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**Exploring the Topology of the Plausible:
Fs/QCA Counterfactual Analysis and the Plausible Fit of Unobserved
Organizational Configurations**

Giuseppe Soda, Bocconi University and SDA Bocconi School of Management, Milan

Santi Furnari, Cass Business School, City University London, UK

From Observed to Plausible Worlds: A New Perspective on Configurational Fit

Few ideas have been more persistently central in both strategy and organization research than the concept of fit (Child, 1974; Miller, 1992; Sinha and Van de Ven, 2005; Parker and van Witteloostuijn 2010). Beyond its theoretical appeal, the prominence of the idea of fit in the management literature is also due to its powerful practical applications. In fact, the conceptual frameworks developed around this idea have offered a systematic approach that can be applied to any organization to uncover areas of misalignment that may affect performance goals (Tushman and O'Reilly, 2002).

Since early contingency approaches, research has focused on a *two-dimensional* notion of fit, investigating, for example, the internal fit between strategy and structure (e.g. Chandler, 1962; Miller 1992) or the external fit between structure and contextual factors (e.g. Lawrence and Lorsch, 1967) as bi-variate relationships. Drawing on these fundamental intuitions, in the last two decades scholars have developed the notion of *configurational fit*, defined here as “*the systemic relationship among multiple sets of elements, either internal or external to an organization*” (cf. Drazin and Van de Ven 1985; Meyer et al. 1993; Siggelkow 2002; Snow et al. 2005). More precisely, configurational fit captures the multi-dimensionality and complexity of the relationships linking organizational elements (such as organizational structures, integration mechanisms, and people); attributes of a firm's strategy (such as degree of diversification, vertical integration, customer orientation); and environmental dimensions (such as market volatility, technological dynamism, regulation, and environmental munificence). An emergent and promising stream of literature has also recently expanded the set of factors that can systemically interact in a configuration, including informal organizational elements (Gulati and Puranam, 2009; Soda and Zaheer, 2012), showing how the multidimensional interaction among these factors can generate positive or detrimental effects on performance.

Despite the intuitive appeal and relevance of configurational fit, our understanding of this central construct remains plagued by one major theoretical limitation: virtually all our analyses of fit rely on investigations of existing observed configurations rather than *possible configurations*, empirically unobserved, yet plausible and potentially more effective. In fact, the dominant research tradition in organization theory and strategy has examined the fit of configurations *ex-post*, as empirically emerging from observed data. Similarly, by narrowing the discussion to organizational and strategic archetypes that are more frequent, scholars have largely limited the possibility of examining cases of strategic absence (Inkpen and Choudhury 1995) or small samples of few cases (e.g. March et al. 1991) that might be as meaningful and relevant as those that cover large proportions of a population. For instance, for a long time we had been discussing the relative superiority of markets vs hierarchies, without considering the theoretical possibility of intermediate configurations (such as inter-firm alliances or networks) between the two. However, as soon as these hybrid organizational configurations became empirically widespread, they yielded a central place in our scholarly attention. More generally, the “relevance” of management research has been often justified on the basis of the empirical observation of new phenomena, argued to be widely diffused or in the process of becoming widely diffused. To keep with the example above, scholars investigating hybrid organizational forms initially justified the relevance of their research by claiming that these forms were becoming empirically frequent, yet they were different from what the scholarly community had typically been studying up to that time. Differently from this empirically-driven *ex-post* approach, our point in this work is that we can imagine and theorize the *plausibility* of new configurational forms *before* their empirical diffusion, much in the same way architects and designers envision the possible existence of new forms, which are still unobservable to the human eye.

Our claim is *not* to move away from empirical observation of configurations. Rather, we argue that the available empirical and theoretical knowledge of existing configurations can, and should, be usefully leveraged to craft a rigorous analysis of the *plausible*, yet not empirically manifested, configurations. The analytical payoff of this approach is to unleash the *generative* potential of organization design in its strongest sense –i.e. design as the *discovery* of yet not existing, but potentially more effective, organizational configurations (e.g. Leblebici 2000; Liedtka 2000; Grandori 2001; 2010; Hatchuel 2001). This generative conception of design is at stake with an approach to configurational fit uniquely based on empirically emerging configurations and on the *ex-post* identification of fit through the observation of interaction effects or other empirical indicators (cf. Grandori and Soda 2006; Grandori and Furnari 2008). In contrast with this conservative approach, we invoke a revitalization of design as a much more open and creative discipline concerned “[...] not with how things are but with how they might be” (Simon 1996: xii). This rejuvenated idea of organization design as a “generative grammar of organization” (Salancik and Leblebici 1988) mirrors the most recent progresses in biology and chemistry. Indeed, even these natural sciences traditionally grounded in a systematic analysis of the observable world, are now revisiting the classic neo-Darwinian assumptions of complex systems’ evolution, by challenging the idea that natural selection operates within imposed fitness landscapes; and by calling for new analyses of the “topology of the possible” (Fontana, 2003), which underlies the emergence of new forms (cf. Padgett and Powell, forthcoming). Similarly, we believe that organization and strategy configurational research should provide guidance for a methodologically rigorous “*discovery of the plausible*”, supporting the exploration of innovative alternatives instead than only the observation of empirical regularities. If we keep our eyes firm on the existent, our research is doomed to lag behind the past, limiting our potential to improve the future.

