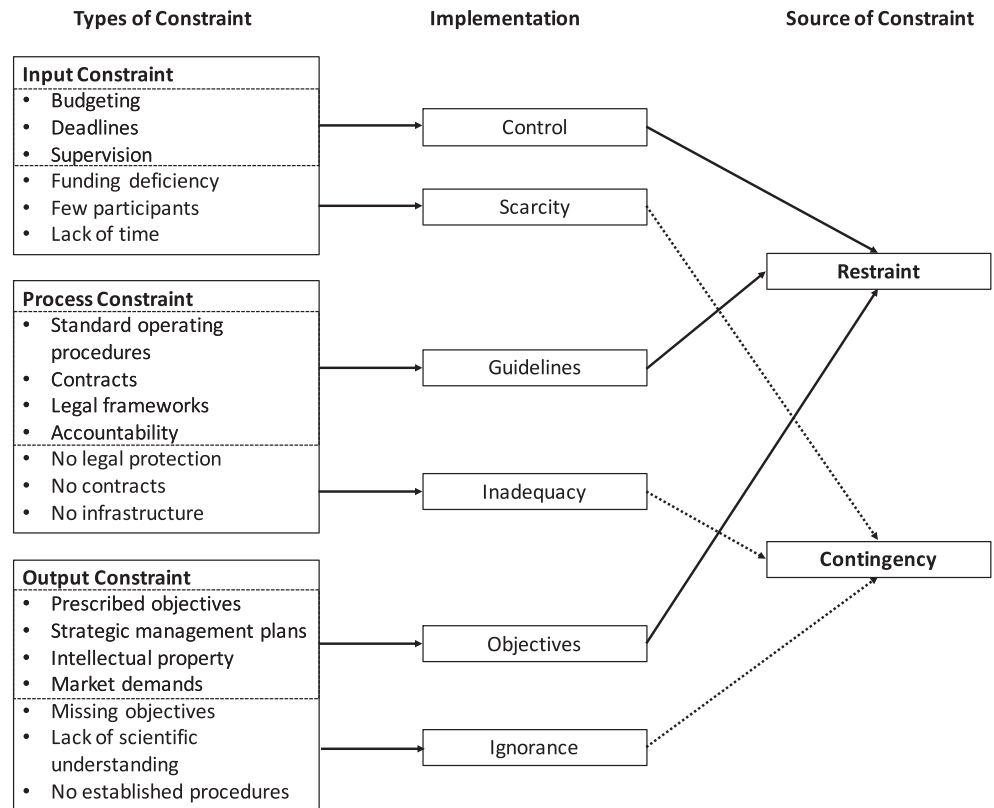


FIGURE 1 Coding structure

Contingency denotes constraints resulting from scarcity (input constraint), inadequacy (process constraint), and ignorance (output constraint), like lack of funding, incompetence, inaccessibility, and legal uncertainty. In phases of contingency, the development is based on informal network and community coordination lacking formalized structure and resources. There is no definite deadline, no explicit management plan, no prescribed objective, no legal ramifications, and no contractually enforced partnerships, but also no access to funding, little infrastructure, hardly any human resources, and no legal protection. This source of constraint is denoted as contingency here, because the actual constraints derive from a paralyzing experience of too much possibility without any guiding structure (Luhmann, 1984, p. 152). Hence, constraint from contingency is an unintended consequence of aiming for “freedom” in development.

Lastly, with constraint source and the underlying concepts of restraint and contingency as a coding heuristic, every creativity biography was analyzed again individually using qualitative content analysis. Thereby, the goal was to identify distinct phases regarding constraints during the creativity biographies, by examining (1) the constraint source, (2) the stability of the involved constraints, (3) present (inter-)actions, and (4) the emergence of collective creativity. During the analysis two phases emerged from the data: *enablement* and *transition* (for an overview, see Table 2). The qualities of these phases were sharpened through a cross-case comparison.

