

THE INTERDISCIPLINARY STUDY OF VIABILITY

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Abstract:

This paper analyses the concept of viability in scientific areas of conservation biology, medicine, management, mathematics and philosophy.

It is an interdisciplinary study in the perspective of convergence that seeks a better understanding of the concept by analyzing the concept in different areas.

The viability concepts considered were population viability analysis in conservation biology, fetal viability in medicine, business viability study in management, viability theory in mathematics and viability criterion in philosophy.

The analysis is performed providing a definition for each viability concept and associated methodology, followed by a comparison between the different definitions and methods to determine resemblances and differences between them.

Resemblances between the several viability concepts are a perception of the future based on a conception of the world.

Differences between the several viability concepts exist in the conceptions of the world and in the moment of time for which the viability is assessed. The conceptions of the world present differences on whether or not they are constituted by pre-defined elements of analysis, being the analysis elements quantitative or qualitative and if proposes new kinds of realities that depend on human action. The moment of time, for which the viability is assessed, can differ between the present and a moment of time in the future.

Key Words: Viability, Interdisciplinary, Convergence

Introduction:

This paper examines the viability concept in distinct scientific areas.

It is an interdisciplinary study in the perspective of convergence (Pombo, 2004, p. 94) that seeks a better understanding of the concept by analyzing the concept in different areas.

The analysis is performed providing a definition for each viability concept and associated methodology, followed by a comparison between the different definitions and methods to determine resemblances and differences between them.

The selection of viability concepts examples analyzed was made by an internet search in the library of knowledge online (UMIC, 2004) that provides access to the texts of scientific journals, and google scholar (Google, 2004) which indexes scholarly literature.

The examples of viability concepts analyzed are not an exhaustive list of existing concepts of viability. The diversity in scientific areas was privileged in the selection made.

Viability concepts examples:

This section presents the examples of viability concepts analyzed. The scientific area of origin and the title of the viability concept are given for each example, followed by a definition of the concept and associated methodology.

Conservation biology: Population Viability Analysis

Definition: The term population viability analysis refers to the use of quantitative methods to predict the likely future status of a population or collection of populations of conservation concern. It aims to answer two critical questions. First, what is the likelihood that a known population of a

species of conservation concern will persist for a given amount of time? Second, how many populations must be preserved to achieve a reasonable chance that at least one of them will avoid extinction for a specified period of time? (Morris, 1999, p. 1).

Methodology: The choice of methods in population viability analysis can be determined by the data sets available for analyze (Morris, 1999, p. 4). Data sets are classified according to the type of data, the number of locations, and the number of years in which data were collected. By type of data, it means whether the persons who collected the data recorded counts of individuals in one or more life stages, or demographic information about individual organisms that is, whether each individual survived from one census to the next (Morris, 1999, p. 5). Three methods exist to distinct general classes of data sets (Morris, 1999, p. 6).

The count-based extinction analysis method is suitable for data sets constituted by counts of individuals in a single population obtained from censuses performed over multiple years.

The projection matrix models method is suitable for data sets constituted by detailed demographic information on individuals collected over 3 or more years.

The Multi-site extinction analysis method is suitable for data sets constituted by counts from multiple populations, including a multi-year census from at least one of those populations.

Medicine: Fetal Viability

Definition: The concept of viability implies a prediction as to whether a delivered fetus is capable of survival. A prematurely delivered fetus is viable when a minimal number of independently sustained, basic, integrative physiologic functions are present. The sum of these functions must support the inference that the fetus is able to increase in tissue mass (growth) and increase the number, complexity and coordination of basic physiologic functions (development) as a self-sustaining organism (Rayn, 2006, p. 55).

Methodology: The following functions, taken together, constitute the minimal number of basic integrative physiologic functions to support an inference of viability: (1) Perfusion of tissues with adequate oxygen and prevention of increasing accumulation of carbon dioxide and/or lactic and other organic acids. (2) Neurologic regulation of the components of the cardio-respiratory perfusion function, of the capacity to ingest nutrients, and of spontaneous and reflex muscle movements (Rayn, 2006, p. 56). This is a decision to be made by a physician (Rayn, 2006, p. 5).

The absence of the sum of these functions, can be assessed indirectly in a reasonable and reliable manner by measurement of weight and an estimation of gestational age (Rayn, 2006, p. 56). These values can be compared with minimum values acquired by survey of known and documented situations of survival (Rayn, 2006, p. 55).

Criteria for viability are based on current technology, which is subject to change. Accordingly, the criteria should be reviewed periodically (Rayn, 2006, p. 57).

Management: Business Viability Study

Definition: A business feasibility study is essentially a process for determining the viability of a proposed business venture and determination if the proposed investment or business is feasible based on the results obtained from a well-prepared and researched study (Thompson, 2005, p. 227).

Methodology: Business viability analysis process is constituted by a series of questions that consider the viability of individual dimensions of the business itself and it is only from a cumulative contribution of these dimensions that the overall business can be determined to be viable (Thompson, 2005, p. 176).

Individual dimensions to analyze are: market viability, technical viability, business model viability, management model viability, economic and financial viability and exit strategy viability. To assess the viability of each of these individual dimensions is necessary analyzing a set of defined viability measures. For instance the individual dimension of market viability is constituted by the viability measures of market size, competitors, similar products, pricing, packaging, distribution to markets and advertising (Thompson, 2005, p. 178). Individual dimensions list are not rigid and can be modified to best fit the business situation being assessed (Thompson, 2005, p. 180).

It is suggested that when the overall viability in the proposed business venture is more than 80%, the decision made should recommend the business as being commercially viable. However, if

individual dimensions of viability of the model fall below their critical validation rating, then the overall model is not viable (Thompson, 2005, p. 177).

