# Navigational quality of solution spaces for multi-actor systems under conditions of repetitive decision making

## Abstract for ECCON 2009

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**Abstract**

*Solution spaces* emerged as a central concept in the 2008 ECCON conference. Introduced in the Van Asseldonk & Vos (2007) and Van Asseldonk & Den Hartigh (2008) ECCON papers, solution spaces were presented as a concept to govern entropy in organisational systems to enable improving economic productivity beyond the level of classical organizational configurations. It was argued (2007) that organizing tasks in a number of interlinked process layers creates a number of solutions spaces, enabling actors to selforganize relatively efficiently into adequate supply configurations to respond to market demands. It was shown (2008) that under conditions of multiple input requirements and high output variety, such an approach is superior to classical organizational configuration models

Solution spaces can be regarded as a specifically designed grouping of resource inputs (e.g., people, materials, machines) required to deliver sets of required output (e.g., market demand). In the model of the 2008 ECCON paper, it was supposed that resource inputs would identify their adequate configuration by trial and error, hence essentially by a statistical process. Conceptually they work along similar lines as the trial-and-error solution to the

travelling salesman problem as discribed in Van Asseldonk (1998). Instead of calculating or mathematically proving the shortest possible path length, the algorithm generates “good enough” solutions in a very short time span.

In this sense the solution spaces presented in the 2008 ECCON paper did not have any advanced navigational quality in the sense that it would help resource inputs to converge rapidly into adequate configurations. As the speed of the convergence of the search process determines the productivity of the system, improving the navigational performance of such solu~~ul~~tion spaces is a very powerful tool in designing organisational configurations of business processes.

In this article we aim to investigate the navigational quality of solution spaces and their practical applicability. To be able to do so, we will address three main questions. The first question is *“What are the boundary conditions and basic properties of navigation in solution spaces?”* Issues to be addressed are:

- What is a navigatable solution space?
- Does navigation suppose a solution space at all (see Thurner & Hanel, 2008)?
- Does navigation pre-suppose a system with a finite entropy? We expect that in a system as well as in the envir~~i~~onment in which it operates, sufficient elements of stability must be avaible to provide the basis for navigational guidance. If not, e.g., when the system is truly random, neither will such information be available as to the ex ante qualification of solution quality, nor will ex post memorization of results bear any meaning to the future.
- What is the influence of (multi-)dimensionality of solution spaces?
- What is the influence of the deformation of the solution space as a consequence of movements in this space?

The second question is *“What does a concept of navigation in solution spaces look like?”* Different concepts to be explored are:

- Kauffman (1993) describes the relation between N/k ratio’s of networked systems and the nature of the solution topology of the system. The existence of such topology, if available to the system actors, might be used as a “roadmap” to adequate solutions?
- Even if the topology cannot be used as a roadmap, it might offer directional clues as to in which (multi-dimensional) direction better solutions are likely to be found.

We expect that “fuzzy” directional guidance (informed guesses) will in such case improve the navigational qualtiy of the solution spaces.

- We expect that in many situations the required sytem response is not the optimal solution but just a “good enough” solution. The system might provide many such “good enough” solutions and settling for “good enough” would, e.g. in combination with directional guidance mentioned above, likely reduce the search speed and thereby improve productivity.
- The above mentioned concepts pre-suppose a method to “read” the solution space in the sense that the solution set can be known. This is not always the case. A different approach is the memorization of past results. In this way the system will learn over time which solution sets are more and which are less successful. Whereas this might not generate improvements in a completely randomized market environments, in reality markets will have limited entropy (e.g., Van Asseldonk (1998), showed that market demand in a supermarket has limited dimensionality), and therefore some solution sets might be more relevant than others. Memorizing succesful solution sets, e.g., in the form of solution scripts (Legrenzi, Girotto & Johnson-Laired, 1993), and evaluating these first, may therefore improve the speed of the search process.

The third question is *“What is an adequate fitness measure that can be used to navigate in such solution spaces?”* Issues to be addressed are:

- What is the relation between the fitness of the solution sets and the fitness of the system that generates the solution sets?
- What is the relation between short-term and long-term fitness? A system may generate high performance at time t, but as a consequence be unable to perform at time t+1. This suggests that, apart from a moment-specific fitness measure, we need some kind of measure of “resilience” or “robustness” of systems.
- Which fitness measures connect to real-world business problems. We expect that productivity measures, in which a system output performance (nominator) is related to cost of resource inputs, are an adequate way of measuring fitness. We will build further on the concepts we developed in our 2008 ECCON paper.
- What is the relation between fitness and speed? We expect that the speed of convergence of the search process for an adequate solution set is an important aspect determining the fitness of a solution set as well of the system as a whole.

Based on the above three question and the issues addressed, we aim at providing guidelines for practical applicability of the solution space concept.

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