4 | FINDINGS

4.1 | Enablement

Enablement describes phases in which constraints are consistently implemented through a steady source, either restraint or contingency. Thereby, participants accept, embrace, and sustain the present constraints to enable the emergence of collective creativity. Yet, how constraints enable and restrict the creative process depends heavily on their underlying source: If based on restraint, constraints enable complex practices of collaboration with high demands of formal coordination and resources. If based on contingency, in turn, they enable informal practices building on flexibility. It is important to stress,

however, that phases of restraint and contingency are not coupled with notions of exploitation and exploration (March, 1991). Both, during restraint and during contingency, participants explore new ideas as well as exploit existing concepts.

4.1.1 | Restraint

Phases of enablement with restraint as a constraint source are characterized by “*clear objectives. There is a process which must be addressed, which gives sense to our factory*” (LungTreat-3: 7). These objectives “*must be a challenging task [...] but also [...] formulated in a way that you can take on the problem*” (CancerStop-2: 4). In addition, there is restraint concerning the involved procedure of development: “*the general approach is clear. It is already established*” (NatureComp-4: 106). That does not mean that every aspect is defined to the last detail, but that “*the steps are clear, the procedure is clear, but the execution is open*” (LungTreat-2: 124). Still, development is supervised and controlled:

“*When you live and work in this context of a company, with investors, with its hierarchies. Well, there is a financial plan and they [management] look relatively closely that everything is in budget*” (NatureComp-4: 73).

Yet, these restraints not only limit the creative process, but also enable coordinated execution of the diverse practices involved with pharmaceutical development, which demand a high level of technology, infrastructure, personnel, and knowledge. Restraints synchronize and align these crucial aspects by supplying ways and means “*to get down to business*” (HeartComp-2: 98). A formally restrained frame supplies “*a bigger shovel once you have discovered a golden nugget*” (LungTreat-3: 5). Hence, the involved participants aim to follow the established restraints as much as possible. Thereupon, collaborative synergies constantly add to the development process in “*a constant game of ping-pong between learning and performing*” (CancerStop-4: 243). Coordinated development amongst collaborators is possible and creative insight can emerge in the process of sensible interlocked action:

TABLE 2 Overview of findings

Phases	Constraint source	Characterized by	Exemplary actions	Effect on collective creativity
Enablement	Stable restraint	Control, guidelines, objectives	Laboratory experimentation, data analysis, structural design, patenting	Clear objectives in formalized rules and resources enable collective creativity
	Stable contingency	Ignorance, scarcity, inadequacy	Sharing, collective sensemaking, combining projects	Ignorance and scarcity without prescribed objectives enable collective creativity
Transition	Changing from restraint to contingency	Growing deviation from established restraints	Networking, “skunk”-work, collusion	Prescribed objectives, plans, and rules limit collective creativity
	Changing from contingency to restraint	Increasing convergence on new restraints	Budgeting, creating business plans, specification of therapeutic options	Scarcity of rules and resources limit collective creativity

"And then came the point, when we had new structural ideas, which did not originate in [partner organization], but where we said: We could do that, it would be feasible" (CancerStop-4: 28).

Therefore, phases characterized by restraint are not phases of narrow and uncreative completion: *"we have to replace tests, we have to look: what can we do, what can we combine [...] so there is creativity. But everything is subordinated to the objective"* (HeartComp-2: 33–34). Especially in moments of crisis collaborators need formal restraint *"to push through problems and unexpected events, and not throw the molecule away"* (LungTreat-2: 114). This is the enabling aspect of restraint and the benefit for collective creativity. Restrained, structured, and interlocked collaboration is viewed as a functional frame to execute pharmaceutical development and to enable the emergence of creativity:

"That is [...] the area, which you early described as organized and structured. On the other hand, in such a highly formal process you have the creativity to describe and research the molecule" (LungTreat-2: 46).

While there are severe limitations in restraint, there are also creative possibilities and the freedom to go into detail, to refine, and to enhance development. Thereby, individual constraints can occasionally be altered to meet the refined procedures and ideas; the underlying constraint source, however, is stable. Due to these enabling features, restraints are not opposed by collaborators: *"we did everything in-house and thank god for that"* (LungTreat-2: 110–112). In turn, a breakdown of or independence from restraint is viewed negatively by the participants in these phases of development:

"Everything is harmonized, all the SOPs, standard operating procedures, are coordinated. But then [when they break down] you start to sweat and you try to get everything back to the way it was when it functioned" (HeartComp-2: 88).

