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ISBN 978-3-030-25770-5 ISBN 978-3-030-25771-2 (eBook)
https://doi.org/10.1007/978-3-030-25771-2

This Edizioni della Normale imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

To my husband, Ron Romano, the love of my life.
—Patricia D. Stokes

To Alexander Johannes and Beatrice Theresa, my two cool kids.
—Michael Gibbert

Prefaces/Previews

Pat's Preface

Reversing the order of the title (*Using Constraints to Solve Innovation Problems*), I'll start with the two parts of an innovation problem and then briefly (very briefly) introduce a practical problem-solving framework you can use to solve both.

The Innovation Problem

The innovation problem has two parts: how do you *start*, and how do you *sustain*, innovation. The problem-solving *framework* has three parts: a *structure* (the problem space), a *strategy* (the paired constraints), and a *process* (solution-by-substitution).

Here's my short, much over-simplified, preview.

How do you start doing something new? You start very specifically. You identify a current product/style/situation to work against. This becomes the initial state in your problem space. You then select one element, just one, in that product/style/situation to preclude. Next you select/promote a substitute. Once the preclude-promote pairing begins, it becomes self-sustaining: one substitution suggests or requires another. I call the process *solution-by-substitution*. The substitution series *is* the solution path that solves the innovation problem (Stokes, 2006).

Haven't you also said that the solution path is itself the innovation?

Yes, it is. Thanks for reminding me.

How do you continue doing something new? You start over. Only now, your initial solution becomes the initial state.

Where do the substitutions come from? The *tool box*, the one in your head, the one you can't think outside of. The contents of the tool box are your *expertise*—what you know about your domain and what you can do with what you know.

These are what I call *basics*. *Borrowing* from other experts, and from other domains, are what make your tool box bigger.

Pat, you should tell them more about the tool box.

I will, later. (See Digression II).

Two Examples

Example I: Two authors, two-voices. The hardest part of writing a book is starting it. This is because all books (like all problems) are only realized, structured, and restructured as they are written.[1] The solution path for any book *is* the finished book. This book had an additional difficulty. It was not just that there were co-authors, Michael and me. It was also that we wanted the book to reflect the conversations that created it. To do this would require a number of substitutions, as shown in Table 1.

Table 1 Two-voices problem

Initial state:	Co-authors, one style		
Search space		**Constraint pairs**	
	Preclude	**➔**	**Promote**
	Continuous narrative		Conversation
	Single voice/style		Dual voices/styles
	Shared type face		Distinctive type faces
Goal state:	Co-authors, two styles		

The first substitution precluded a continuous narrative and, in its place, substituted a conversation, its exact form unspecified at first, but suggesting separately written sections interrupted (as conversations are) with comments, suggestions, digressions, questions. The second followed from the first: preclude a single voice and promote dual, distinct voices. The third followed from the second: distinct voices suggested distinct type faces. This is my (Pat's) type face. Michael's is *this* (*italic*).

An important, albeit partial, borrowing for the structure was a book in the form of a continuous conversation.

[1]Annie Dillard (wisely) wrote that the early chapters, especially the earliest which has become so that it is so familiar that it feels indispensable, must be revised because the book does not find its form so fast (Dillard, 1989).

Between?

Edward Said, the literary critic, and Daniel Barenboim, the pianist/conductor (Barenboim & Said, 2004).

Example II: Monet's Innovation—Impressionism. I thought we should have a more complete (albeit abbreviated) example (Stokes, 2001, 2011). So, Monet, a painter I hope is familiar to most of you. Monet's innovation, Impressionism, began with a borrowing, a color wheel published in a Parisian newspaper by a chemist named Chevreul. The wheel, which broke light up into 72 segments gave Monet both his continuing goal (*show how light breaks up*) and his first sub-goal (*on things*). Showing how depended on his existing and *expanding* expertise as a painter. The italics are important: substitutions are additions—new ways of making and of noticing—to an innovator's tool box.

Given the new goal, how did Monet *start* to do his something new?

