

A LOGICAL APPROACH TO THE CONCEPT OF INSTITUTIONAL RESILIENCE

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Abstract: *The paper intends to clarify the concept of institutional resilience and proposes a logical formalization of this concept. In the first part of the paper some clarifications were made regarding the effects of disturbances on the systems and the conceptual family of resilience was proposed. In the next part of the paper, the concept of resilience and the concept of institutional resilience were defined. In order to define the concepts within this paper, a logical approach was proposed by identifying the sufficiency predicates of each concept and performing their logical analysis. The concept of institutional resilience, as a species of the resilience genre, was defined by identifying two additional sufficiency predicates, compared to the general case of the concept of resilience. In the last part of the paper, a logical formalization of the institutional resilience concept was proposed.*

Keywords: *resilience, institutional resilience, disturbances, sufficiency predicates.*

JEL Classification: *P10.*

1. Introduction

In recent years, the concept of resilience has been a concern for many specialists in various fields, many studies being carried out, yet without reaching a consensus regarding the definition of resilience and the establishment of a system of indicators that can be used to measure the degree of resilience of a system.

The term resilience has a long history, although many authors believe that the term was introduced by the ecologist Holling. The resilience comes from the Latin *resilio*, with the meaning of *jumping back*. In the fifteenth century, the concept of resilience was taken over in French (*résiler*), used with the meaning of "withdrawal" or "cancellation" and later on in English (*resile*), used with the meaning of "withdrawal", "return to a previous position" or "renunciation".

This paper proposes to clarify the concept of institutional resilience from a logical perspective. The paper has the following structure: in the first part of the paper, some details are made regarding the effects produced by disturbances on the systems, taking into account both the internal disturbances, generated by the functioning of the systems and the external disturbances, coming from the environment. At the same time, the conceptual family of resilience is proposed. The next part of the paper identifies the sufficiency predicates that are the basis for defining the concept of resilience from a logical perspective, and their logical analysis is performed. In the last part, the concept of institutional resilience is defined. The paper also proposes a logical formalization of institutional resilience and resilience.

In order to define the concepts within this paper, attributes (sufficiency predicates) specific to each concept were identified and their logical analysis was performed (Dinga, E., 2011).

2. The concept of resilience

The concept of resilience was first used in the field of physics, and later on it became widely used, as psychological resilience, biological resilience, economic resilience, social resilience, institutional resilience, financial resilience, political resilience, fiscal resilience, environmental resilience, informational resilience.

In the field of ecology, a first approach to this concept is achieved by MacArthur in 1955, in the paper "*Fluctuations of animal populations and the measure of community*

stability". In this paper, the author refers to the stability and resilience concepts, but does not delimit the two concepts (MacArthur, 1995).

In 1973, the concept of resilience is also addressed by the ecologist Holling. The author considers that resilience is the persistence ability of the systems and their ability to absorb change and disturbance, while still maintaining the same relationships between the populations analyzed or the state variables (Holling, 1973, p.14).

Holling proposes two properties to define the behavior of ecological systems: stability and resilience. In the author's view, stability is the ability of the system to return to a state of equilibrium after being affected by a temporary disturbance. The faster it returns, having a smaller oscillation, the more stable it is. In this definition, stability is the property of the system, and the degree of oscillation around specific states is the result. In terms of resilience, the author believes that this determines the persistence of relationships in a system and is a measure of the system's ability to absorb changes in state variables and driving variables. A system may be very resilient but can present a large oscillation, i.e. low stability, or may have a high degree of stability but low resilience (Holling, 1973, p.17).

Recent studies show that resilience is applicable not only to ecosystems, but also to socio-economic systems. Thus, we mention the following researchers interested in the economic approach to the concept of resilience: the researchers Rose (Rose, 2009) and the researcher Engberg-Pedersen et. al (2008). The concept of resilience is also addressed in the field of behavioral psychology. Researchers Masten (1994) and Kaplan (1999), have the following opinion regarding the resilience of people: resilient people have the capacity for self-renewal and adaptation, while less resilient people degrade and are adversely affected by stressors.

To define the concept of resilience, we considered it necessary to make some clarifications regarding the effects of disturbances on the systems and to propose the conceptual family of resilience.

A system can be exposed to both internal disturbances, generated by its operation, and to external disturbances from the environment. There may be the following situations:

- the system can oppose the intrusion of external disturbances inside it through its membrane (the membrane must have certain properties to allow this);
- the system preserves its identity through a certain disturbance treatment procedure;
- the system accepts a predetermined form of change through a certain disturbance treatment procedure;
- the system accepts the change caused by disturbances.

By disturbance treatment we mean:

- avoiding disturbances by taking measures to avoid their impact (in the case of anticipated disturbances), or by avoiding disturbances by ad-hoc reactions (if the disturbances were not anticipated);
- effective treatment of disturbances: a) neutralization of disturbances by measures to counter them; b) reduction of disturbances through repair measures; c) disruption of disturbances by reorientation measures;
- exposure to disturbances in order to gain benefits from the effects produced by these.