4.1.2 | Contingency

Phases of enablement characterized by contingency are not to be confused with free and unconstrained development but rather involved with disordered volunteering (HeartComp-2: 72), being adrift (LungTreat-1: 23), and missing options for action (CancerStop-1: 181), which constrain possibilities for coordination, accords, targeted execution, and refinement. Due to high levels of ignorance collaborators develop without a specific demand or task: *"it is a very, very general approach, in the sense of: here, you look, even if you have no understanding of it, maybe you have got an idea what to do with it"* (CancerStop-4: 52).

That way, however, constraints from contingency also enable participants to develop fundamental ideas, overcome conceptual

boundaries, make sense of unexpected results, and combine expertise with outsiders. Exactly because there are currently no specific goals or procedures, participants within an informal and unrestrained collaboration can develop an approach which pushes the boundaries of novelty. Similar to phases of restraint, the participants follow and accept these constraints from contingency:

"Everybody plays with your idea, without a task, and without specification. [...] and the advantage is, without contracts, there is no goal. You do not ask a specific question and get a yes or a no. Everybody does what he or she wants. And all of a sudden you use every brain of every scientist for free" (LungTreat-1: 11).

Participants cannot express a specific task, because they themselves have no concrete idea. Instead, informal contributors engage with the already established team to think of ways of sensible interpretation. Thereby, collaborators look "beyond" their current collaborative setting to find expertise that helps to advance development:

"It is part of the creative process to be open. And the group was open and said: We admit it, we lack certain know-how. Now we go interdisciplinary and look for people – even if they are spread worldwide" (NatureComp-4: 88).

4.2 | Transition

Phases of constraint transition consist of alteration in the source of constraints. When novel insights conflict with present constraints, it is not enough to change constraint types, but the source of constraint needs to be altered to enable new possibilities for development. Thus, during these phases of transition, work on the actual idea is paused, and participants aim to change the underlying constraint source. This transition differs depending whether the source alternates from restraint to contingency or vice versa.

4.2.1 | From restraint to contingency

Unexpected results, as well as failure, repeatedly emerge during phases of restraint *"and every interpretation of scientific insight leads to a readjustment or confirmation of your objectives"* (NatureComp-3: 80). Even confirmation can lead to perplexity for the participants: *"we saw it worked. [...] Now, it was unclear why."* (HeartComp-1: 15). Upon emerging insights, collaborators establish new concepts: *"my concept was absolute nonsense. I turn [...] and go another way entirely"* (CancerStop-2: 815). With these readjustments, participants explore options that are not covered by the prescribed procedure: *"and so, we started making substances that were not demanded"* (CancerStop-4: 252).

Such ambitions to follow up on newly emerging insights can fundamentally challenge and contradict the restraints that are embedded

through the established deadlines, budgets, routines, rules, norms, and roles, which serve as systematic guides for collaboration. Examples from the cases include: the interpretation of new results requires expertise from outside the legal regime imposed on participants (LungTreat); the strategic management plan does not cover experimentation on the emerging insight (NatureComp); a failure during development points to potential for discovery, yet a close deadline and spent budgets inhibit further experimentation (HeartComp). In those instances, the initially enabling constraints become a choke-hold for further development and an obstacle that needs to be overcome. Therefore, participants aim to suspend, repeal, or circumvent the restraints to follow a new path. However, this transition cannot be achieved by changing certain individual types of constraint. Instead, the underlying source must be altered to initiate phases of enablement again.

Participants argue, for instance, to suspend execution of SOPs, to authorize non-standard procedures, and to include outsiders. Yet, loosening restraint formally is seldom successful, since any deviation “brings pearls of stress-sweat to the forehead of every management type” (LungTreat-1: 9). Thus, participants try to loosen constraints informally. This is accomplished, for example, through unauthorized after-hour work under the protection and discretion of an informal secret:

“If something goes wrong and you are close to losing your financing, then you need help from your inner alliance. Then you must ask a colleague if he or she can carry out a test in his or her laboratory. But without telling anybody. And if it works, he or she gets a piece of the glory, if not, well everybody keeps quiet” (LungTreat-1: 19).

