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IDEASQUARE COFFEE PAPER

Caramba!! Pancho Villa and the Mexican Innovation Hat

In addition to its main purpose of publishing experimental innovation research related results, CIJ also publishes lighter, inspirational food-for-thought intended "IdeaSquare Coffee Papers". These pieces are collaborative efforts prepared by researchers from various walks of life visiting or staying at the CERN IdeaSquare premises. The identity of the contributing authors is kept anonymous (although known) but helpful hints can be found in the literature references.

EXECUTIVE SUMMARY

At IdeaSquare and CERN, we are constantly on the look-out for sources of inspiration to make our science better and to make orders-of-magnitude jumps in the process, as well. This time around, we take a closer look at Pancho Villa and his Mexican Hat and see how that could explain the relationship between creativity vs. structure in the innovation process.

INTRODUCTION

At IdeaSquare and CERN, we are constantly on the look-out for sources of inspiration to make our science better and to make orders-of-magnitude jumps in the process, as well. Past history is always a good place to look for inspiration for non-incremental thinking, too. This time, in our glorious Hand Library of IdeaSquare, we take a closer look at Pancho Villa and his Mexican Hat and see how that could explain the relationship between creativity vs. structure in the innovation process.

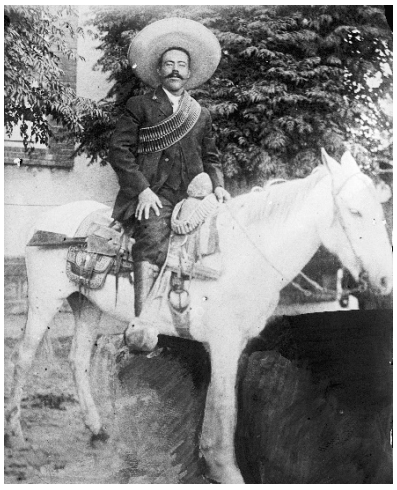

Fig. 1. Pancho Villa and a Mexican Hat. Source: Wikipedia**.**

REBEL AND THE SOMBRERO HAT

Although folks at IdeaSquare are in no way advocating rebel behavior, we nevertheless are intrigued as amateur historians by legendary figures, the good, bad and the ugly, who swim against the mainstream for their beliefs and make their lives difficult for themselves just because they see the world differently from the most of us. Their ways of working can be seemingly illogical, weird, or even brutal but over time tend to shape the thinking of the larger population (for the good or bad). But what makes Pancho Villa, the legendary Mexican bandit

revolutionary in the early part of the last century particularly interesting for us here, is his Mexican Hat. The type with the high cone.

Mexican hats shield from the brutal physical conditions in hot, windy and sweaty places. They can come is all shapes and sizes (heights),and are often tailor-made to adapt to the personality and imagination of their bearers. They typically also include a wide range of decorations and add-ons. These can include artefacts like feathers, ornaments, beads or balls. It is the latter that catches our eye, although history books are not quite so detailed on whether Pancho wore them or not.

The interesting fact is that attaching balls to the Mexican hat makes it unstable at moments if attached to pieces of string. Although looking spectacular (or amusing) while riding, they alone represent an interesting, confined set of possible movements that describe a chaotic system of seemingly arbitrary changes in state. Like the one(s) in Mexico at the time but that is another story.

Instead, we wish to focus on the idea of the unstable Mexican hat and the connection with symmetry. A hat with arbitrarily whirling balls is not symmetrical, thus hard to keep on one's head. The only way to keep the hat stable is to connect balls in a symmetrical manner. But what is the simplest symmetry?

As experimenting and prototyping[1] is in the heart of the way of working here at CERN, based on best guesses of the related Hamiltonian functions[2], our team spent a hot, windy and sweaty summer afternoon at the staples next to the CERN site figuring this out.

Putting aside some of the most innovative (and embarrassing) solutions, and to protect the identity of the authors, two solutions are presented here. The first includes using balls around the rim of the Sombrero (Figure 2).

Fig. 2. Placing balls around the Sombrero in a symmetrical manner. Source: Mazz Access.

Our personnel found this stable but a heavy solution which also caught the attention of the riding horse (mistakenly took them for goodies).