To overcome this fundamental limitation, we suggest that a much more generative approach to organization design should include strategic and organizational configurations which are *plausible* because their existence and outcomes are justifiable from a theoretical and logical standpoint. In this contribution, we outline how counterfactual analysis (e.g. Tetlock and Belkin 1996) can provide a systematic approach to a theoretically-informed, logically-sound, exploration of the plausibility of unobserved configurations. Particularly, we build on fuzzy-set/qualitative comparative analysis (fs/QCA) as a methodology incorporating a counterfactual understanding of configurations of causal conditions (e.g. Ragin 1987; 2000; 2008). While previous research has emphasized how the *configurational logic* embedded in fs/QCA provides new valuable insights into traditional analyses of organizational configurations (Fiss 2007; 2011; see Greckhamer et al. 2011), the *counterfactual logic* characterizing this methodology since its origin (Ragin 1987) has remained relatively less explicit in its existing applications in management studies. Therefore, our point of departure from previous studies is to unpack the elements of counterfactual analysis contained in fs/QCA in order to illustrate how a counterfactual approach can strengthen the generative design potential of current configurational analyses (i.e. the capability of these analyses to allow for the creative generation and discovery of new configurational designs).

Fs/QCA Counterfactual Analysis and the Discovery of Plausible Configurations

We explore the use of counterfactual analysis to enrich empirically-based approaches to configurational fit, expanding their scope to unobserved, yet logically possible, “counterfactual configurations” –i.e. organizational configurations that lack empirical instances and “therefore must be imagined” (Ragin 2008: 150). Counterfactual analysis consists in evaluating the plausibility of given counterfactual configurations and their outcomes. Despite the use of counterfactual analysis in management research has been rare

(e.g. Booth 2003; Durand and Vaara 2009), this mode of inquiry has a long tradition in social science and history (e.g. Hicks et al. 1995) and in the philosophy of science (e.g. Lewis 1973). Here, we draw on fs/QCA (Ragin 1987; 2000; 2008), a methodology explicitly incorporating *both* a counterfactual and a configurational logic to causation in order to examine how multiple causal conditions jointly produce a given outcome of interest. To illustrate how to leverage counterfactual analysis within fs/QCA, we start by briefly introducing the basic configurational logic underlying this methodology. This introduction contextualizes our discussion of counterfactual analysis of organizational configurations, which constitutes the main focus of this essay.

Fs/QCA conceptualizes cases as configurations of qualitatively distinct causal conditions, aiming at identifying which sets of conditions are jointly sufficient to produce an outcome. Configurations are typically represented in terms of the presence or absence of the multiple conditions considered. The conditions are typically identified on the basis of available theoretical or substantive knowledge of the cases and settings examined¹. For example, suppose to be interested in understanding how economic incentives (I), level of formalization (F), and teamwork (T) practices (i.e. causal conditions) combine to produce the outcome of organizational innovation (e.g. Furnari 2007). In fs/QCA, the data collected on the presence/absence of these conditions and outcomes are used to generate a *truth table*, representing all the logically possible combinations of conditions and their respective outcomes, such as Table 1 reported below. The typical objective of a fs/QCA analysis is to identify the minimal number of configurations that “cover” the truth table -i.e. that explains the occurrence of the outcome. These “minimized configurational solutions” are obtained by

¹ Some times, the number and type of conditions considered in a fs/QCA analysis are fixed and do not change during the analysis. One may therefore wonder how this methodology can actually allow for the discovery of new elements. In its basic use, the generative potential of the fs/QCA methodology lies mostly in the discovery of *new combinations of elements* rather than of *new elements* per se. However, in its strongest use, fs/QCA is envisioned as an “iterative” methodology in which the results and possible contradictions emerging in initial analyses inform the selection of new conditions to be included in subsequent analyses (Rihoux and Ragin 2009; cf. Ragin 1987).