Such alliances are not only within organizational boundaries. In the case of LungTreat, for instance, the lead scientist shared secret insights on the substance and even its structural formula with acquaintances from his university days, directly ignoring and thereby breaking the explicit legal restraints imposed by non-disclosure agreements from his employing organization. Such measures do not merely replace singular constraints, but significantly change how constraints are implemented and enforced, and thus how collaboration is conducted, altogether.

4.2.2 | From contingency to restraint

New insights also emerge during enablement under contingency. However, these insights are typically vague, preliminary, or ambiguous, especially concerning objectives and procedures. The transition from contingency to restraint is initiated when participants concur on definite objectives or procedures. While developers push the boundaries of their idea during phases of contingency, eventually clear goals, recognized procedures, long-term contributors, and a definite division of labor are necessary:

“At some point, you can't say: we want to make something in the cardiovascular area, but you have to define clearly, which indication [...] and then again clearer descriptions: to use before, after, acute, prophylactic? [...] all these questions [...] and that was a tedious process [...]” (NatureComp-4: 104).

Again, restraint is needed to re-focus development. Particularly because there are no structural limitations, participants are uncoordinated and unaligned. Numerous diverse ideas are brought forth, many of which are futile for development. That puts a high emphasis on filtering and selection:

“You must, from such a process, which is probably rather diffuse, develop a good filter-mechanic to connect those few remarks, ideas, approaches, which enable the innovative advance, meaning the big leap” (NatureComp-3: 182).

To address these problems from contingency, participants establish new restraints. Over time, participants synchronize the creative process through defining objectives, limiting participation, imposing legal regimes, setting deadlines, and establishing standard procedures. They converge on specific restraints that enable the execution of development: “then you can start and work on the details and set up a concrete plan on what to do” (Context-1: 107).

Even more so, access to infrastructure, technology, funding, and legal frameworks, which is lacking during phases of contingency, must be established to advance any further development. This transition takes different forms, like setting up a new branch or “task force” within the institution (LungTreat; CancerStop), implementing new SOPs (LungTreat), founding a start-up/spin-off (NatureComp; HeartComp; CancerStop), formalizing inter-organizational collaboration (NatureComp; HeartComp; CancerStop) or including new investors (NatureComp).

For instance, participants lobby for their idea and try to convince management or other investors of their new approach: “it depends on the local situation, the momentary situation. But you have to invent a new story [for management]” (LungTreat-2: 103-109). In the case of NatureComp, for example, the transition was done in frequent talks between scientists and potential investors. Together they re-integrated restraint into the development process until they “had a specific plan that made sense” (NatureComp-1: 196). Again, this transition cannot be achieved by merely changing singular constraints based on certain types. Instead, the transition concerns the underlying source of constraints.

5 | CONTRIBUTIONS

The core findings in the present study show how collective creative processes alternate between phases of enablement and phases of transition regarding constraints. During phases of enablement, the present constraints enable collective creativity, based either on restraint or contingency. Yet, the enabling possibilities are limited.

Thus, participants eventually try to change the underlying constraint source. With these findings, the present study makes three related theoretical contributions.

First, organizational and management studies focus heavily on the type of constraint, as the aspect of collaboration or development being restricted (Acar et al., 2018; Lampel et al., 2014; Rosso, 2014). However, there is hardly any insight into how constraints are imposed and enforced and, moreover, how different forms of their implementation influence collective creativity. The inductively found implementation-based distinction between restraint, as self-imposed limitations and restrictions, and contingency, as unintended constraints based on missing rules and resources, can service as a starting heuristic to reflect these aspects. Thereby, constraints are not external factors that influence creativity, but internal to the mode of collaboration. Hence, constraints are not detached from the creative process, but instead depend on interactions and coordination. Therefore, changing the underlying constraint source is only possible by also changing the way collaboration is organized and conducted.