The second solution incorporates a ball placed at the top of the cone of the Sombrero. This is a simpler, lighter and more stable solution (even as you increase the size of the ball), as the ball is symmetrically positioned irrespective of the rotation or spin of the hat. It also is outside the view of the hungry horse below.

Fig. 3. An anonymized rider testing the prototypes of the Mexican Hat. The colour of the ball is arbitrary but not to be mistaken for a round carrot.

[1] See e.g. S. Thomke, Experimentation Matters, Harvard Business Books, Boston MA 2003.

[2] For the more interested reader, we specifically refer to the Hill equations. These are used for understanding how the ponytail of a jogger sways, similar to our original system of whirling balls.

MEANWHILE, BACK IN THE HOT CBI CLASSROOM…

While the athletic side-branch of IdeaSquare staff (the "Panchos") were completing their experimentations on the nearby horse track, the other branch kept on pressing the cross-disciplinary Challenge Based Innovation (CBI) students on their Sustainable Development Goals-related project assignments. The purpose of CBI is to inspire the students to move outside their "comfort zone" and to come up with system-level solutions, applying methodologies like the Design Thinking for addressing Sustainable Development Goal (SDG) challenges. The students are thus pushed, in a friendly way, to come up with new ideas and fresh ways to look at the systemic problems facing Planet Earth.

But while doing this, the IdeaSquare staff has noticed that imposing too much structure limits creativity, but creativity does benefit from (some) structure. But it does not appear to be entirely symmetrical[3]. So what then *is* the relationship? In the IdeaSquare Coffee Room this is a recurrent topic and an eternal source of delightful discussions between the more "Structuralist[4]" and the "Creativity-as-a-discipline[5]" minded thinkers. Roughly speaking, in the former, relationships (and the quality) between people matter more than objects being worked on whereas in the latter, the quality of prepared steps in the process determine also the quality of the outcome.

As the discussion is interrupted and diverges into contemplating on "how many Mexican Hats can fit in a Coffee Room", the notion of the importance of symmetry in physics[6] is recognized in solving this problem. Equally, the significance of *symmetry breakdown*[7] is raised in the connection of questioning whether or not flattening of the Mexican Hats could be taken into account.

As serendipity would have it, the movement and concentration of the IdeaSquare Panchos in their Mexican Hats in front of the coffee machine triggers this thought: *Could symmetry breakdown and the Mexican Hat be used as a concept to look at the relationship between the level of creativity and structure?*

And this is how Pancho Villa truly enters the scene.

I, PANCHO AND THE SPACE AROUND US

As any physicist will know, a dynamic problem worth solving is in some part or form of a (multi-dimensional) Phase (P) Space. A quick read in the IdeaSquare Handbook Library indicates that design processes and structures are shown only a two-dimensional feedback loops[8], thus offering only piecemeal and incomplete views of the entire innovation sequence.

As any mathematician will know, increasing the number of dimensions increases exponentially the number of local minima (solutions)[9]. As a Mexican Hat (with a cone) needs only 3 dimensions to capture all its symmetry properties, so should also a visualization of the innovation process.

And as any innovation scholar will know, innovation process is a complex mix of product/service development and human behavior[10]. This includes, among others, different types or forms of process structures[11], cognitive traits[12], and motivational aspects[13]. For problem visualization purposes, the IdeaSquare staff concentrates here only on the above-mentioned three attributes and adjusts their definition within the IdeaSquare context as follows (see Figure 4):

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[3] For some insights, see e.g.: "Creativity Versus Structure: A Useful Tension", John Seely Brown and Paul Dugui; MIT Sloan Management Review (Vol. 42, Issue 4, 2001).
[4] See the approach in Structuralism e.g. here: https://www.sciencedirect.com/topics/social-sciences/structuralism
[5] One example of this approach can be found here: https://online.stanford.edu/creativity-and-innovation-management
[6] See e.g. https://pubs.aip.org/aapt/pte/article/4/4/161/273028/Symmetry-in-Physical-Laws.
[7] https://arxiv.org/pdf/1201.6045.pdf. This is useful for e.g., understanding the nature of the Higgs particle discovered at CERN in 2012 (see Figure 1).
[8] See e.g. Rosenblueth, 1943; Geen, 1995; Epstein et al. 1996; Kimbel, 2015; McCarthy 2010; Saggar et al. 2015; Buijs, 2003; Chirumalla, 2017.
[9] For all the boffins in the Coffee Room, here we are referring to the Griewank test Function . See e.g. https://link.springer.com/content/pdf/10.1023/A:1021956306041.pdf?pdf=inline%20link
[10] See e.g. Ceschin, Gaziulysoy (2016), Hargadon, Sutton (1997).
[11] See e.g. Donnellon (1993).
[12] See e.g. Guilford (1980).
[13] See e.g. Sethi, Smith, Park (2001).