applying simple Boolean minimization algorithms to the truth table. For example, a basic rule of Boolean minimization is the following: if two configurations differ in only one causal condition, yet they produce the same outcome, then the differentiating causal condition is redundant for the outcome and can be removed to create a simpler, more minimized, configurational solution (Ragin 1987). Consider, for example, organizational configurations 1 and 2 in Table 1: they differ only in terms of formalization, yet they both conduce to innovation (i.e. they are equifinal). Therefore, formalization can be considered as a redundant element and the two configurations can be reduced into a more minimal configuration composed by teamwork and incentives. In Boolean language, this simple minimization rule is expressed as following $I*f*T + I*F*T = I*T$, where capital letters indicate the presence of an element and lower-case indicate the absence of it, while the Boolean operators “+” and “*” indicate, respectively, equifinality or substitutability (“+”) and complementarity (“*”). Applying this simple minimization algorithm to the entire truth table below, we obtain the minimal configurational solutions for innovation, which can be expressed as: $T*F + F*I \rightarrow$ **INNOVATION**. This expression summarizes the typical final outcome of a fs/QCA analysis, that is, a minimal set of configurations explaining the outcome in question.²

INSERT TABLE 1 ABOUT HERE

Note that Table 1 describes an ideal scenario in which the researcher was fortunate enough to find data (i.e. cases) per each logically possible combination of the three organizational elements considered. In this abstract situation, we would not need to worry about unobserved,

² In this oversimplified exposition of the fs/QCA methodology, we are not considering the important issue of the different number of cases that exhibit certain configurations and outcomes. We refer the interested readers to Ragin (2008) and Fiss (2011) for an illustration of how the most recent developments in fs/QCA take into account this issue through the measures of coverage and consistency. Similarly, while QCA initially formalized the presence or absence of conditions in binary terms, further developments use fuzzy-sets to measure the degrees to which cases exhibit a given causal condition (Ragin 2000).

perhaps more effective, configurations. However, the above “fully saturated” research design is very difficult to obtain with observational non-experimental social science data, which are typically characterized by “limited diversity”—the fact that several combinations of causal conditions may show no empirical instance because of naturally occurring selection processes (Ragin 1987). The problem of limited diversity is especially salient for analyses embodying a logic of conjunctural causation, such as the analysis of configurational fit in strategy and organization research. Indeed, as the number of conditions that we want to examine increases, the number of cases that we need in order to identify multiple paths of conjunctural causation increases geometrically according to the function 2^k , where k is the number of conditions considered. For example, if we are interested in examining configurations of 10 elements, we would need to have at least 1024 cases to obtain a fully saturated design, assuming only one case per configuration. Therefore, a more realistic scenario for any analysis of configurational fit would be a situation of considerable limited diversity in which many of the logically possible configurations of causal elements considered will exhibit no empirical instances, i.e. they will be counterfactual configurations. In the following paragraphs, we illustrate how the analytical apparatus developed within fs/QCA can be used to systematically explore counterfactual configurations and evaluate the plausibility of their outcomes (i.e. their “plausible fit”). More specifically, we illustrate four ways in which fs/QCA can be used for a systematic analysis of counterfactual configurations. These four analytical means can be conceived as sequential steps in a counterfactual analysis of unobserved configurations, but they may also be carried out separately, depending on the objectives of the configurational analysis.

Mapping the Possibility Space: Formalization and Visualization of Counterfactual Configurations

An important first step in the analysis of counterfactual configurations consists in identifying the “possibility space” constituted by the possible, yet unobserved, configurations. In this respect, the truth table is valuable for visualizing and formalizing the counterfactual configurations. For instance, going back to the hypothetical example examined above, in a more realistic situation of limited diversity our truth table would include both observed and unobserved configurations as in Table 2 (counterfactual configurations are indicated with a ?). In fs/QCA language, these counterfactual configurations are defined as “logical remainders” because they lack empirical instances but are nevertheless logically possible. As any other configuration, logical remainders can be formalized through concise Boolean expressions. For example, the possibility space contained in the truth table below can be formalized as $I^*F^*t + i^*F^*T + i^*f^*T$. In addition, the possibility space can be visualized through n-dimensional areas or Venn diagrams, as illustrated in Figure 1³. Although the value added by the formalization and visualization of counterfactual configurations may seem trivial at a first glance, this step is crucial for making the researcher aware of the composition of the unobserved configurations. Further, it is an important step to make more explicit the simplifying assumptions on the plausibility of counterfactual configurations and their outcomes in further steps of the analysis.