Second, transformation of constraints and creativity are considered to be closely connected in the literature (Brinks et al., 2018; Joas, 1996; Ortmann & Sydow, 2018). For instance, Lombardo and Kvålshaugen (2014) illustrate how constraint handling is inextricably intertwined with all creative action and how existing constraints are shattered in creative action for novel problem solutions. Similarly, Ortmann and Sydow (2018) build on Nietzsche's thoughts on the issue by illustrating the "forging" of constraints during creative processes. The present paper contributes to these studies by showing that phases of collective creativity and phases of constraint transition are distinctly separate. During phases of enablement, constraints are embraced and sustained to foster collective creativity. Participants aim to alter constraints only after new insights emerge in interaction. These phases of transition comprise a wide-ranging conversion of how collaboration is conducted and how limitations are imposed and enforced.

Third, organizational and management studies commonly theorize that constraint and freedom constitute a mutually exclusive dualism: the more constraint, the less freedom (Amabile, 1996; Davis & Scase, 2000; March, 1991; Sonenshein, 2016). Based on this assumption, the typical management advice is to balance constraint and freedom to optimize for creativity (Chen, 2012; Cirella, 2016; Davis & Scase, 2000; Gilson et al., 2005; Lampel et al., 2014; Rosso, 2014; Shalley & Gilson, 2017). While constraint is employed to maintain control, freedom is utilized for creativity (Amabile, 1996; Davis & Scase, 2000). In contrast, this study argues for transition instead of balance. For one thing, deviation from or loss of self-imposed restraints does not lead to radical freedom, but rather also induces unintended constraints from contingency. Hence, balancing constraint and freedom does not seem like a helpful notion to organize for collective creativity. Furthermore, suggestions to balance fall back to a simplistic understanding of constraints as only limitation. Yet, during restraint *and* during contingency, novelty emerges and in both instances participants are enabled as well as restricted by the given constraints (see Giddens, 1984; Ortmann & Sydow, 2018). In addition, constraints eventually conflict

with new development paths, either because they restrain novel approaches or because too much contingency limits focused collaboration. Either way, constraint transition is necessary. This transition cannot be accomplished by changing a few selected constraints, but must instead target the underlying constraint source. Therefore, organizing constraints for collective creativity is not a matter of balancing constraint in one optimized constellation. Instead, constraint transition can service as a practicable way to organize for collective creativity.

6 | IMPLICATIONS AND LIMITATIONS

Building on these contributions, management practitioners and scholars should critically reflect on the notion of balancing constraint to foster collective creativity, leading to three implications for the management of collective creativity. First, there are no per se optimal constraint compositions for collective creativity. All constraints potentially restrict and enable collective creativity (Ortmann & Sydow, 2018; Rosso, 2014), however not indefinitely and not always. What starts out as an inspiration or guidance can turn into an obstacle over time. Hence, transition of constraints is necessary to "revitalize" collective creative processes. Second, currently beneficial constraints should not be "balanced", but fully enforced, since they enable whatever is necessary at that moment. In turn, they should change drastically when those constraints eventually become hindering, again putting a strong emphasis on the transition of constraint source along the creative process. Third, transitions of the source of constraints are resource- and time-intensive phases that pressure participants as well as management. They are crucial moments during development that can make or break the creative process. Moreover, these transitions can be enacted by participants and are not only initiated by external circumstances. Therefore, management can support the creative process by easing or inhibiting transitions of constraint source at a favorable time. A possible way to advance this research is thus to understand in more detail how management can support or inhibit constraint transition.

The limitations of the present article result from the specifics of the chosen empirical field. By drawing data and building cases from the pharmaceutical industry, the insights are limited to long, expensive, and elaborate creative processes. While data from a single empirical field is advantageous for comparing cases, it limits the validity of the findings to similar fields of development. Especially the need for restraint might not be necessary in cheaper and shorter areas of development with less demand for technology and infrastructure (e.g. arts, music, and literature).

ACKNOWLEDGEMENTS

I would like to thank all the members of the DFG-research unit Organized Creativity (FOR: 2161) for years of collaborative work and guidance, especially Oliver Ibert, Gregory Jackson, and Jörg Sydow. I would also like to thank my colleagues at the Leibniz-Institute for Research on Society and Space (IRS), especially Andreas Kuebart, as well as the two anonymous reviewers for their insights and efforts in making this paper better.

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How to cite this article: Vogelgsang L. Transition rather than balance: Organizing constraints for collective creativity in pharmaceutical development. *Creat Innov Manag.* 2020;29: 413–423. <https://doi.org/10.1111/caim.12391>