1. Level of Structure: describes a process from its methodological point of view (absence vs. presence of identified structure).
2. Cognitive Trait: considers information processing exercised or required by the practitioner from a cognitive point of view (experiential vs. rational).
3. Level of Motivation: considers process from the point of view of the level of expectations, set goals or the absence of them (aimless vs. purpose-seeking).

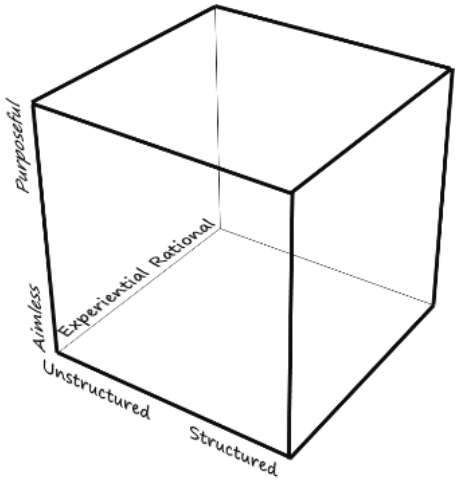

Fig. 4. The 3-D Space framework for looking at level of creativity in innovation vs. structure.

Building upon the Information or I-Space concept developed by Boisot (1995) and using the Social Learning Cycle in Boisot et. al. (2011) as a guiding framework, the different innovation (sub) cycles described in the literature can be sequenced in time as a three-dimensional loop in which we call the "Pancho Villa Space" to describe a non-incremental innovation space or P-Space in short, as demonstrated in Figure 5.

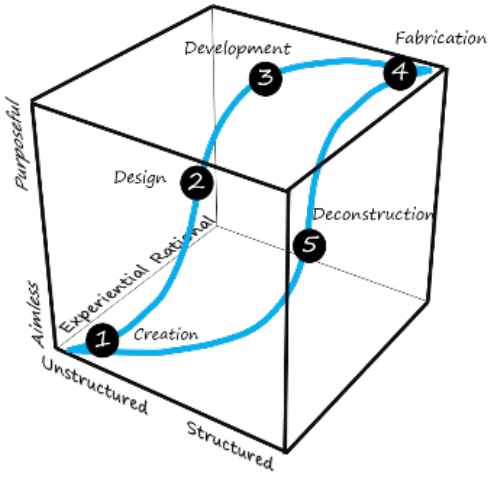

Fig. 5. Process classification in the P-Space.

The following five sub-processes can thus be identified (inspired by Boisot et al, 2011):

1. Creation process: is the starting point in the hysteresis loop and is characterised by being initially purely experiential, without a specific aim or intended structure. This is descriptive (a posteriori) and not prescriptive (a priori). This would typically include, for example, an artistic creation processes.
2. Initial Concept Design process: in comparison with the creation process, is characterised by being less experiential and having more structure. In other words, the process becomes more codified (see Figure 6). It departs the purely experiential realm by entering into the rational domain by introducing some form of purpose

which is to be achieved. This would e.g. include the "Fuzzy Front End[14]" part of in the industrial and service product design cycles.

3. Development process: is characterised by yet a higher level of codification. The purpose is to increase both the degree of rationality and built-in structure. For example, this would include the assembly of scalable prototypes following a round of previous iterations and developed concrete, verified specifications.

4. Fabrication process: is characterised in the P-Space by the highest degree of rationality, structure and purpose. Here, the level of codification is at maximum. As an example, this would include any (industrial) scalable fabrication process.

5. Deconstruction process: is characterised by the eventual need by the practitioner to depart from the obtained highest degree of rationality, structure and purpose and to step back into the creative realm again (i.e. going back to the drawing board). This process requires un- or decodifying the achieved knowledge structures by e.g. reverse engineering a given object or concept back to "atoms" or revisiting the major assumptions made before.