With a single substitution (the first constraint pair in Table 2). He precluded contrasts in value (dark-light) and substituted/promoted contrasts in hue. If we think of hue as pure color, this pairing also substituted pure for mixed colors. It also suggested, in fact required, a second pairing (preclude depth, promote surface) and a third (preclude continuous brush strokes, promote a mosaic of separate color patches). The first three produce the fourth, preclude depth, and promote surface.

Table 2 Monet's first substitution series

Initial state 1:	Show how things look (traditional landscape painting)		
Search space		**Constraint pairs**	
	Preclude	**➔**	**Promote**
	Contrasts in value		Contrasts in hue
	Mixed colors		Pure colors
	Continuity strokes		Separate strokes
	Depth		Surface
Goal state 1:	Show how light breaks up on things		

Stop. I've seen your Monet sketches. Can't we include at least one here.

Good idea.

My cartoon version of *Regatta at Argenteuil* (Fig. 1) shows light breaking up into clear, bright, and clearly separated oblongs of pure color. The houses are sketched in separate strokes of pure cadmiums (red and orange). Their reflections overlap but do not mix with the pure blues of the sky and the pure greens of the trees and grasses. The sails and their reflections also break up (into cream-colored lozenges). The sails are closer to us, so their reflections are larger than those of house and tree, but all three (houses, trees, sailboats) sit on the same surface. Since dark-light contrasts (in value) are precluded, there is no depth separating them.

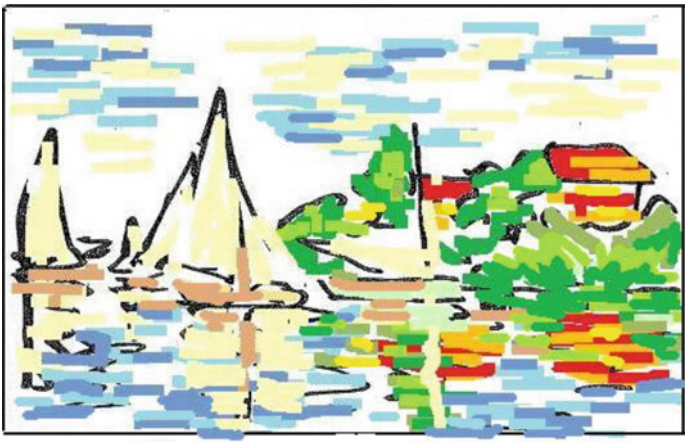

Fig. 1 Regatta at Argenteuil (1872)

Amazing but only the start—which leads to our next question: How did Monet *continue* doing something new? The answer is by *starting over*, re-structuring his own solution, changing his sub-goal from light breaking up *on* things to light breaking up *between* things. This shift led to what I call the second substitution series, summarized in Table 3.

Between things means (in French) the *enveloppe* or (in English) the atmosphere. Since the *enveloppe* is continuous, the first substitution precluded local color (the green of leaves, the blue of the sky) and promoted shared colors. Since the colors were shared, the original mosaic of separate strokes was precluded and, in its place, a continuous web of common colors was promoted. Finally, since the *enveloppe* changes continuously, the single study was precluded, and in its place, each image (poplars, haystacks, the façade of the cathedral at Rouen) was painted (again and again) on separate canvases that became a series.

Table 3 Monet's second substitution series

Initial state 2:	Show how light breaks up *on* things		
Search space		**Constraint pairs**	
	Preclude	**➔**	**Promote**
	Local color		Shared color
	Separate strokes		Web of shared strokes
	Single study		Series of studies
Goal state 2:	Show how light breaks up *between* things		

Images of the series are easy to find online. Just type in *Poplars*, there are over 20 paintings in the series. You should also look at images of his third and most radical innovation, the *Grandes Decorations*, which I've discussed in great detail elsewhere. Start with *Water Lilies—Reflections of the Willow.*

Michael's Preface

My interest in constraints started as a Bachelor Honors student at the University of Stellenbosch, South Africa, back in 1998. I was renting a granny flat with a parish priest. The priest was a thoughtful, bookish man and he encouraged me to explore his extensive library. One cold winter evening, looking for something to keep me in front of the one source of heat in the house (an open fireplace), I stumbled over an A-4 sized manuscript, which seemed to be a bound thesis of some kind. It wasn't thick, maybe 150 pages or so, and had the intriguing title "Modeling Complexity." Its author was the late Paul Cilliers, and it was his Ph.D. thesis at Cambridge (under the supervision of Marie Hesse).