To establish the conceptual family of resilience we propose the following characteristics of a system in relation to the effects produced by disturbances:

- the system memorizing capacity of the previous state produced by the disturbance (M);
- accumulability – accumulation of tension for change (A);

- rigidity – resistance to disturbances (R);
- elasticity – return of the system to the initial state after having passed into another state as a result of disturbance effects (E);
- plasticity (P);
- dissipation of the tension for change in the internal structure (D);
- structural reorganization (S);
- punctual alterations of identity (AI).

We next proposed the following composition of the conceptual family of resilience: stationarity, stability, sustainability, robustness, autopoiesis, inertia, homeostasis, antifragility.

Table 1. The conceptual family of resilience

	M	AI	A	R	E	P	D	S
Resilience								
Stationarity								
Stability								
Inertia								
Homeostasis								
Autopoiesis								
Robustness								
Sustainability								
Antifragility								

Source: autor's research

These concepts are defined as follows:

- *stationarity* is the property of a system to maintain constant the value of its defining parameter ;
- *stability* is the ability of a system to maintain the value of its defining parameter within a pre-accepted numerical interval;
- *sustainability* is the property of the system to maintain the value of its defining parameter in predetermined dimensional and temporal intervals, with the possibility to alter the identity in a punctual way;
- *robustness* is the ability of a system to maintain its structure through resistance to external disturbances;
- *autopoiesis* is the ability of the system to restore its initial conditions after the effect of external disturbances, through structural reorganization;
- *inertia* represents the ability of the system to preserve its structure, by integration of external disturbances and dissipation of their effect in its internal structure, accumulating tension for change up to a certain threshold;
- *homeostasis* is the property of a system to integrate external disturbances, dissipating their effects in its internal structure, within limits that allow it to preserve its identity.
- *antifragility* represents the ability of the system to gain more benefits than disadvantages due to external disturbances, having internal structures capable of obtaining these advantages. Antifragile systems are capable of seeking out disturbances and gaining advantages, if possible, not just avoiding, countering or treating disturbances.

Defining the concept of resilience

To define the concept of resilience, we first identified the sufficiency predicates of this concept. We noted with R the concept of resilience and $M(R)$ the set of the sufficiency predicates of resilience. We propose the following predicates of sufficiency for the concept of resilience:

- P_1 : capacity to memorize the state prior to the disturbance;
- P_2 : system elasticity – return of the system to its initial state after it has passed into another state due to the disturbance effects.

Logical analysis of the identified predicates

a) Independence analysis - it will be considered that neither of the two identified predicates is the logical result of the other predicate.

- P_1 and P_2 : P_1 does not result from P_2 and neither P_2 is the logical result of P_1 ;

b) Consistency analysis - it will be shown that the two identified sufficiency predicates are not contradictory.

- P_1 and P_2 : P_1 is not contradictory to P_2 and P_2 is not contradictory to P_1 ;

c) Completeness analysis

Regarding the completeness condition, the simultaneous relevance of the two sufficiency predicates identified for the concept of resilience is considered.

Following the logical analysis of the two identified predicates, it turns out that they fulfill the conditions of independence, consistency and completeness.

The logical expression of resilience has the following form:

$$M(R) = \{P_1, P_2\} \quad (1)$$

Or:

$$(P_1 \wedge P_2) \rightarrow R \quad (2)$$

Where: \wedge - symbol for logical conjunction.

As a result of the aspects presented above, we can define resilience as: *the capacity of a system to preserve its structure following disturbances, due to the presence of the elasticity capacity of the system.*

3. The concept of institutional resilience

The analysis of the resilience of socio-ecological systems largely depends on the institutional factors. In the analysis of resilience, in addition to the size of the shock faced by the system, the structure of the existing institutions plays an important role.

N. Taleb refers to antifragile institutions. The author considers that the current financial system has created a fragile context, and the reaction to combat this fragility is to create anti-fragile institutions, not robust institutions (Taleb, 2012).

Folke and Berkes believe that memory and social values play an important role in institutional resilience. The ability to adapt and self-regulate are also important features of institutional resilience (Folke and Berkes, 1998).

In most studies, the resilience analysis is based on the concept of social-ecological system, modeled as the interaction between the institutional and cultural arrangements of the society on the one hand, and its physical environment on the other hand.

In the academic literature, three components relevant to institutional resilience are proposed: responsiveness, adaptability and avoidance of slippery slopes. In terms of the responsiveness of society, resilience can be understood from the perspective of equilibrium. An ecological social system is resilient if it is able to successfully resist the sudden and unexpected changes of the environment. Researchers also refer to the "absorption capacity" (that is the size of shock that the system can cope with) or "the speed of recovery" from a specific shock (Walker, Holling et al., 2004). Both absorption capacity

and speed of recovery are related to the pre-existing situation, which is conceptualized as a state of equilibrium.