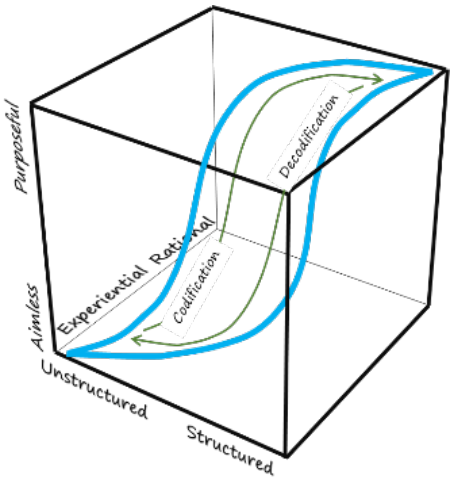

Fig. 6. Codification and Decodification pathways in the P-Space, forming the Innovation Cycle.

We wish to emphasize that the hysteresis loop in Figures 5 and 6 are to be considered as its "cousins" in physics: it is non-linear by nature and its state depends on its history. The hysteresis cycle follows its maximal path. Moving back is possible – e.g. by Decodification – but only following a different pathway. This means that returning to or switching across different processes changes the shape of the initial loop. That is, there can be an internal loop in e.g. the Initial Concept Design process but it will then change the shape of the entire hysteresis loop. Thus, there is no going back without affecting the future. We therefore refer to this maximal hysteresis loop as the Innovation Cycle, a three-dimensional, dynamic representation of innovation cycles discussed in existing literature (see e.g. Sheffi, 2004).

CARAMBA! IT'S A THINKING HAT!

Finally, here's how rebel (non-incremental) innovation thinking and symmetry (lack of it) between structure really boils down to a Mexican Hat. As the Innovation Cycle (Figure 6) is non-linear and its shape is determined to the past history of the different (sub) processes, the innovation curve depicted above does not offer a static symmetry. This means that it will "snap" in shape as it moved from one cycle to the next. This is known in physics as a phase transition and one well known example of that is related to the Higgs-particle discovered at CERN in 2012 (see footnote 7). Inspired by this connection, we can now introduce the Mexican Innovation Hat (see Figure 7). This helps us to illustrate the trade-off between creativity and process structure (or methodologies) in innovation.

[14] See e.g. Reid, De Brentani (2004).

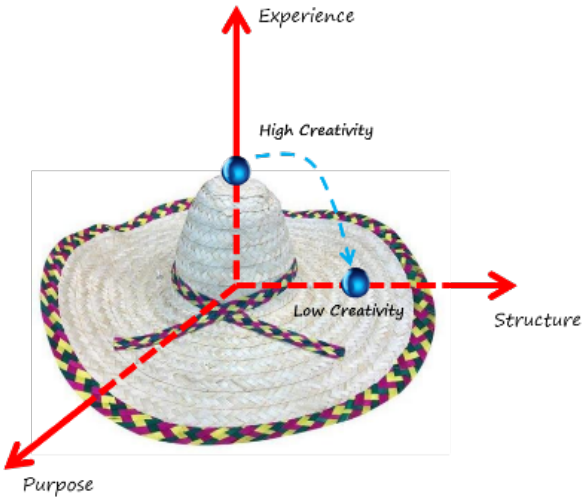

Fig. 7. The P-Space Mexican Innovation Hat.

Our conclusion: The more structure or purpose we build into an experiential process (or methodology), the less creative we risk to make it. In other words, the more we codify a process, the less serendipitous we make it, in terms of the options space we could explore. An increase in the purpose or built-in structure in a given process leads to the immediate drop in the creative realm.

The Mexican Innovation Hat suggests that the relationship between creativity and structure is not linear. Instead, in need of abundance of, it is either-or, like applying a "switch" between the two states in a process. This should then be taken into account when demanding or expecting high doses of (experiential or "raw") creativity as one moves up in the level of codification. Moreover, (re)starting the innovation cycle will require a full deconstruction and a state of an unstructured and experientially anew-starting point void of a pre-specified clear aim.

Finally, we note that it is possible to execute innovation processes where their experiential creative character can be preserved as long as the degree of codification is kept low.

And thus the IdeaSquare staff, all wearing their Mexican Hats, went outside into the heat to think hard about their achievements.

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