Mathematics: Viability Theory

Definition: Viability theory designs and develops mathematical and algorithmic methods for investigating the adaptation to viability constraints of evolutions governed by complex systems under uncertainty that are found in many domains involving living beings, from biological evolution to economics, from environmental sciences to financial markets, from control theory and robotics to cognitive sciences. (Aubin, Bayen, Saint-Pierre, 2011, p. 1).

Methodology: Viability theory provides a set of mathematical tools such as viability kernels and capture basins. The theory can be applied to situations or problems that can be modeled by the mathematical tools. The methodology involves an early stage to consider whether you can represent the situation or problem with the mathematical tools provided by the theory. If it is considered that it is possible then proceeds to the modeling.

The mathematical tools available are sufficiently flexible to allow the modeling of a wide variety of situations. Examples of application of the viability theory are: rallying a target while avoiding obstacles (Aubin, Bayen, Saint-Pierre, 2011, p. 20), autonomous navigation in an urban network (Aubin, Bayen, Saint-Pierre, 2011, p. 23), safety envelopes for landing of plane (Aubin, Bayen, Saint-Pierre, 2011, p. 25) or management of renewable resources (Aubin, Bayen, Saint-Pierre, 2011, p. 26).

Philosophy: Viability Criterion

Definition: Viability means the approval as viable by the peers of an accomplishment plan of something that has interest and doesn't exist yet (Coimbra, 2010, p. 1).

Examples of accomplishment plans are technical specifications of products, production processes definition or the social coordination mechanisms definition.

The relevance of viability criterion is the exclusive focus in the analysis of things that begin to exist only in human imagination and that only can be accomplished by human action. Viability puts in highlight the fact that research does not need to have like starting point facts and problems. Research can have as a starting point imagination and interests. Viability puts in highlight the fact that research does not need to have as a result the elaboration of explanations. Research can have as a result the elaboration of transformations plans. Finally, viability also puts in highlight the fact that is not always necessary to build prototypes to make an evaluation.

Methodology: The sharing of the accomplishment plan with peers and obtain the feedback of approval or rejection. The writing of the results of the scientific research is important for its disclosure and validation. The existence of different kinds of works and of different scientific areas leads to the existence of a multiplicity of possible structures for the written works. A common and possible structure is those of context, problem, why the problem is a problem, solution, and how the solution solves the problem. Is suggested the structure of proposal, relevance of the proposal, justification of the relevance, accomplishment plan and conclusion with the purpose of facilitating the writing of works based in viability (Coimbra, 2010, p. 4).

Comparison between viability concepts examples:

Table 1 shows the comparison between viability concepts examples. Each column of the table corresponds to one example of viability concepts. Each row of the table corresponds to a characteristic by which the viability concepts are compared.

Each row of the table is described below.

Scientific area of origin: it specifies the scientific area where it was developed the viability concept.

Scientific area of application: it specifies the scientific areas where the viability concept can be applied. The scientific areas of application can be different of the scientific area of origin.

Moment in time, for which the viability is assessed: it specifies the moment of time, for which the viability is assessed. It can be the present or a moment of time in the future. The viability concepts have a conception of the world. The viability concepts with methods that allow the analysis of one point in the future have also a representation of how evolution occurs.

Analysis Type: it indicates whether the viability analysis uses quantitative or qualitative elements.

Dimensions of analysis pre-defined: it indicates whether the elements to be analyzed are pre-defined in the method. There are viability concepts such as business viability study, where the elements are pre-defined but it is indicated that the default is a proposal that can be adapted and changed (Thompson, 2005, p. 180).

Proposes new kinds of realities that depend on human action: it indicates if is evaluated the existence of new realities that can only be accomplished by human activity.

	Population Viability Analysis	Fetal Viability	Business Viability Study	Viability Theory	Viability Criterion
Scientific area of origin	Conservation biology	Medicine	Management	Mathematics	Philosophy
Scientific area of application	Conservation biology	Medicine	Management	Application in several areas	Application in several areas
Moment in time, for which the viability is assessed	Future	Present	Present	Present Future	Present
Analysis Type	Quantitative	Quantitative Qualitative	Quantitative Qualitative	Quantitative	Qualitative
Dimensions of analysis pre-defined	pre defined	pre defined	pre defined	Not pre defined	Not pre defined
Proposes new kinds of realities that depends on human action	Continuity	Continuity	New kinds of realities	Continuity	New kinds of realities

Table 1 - Comparison between viability concepts examples

Conclusion:

The several viability concepts are a perception of the future based on a conception of the world.

Resemblances between the several viability concepts are that they are analysis process constituted by a series of questions that consider the viability of individual dimensions and it is only from a cumulative contribution of these dimensions that the overall viability can be determined. As technology is subject to change, viability should be reviewed periodically, when the use of technology is relevant.

Differences between the several viability concepts exist in the conceptions of the world and in the moment of time for which the viability is assessed. The conceptions of the world present differences on whether or not they are constituted by pre-defined elements of analysis, being the analysis elements quantitative or qualitative and if proposes new kinds of realities that depend on human action. The moment of time, for which the viability is assessed, can differ between the present and a moment of time in the future.

The concepts of viability theory and viability criterion are applicable to a variety of problems. The concepts of population viability analysis, fetal viability and business viability study are applicable to specific problems. As a future research, it can be examined whether the more general viability concepts can be implemented and with which results, to the problems analyzed by the more specific viability concepts. For instance the application of the viability theory to the problems analyzed by population viability analysis, or the application of the viability criterion to the problems analyzed by the business viability study.

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