INSERT TABLE 2 ABOUT HERE

INSERT FIGURE 1 ABOUT HERE

³ Of course, the higher the number of conditions considered in a configurational analysis, the more difficult and complex the visualization of the corresponding possibility space becomes. Useful aids for visualizing multi-dimensional configurational spaces through Venn diagrams are currently available via the software TOSMANA (Cronqvist 2004; for more information see: <http://www.compass.org/software.htm>).

Identifying the Lower and Upper “Plausibility Bounds” of the Possibility Space

Once we have determined the basic topology of the possibility space, we can identify the upper and lower bounds delimiting the subset of plausible configurations within the possibility space, intended here as the configurations that plausibly have positive performance outcomes.⁴ We can initially identify these plausibly fit configurations by making simplifying assumptions about the plausibility of the outcome of each counterfactual configuration included in the possibility space. One first conservative strategy is to assume that the outcome of *all* the counterfactual configurations reported in our truth table would have been negative, had they existed. This simplifying assumption is rooted in the idea that “history optimizes”, so that unobserved configurations do not exist because they have been selected out via evolutionary pressures. However, as Kogut (2010: 149) well argues, “this type of ‘survivor bias’ reasoning is quite frequently made, and only sometimes with justification”. Formally, this simplifying assumption involves changing the outcomes of all the unobserved configurations (3,4,7) reported in our hypothetical truth table (Table 2) from an unobserved outcome (?) to a negative one (0). Once made this conservative assumption, we can apply the Boolean minimization algorithms described above to our simplified truth table, obtaining a new set of minimized configurational solutions: **I * T → INNOVATION**. By considering all unobserved configurations as negative instances of the outcome, we determine what may be called the “lower plausibility bound” of the possibility space, defined by the *minimum* number of counterfactual configurations whose outcomes can be considered plausibly positive had they existed (i.e. by assuming that all unobserved configurations would lead to negative outcomes had they existed, we are de facto restricting the space of plausibly fit configurations to zero).

⁴ Please note that here by “plausible” configurations we mean “plausibly fit”, that is, configurations that have plausibly positive performance outcomes. However, the same counterfactual analytic logic can be used to evaluate the plausible misfit of configurations.

At the other extreme of this conservative strategy, we can choose to rely on the simplifying assumption that all the logical reminders can have *either* positive *or* negative outcomes depending on whether having one or the other type of outcome will help obtaining more minimized configurational solutions. In a nutshell, this strategy consists in making as many simplifying assumptions as possible on the outcomes of counterfactual configurations so to identify the ideally minimal solution. This counterfactual strategy –which is formally implemented in most fs/QCA software (for more information see <http://www.compasss.org/software.htm>)- typically provides more parsimonious results, which however rely on very strong simplifying assumptions on the plausibility of counterfactuals. More than as actual results of an empirical analysis, these parsimonious configurational solutions can be interpreted as an ideal benchmark useful as a reference point for comparison in the subsequent, typically more theory-driven, explorations of plausibility of counterfactual configurations (see below). The counterfactual configurations leading to positive outcomes, according to these strong simplifying assumptions, identify what may be defined as the “upper plausibility bound” of the possibility space, defined by the *maximum* number of counterfactual configurations whose outcomes can be considered plausibly positive had they existed (i.e. by assuming that as many as possible unobserved configurations would lead to positive outcomes, had they existed, we are de facto stretching the space of plausibly fit configurations to its upper boundary). In the case of our hypothetical truth table (reported above), this more parsimonious solution can indeed be expressed by the only presence of one condition: **T → INNOVATION.**

Differentiating the Plausibility Space via Counterfactual Analysis: “Strong” vs “Weak” Counterfactual Configurations

The two strategies of counterfactual analysis illustrated above constitute two extremes of a continuum, one relying on very simple simplifying assumptions which reduce the plausibility space; the other relying on quite strong simplifying assumptions which allow the researcher to make the maximum use of the empirical evidence and counterfactual configurations by hypothesizing a larger plausibility space. Although these extremes constitute useful benchmarks as explained above, a rigorous counterfactual analysis requires evaluating the plausibility of the outcomes of each single counterfactual configurations included in the possibility space. Unfortunately, there are no established methodological criteria to guide this evaluation, so in what follows we sketch two different ways to approach this complex problem with the aim of sensitizing further research on the topic.