It was, I think, the first Ph.D. thesis I ever read, and I was awestruck by some of the statements, in particular the idea that boundaries and constraints are both enabling and constraining. In the sense that while they separate, they also unify since they constitute that which they bound.

My landlord could see my fascination with the manuscript and told me that Paul Cilliers was a Professor of Philosophy at Stellenbosch University, and so we got together. The various excellent dinners at Paul's house that winter (aided by venerable old reds from the Western Cape) were foundational in my interest in the ambivalent nature of constraints*, in their role as innovation drivers. Several special issues, books, and articles later, Pat and I crossed paths and realized we had been working on the same topic, but from different directions, and the idea for this book was born.*

My background (aside from cooking) is business management, with master's and Ph.D. theses on strategic renewal. The first academic job I got was as a Professor of Marketing at Milan's Bocconi University, and the title stuck. Much of my research focused on innovation management under constraints, but constraints defined in a more traditional, standard dictionary way. This way. According to Webster's, constraint is derived from two Latin words, con *(together) and* stringere *(to draw tight). "To draw tightly together" becomes, in the standard definition, confinement or restriction, compulsion or coercion. Constraints of this kind generate a kind of innovation problem, commonly known as a problem of necessity* (Hoegel, Gibbert, & Mazursky, 2008). *Popular parlance has it that necessity is the mother of innovation, but innovation is not an immaculate conception, which leads to my first question.*

Michael's Questions

If necessity is the mother of innovation, who is the father? *I find this analogy striking. Think about it. Unless there is some kind of added ingredient, constraints are simply counterproductive when it comes to innovation. The thesis of this book is obviously that they are not counterproductive. A promising candidate for the added ingredient is the second of the constraint pairs that Pat introduced. The first, as expected, precludes. The second, unexpectedly, promotes the substitutions that father the innovation. Interestingly, very interestingly, this dual role also appears in postmodern philosophy. So, to answer Pat's earlier question, let me elaborate (briefly here) on boundaries and constraints in this more inclusive sense.*

Wait! Wait! Couldn't we extend the analogy further? The Mother of Invention (Necessity), The Father (Strategy or Philosophy), The Fairy Godmother (Opportunity).

Wait Pat. Let me follow my train of thought first.

How can boundaries both enable and constrain? *The inclusiveness here comes from seeing boundaries and constraints as both enabling and constraining. When I say "boundaries" I really mean constraints, things that hold us back. Our natural reactions to things that hold us back are either (1) to literally and figuratively break through them to get to the other side somehow or (2) to accept them as impenetrable and submit to their dividing our space. But there is another reaction, I think. And that reaction is what this book is about.*

Let's go back to Paul Cilliers' thesis (1998). *Boundaries separate one thing from another and yet, automatically, they are also part of the things that they set apart. They are* <u>both</u> *the problem and the solution. Many approaches in systems thinking rely on a similar idea—the interdependence of problem and solution. For example,* obliquity *refers, not to taking a direct solution path (the one which perhaps is most immediately available, though not necessarily the most efficient or creative), but rather to taking a detour. The question is:* which detour? *In theory, the number of detours (think of the possible paths in Pat's search space) is limitless. Without guidance, detouring leads everywhere. Too much guidance leads to more of the same. It's in this area where I see boundaries and constraints as instrumental. If we cannot follow the intuitive, direct, solution path, we need to take the detour—and constraints point us in the right direction, to the right detour.*

Why is less more, but not for everyone? *Let me answer with an example. There's a saying in the Finnish army: if three soldiers cannot move the cannon, take one away. In another army, another soldier is summoned. In a third, the cannon is abandoned. The different responses depend on whether constraints (the immovable cannon, the adequacy of resources to move it) are seen as enabling or disabling* (Gibbert, Valikangas, & Hoegl, 2009).

We can sort these views into four categories, each defined by how individuals respond to abundant vs constrained resources. The Finns are among the