Defining the concept of institutional resilience

The sufficiency predicates identified for resilience will be customized for the institutional resilience concept. Which means that one or more additional sufficiency predicates will be introduced compared to the general case of the concept of resilience. The concept of institutional resilience was noted with RI , the set of sufficiency predicates for institutional resilience with $M(RI)$ and the set of additional sufficiency predicates with $M(PSRI)$.

The following additional sufficiency predicates for institutional resilience have been identified:

- $PSRI_1$: is designed by the cultural subject;
- $PSRI_2$: presents the ability to be transmitted intra-generationally and inter-generationally through the behavior generated by the respective institution or/and by the persistence of the norm that imposes it.

The logical analysis of the identified additional predicates implies the analysis of their independence, consistency and completeness. Neither of the two sufficiency predicates is the logical result of the other sufficiency predicate and at the same time it does not contradict the other predicate of sufficiency. The two additional sufficiency predicates are simultaneously relevant to the concept of institutional resilience.

To define the concept of institutional resilience, we performed the logical analysis of the two sufficiency predicates identified for the resilience concept and of the two additional sufficiency predicates identified for the institutional resilience concept. Thus, we logically analyzed six possible cases (C_4^2) from the perspective of the conditions of independence, consistency and completeness.

Logical analysis of the identified predicates

a) Independence analysis:

- P_1 and P_2 : it was shown in the logical analysis of the sufficiency predicates identified for the concept of resilience;
- P_1 and $PSRI_1$: the ability of the system to memorize the state before the disturbance occurs is not the logical result of the fact that the institution is designed by the cultural subject and neither $PSRI_1$ is the logical result of P_1 ;
- P_1 and $PSRI_2$: P_1 is not the logical result of $PSRI_2$ and neither $PSRI_2$ is the logical result of P_1 ;
- P_2 and $PSRI_1$: P_2 is not the logical result of $PSRI_1$ and neither $PSRI_1$ is the logical result of P_2 ;
- P_2 and $PSRI_2$: P_2 is not the logical result of $PSRI_2$ and neither $PSRI_2$ is the logical result of P_2 ;
- $PSRI_1$ and $PSRI_2$: it was shown in the logical analysis of the additional sufficiency predicates.

b) Consistency analysis:

- P_1 and P_2 : it was shown in the logical analysis of the sufficiency predicates identified for the concept of resilience;
- P_1 and $PSRI_1$: the ability of the system to memorize the state before the disturbance occurs is not contradictory to the fact that the institution is designed by the cultural subject and neither $PSRI_1$ is contradictory to P_1 ;
- P_1 and $PSRI_2$: P_1 is not contradictory to $PSRI_2$ and $PSRI_2$ is not contradictory to P_1 ;
- P_2 and $PSRI_1$: P_2 is not contradictory to $PSRI_1$ and $PSRI_1$ is not contradictory to P_2 ;

- P_2 and $PSRI_2$: P_2 is not contradictory to $PSRI_2$ and neither $PRIS_2$ is contradictory to P_2 ;
 - $PSRI_1$ and $PSRI_2$: it was shown in the logical analysis of the additional sufficiency predicates.
- c) Completeness analysis

As regards the condition of completeness, we notice the simultaneous relevance of the four predicates of sufficiency for the concept of institutional resilience. Therefore, completely verifying the predicates identified by some entity gives it the qualification of institutional resilience.

From the formal point of view, the following logical expression of institutional resilience can be written:

$$M(RI) = \{P_1, P_2, PSRI_1, PSRI_2\} \quad (3)$$

Or:

$$(P_1 \wedge P_2 \wedge PSRI_1 \wedge PSRI_2) \rightarrow RI \quad (4)$$

Where: \wedge - symbol for logical conjunction.

As a result of the aspects presented above, we can define the institutional resilience as: *the capacity of a system to preserve its structure following disturbances, due to the presence of its elasticity capacity, the system being designed by the cultural subject and presenting the capacity of intra-generational and inter-generational transmission through the behavior generated by the respective institution or/and by the persistence of the norm that imposes it.*

4. Conclusions

The concept of resilience has been a concern for many specialists in various fields, and comprehensive studies have been carried out to clarify this concept. An important role in the analysis of the resilience of the systems is played by the size of the shock that the system is facing, and also by the structure of the existing institutions. To create resilient systems, resilient institutions are needed.

The main contribution of this paper is defining the concept of institutional resilience from a logical perspective. In order to define this concept it was first necessary to clarify the concept of resilience. To define the two concepts, the sufficiency predicates (two sufficiency predicates for resilience) and the additional sufficiency predicates (two predicates of additional sufficiency for institutional resilience) were identified, and their logical analysis was performed. Another contribution of the paper is the logical formalization of the two concepts. A novelty element of this study is the proposal of the conceptual family of resilience.

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