Leveraging Theory to Evaluate the Plausibility of Counterfactuals

Tetlock and Belkin (1996) provide an interesting guideline consisting of six general criteria by which to evaluate counterfactual arguments. Among these criteria, they emphasize *theoretical consistency*, that is, the idea that counterfactuals can be considered more plausible when they are “consistent with “well established” theoretical generalizations relevant to the hypothesized antecedent-consequent link” (Tetlock and Belkin 1996: 18). Similarly, we propose to evaluate the plausibility of the outcomes of logically possible, yet not observed, configurations by using *ex-ante* theoretical knowledge on the “combinatory rules” connecting the elements of an organizational configuration. Based on previous empirical evidence and pre-existing knowledge on how the organizational elements of a configuration interact, it is possible to evaluate the plausibility of the outcomes of certain combinations of elements. For example, the extensive literature on organization can rely on a well-established body of

knowledge on what are the types of organizational elements that produce complementary effects (e.g. Milgrom and Roberts 1995; Porter and Siggelkow 2008). Taken together, this body of knowledge and its related cumulated empirical evidence define a series of more or less established “design rules” (Romme and Endenburg 2006; Van Aken 2004) specifying possible areas of fit and misfit among organizational elements (Burton et al. 2006). In a similar fashion, using chemistry as an analogy, Grandori and Furnari (2008) identify specific combinations of elements which are complementary or substitutable in producing certain positive outcomes such as organizational efficiency and innovation (cf. Grandori and Soda 2006; Soda and Zaheer 2012). Our argument is that this well-established body of knowledge can be used to specify empirically-grounded and theoretically-rigorous “combinatory rules” specifying how two or more organizational elements interact; generating different types of configurational outcomes, such as additive, super-additive and substitution effects⁵. From this perspective, counterfactual analysis consists theorizing on the type of plausible outcomes generated by a set of combinatory rules among elements whose combinations are not directly observed. Thus, a given possible configuration of elements can be considered to generate a plausibly positive outcome when the combinatory rule linking its elements has been consistently proven to be complementarity (i.e. the outcome generated by their interaction is super-additive). Conversely, we can justify the plausibility of negative outcomes for a counterfactual configuration when we can rely on well established theories and evidence on their negative interactions (i.e. substitution effects). Although many counterfactual configurations might include both types of (complementary and substitutive) combinatory rules, depending on the number of elements considered, the systematic and informed use of

⁵ In additive effects the interaction among the elements of a configuration does not generate any additional outcomes beyond the sum of outcomes generated by each element individually. Super-additivity instead arises from the positive interaction among elements of the configuration and complementarity is often invoked to explain this type of outcome (Milgrom & Roberts, 1995; Porter & Siggelkow, 2008). Finally, substitution effects are determined by a negative interaction among elements.

theoretical knowledge can substantially help the specification of the space of plausible configurations (cf. Ragin 1987; 2008).

Leveraging Logical Consistency to Evaluate the Plausibility of Counterfactuals

To be considered plausible, counterfactuals need also to be logically consistent (Tetlock and Belkin 1996). Fs/QCA provides a number of ways to check the logical consistency of simplifying assumptions on the outcomes of counterfactual configurations. One possible approach consists in comparing the most parsimonious solutions obtained for positive and negative outcomes. As discussed above, these more parsimonious solutions consider plausible as many counterfactual configurations as possible in order to identify the most parsimonious solution to the truth table. An important criterion of logical consistency is to avoid that the same counterfactual configuration is used to obtain minimal solution for positive *and* negative outcomes, thereby “making contradictory assumptions regarding the outcome of that logical reminder” (Rihoux and Ragin 2009: 136). Indeed, logically, each given outcome (innovation or not-innovation in the example above) need to be explained by the same configurations of conditions. Thus, any unobserved configuration assumed to explain *both* cases with a positive and negative outcome creates a logical inconsistency. Instead than considering these logical inconsistencies as problems, fs/QCA provides tools to identify these contradictory counterfactual configurations (by mapping and comparing the minimized solutions onto the counterfactual configurations and identifying the counterfactuals that are included in both solutions), so that the analyst can either eliminate or further investigate these logical contradictions with the use of theory.

Through these counterfactual analyses of plausibility, we should be able to further differentiate the counterfactual configurations inhabiting the plausibility space into

theoretically substantiated, logically consistent, counterfactuals –what may be called “strongly plausible” counterfactuals- and “weakly plausible” counterfactuals, not rooted in previous knowledge and logically contradicting the configurations identified in our data. This further analytic step can then guide the empirical search for, or simulation of, new cases matching different types of counterfactual configurations.

Informed Selection or Simulation of Plausibly Effective Configurations

Differently from most traditional, correlation-based, empirical research, the final aim of the counterfactual approach sketched here is not identifying, *ex-post*, empirically robust patterns of association in observed data. Rather, the objective is informing, *ex-ante*, the discovery of yet not existing, but possibly more effective, organizational configurations. Thus, our perspective holds that a rigorous counterfactual analysis of organizational configurations can constitute a solid backdrop for an informed selection of new empirical cases matching the plausible configurations identified (either the weakly plausible or the strongly plausible ones, depending on the objective of the research). Another fascinating, still to be fully explored, outcome of a counterfactual approach is a theory-informed simulation of possible worlds and their outcomes (see Cederman 1996 for an example).

Conclusion

In sum, the main aim of this contribution is to expand the dominant rationale of organizational design research by including solutions and possibilities which are not observed in reality. We believe that the counterfactual approach to configurations responds to a still open call in organization theory and strategy to move the modelling of fit towards a more robust and theory-based specification (e.g. Drazin and Van de Ven 1985). With this new approach we propose to re-discover the roots of organization design as a distinct normative

discipline that *'should stand approximately in relation to the basic social sciences as engineering stands with respect to physical sciences or medicine to the biological'* (Thompson 1956: 103). At a more general level, our view implies an expansion of the dominant meaning of the concept of "relevance" in management research. While we agree with Gulati (2007: 780) that we as scholars should probe "more deeply into the problems and other issues that managers care about" (Gulati 2007: 780), we also believe that relevance does not necessarily mean that researchers have to use an *ex-post* rationality by studying only empirically frequent phenomena. In contrast, we think that any management researcher should bring with herself a fragment of the spirit of the great Greek philosopher Anaximander (Ἀναξίμανδρος, c. 610 – c. 546 BC), which foresaw the concept of the infinite universe without the support of any empirical observation and against the predominant wisdom of the time. Not by chance, Karl Popper (1998) considered Anaximander's intuitions among the most vivid demonstrations of the power of human thought and logic.

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Configuration ID	Incentives	Formalization	Teamwork	Innovation	Number of cases per Configuration
1	1	0	1	1	10
2	1	1	1	1	8
3	1	1	0	1	14
4	0	1	1	0	6
5	1	0	0	0	7
6	0	0	0	0	3
7	0	0	1	0	4
8	0	1	0	0	2

Table 1 – Truth Table of Logically Possible Configurations (“Fully Saturated” Design)

Configuration ID	Incentives	Formalization	Teamwork	Innovation	Number of cases per configuration
1	1	0	1	1	10
2	1	1	1	1	8
3	1	1	0	?	0
4	0	1	1	?	0
5	1	0	0	0	7
6	0	0	0	0	3
7	0	0	1	?	0
8	0	1	0	0	2

Table 2 – Truth Table of Logically Possible Configurations (with Limited Diversity)

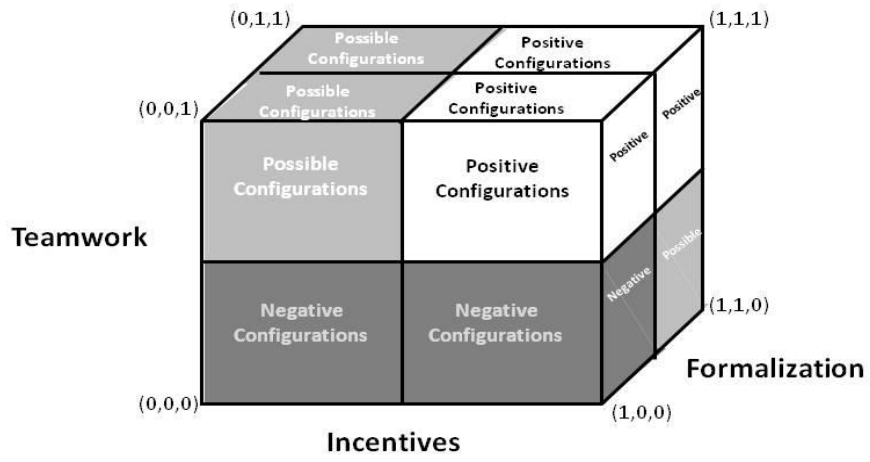


Figure 1 – A Three-Dimensional “Possibility Space” (Light Grey Areas)