

Review: In the complex epoch is sustainability “out” resilience “in”?

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Abstract

The scientific literature since 2000s shows that sustainability definitions have been evolving by fascinating new notions. The main concern of sustainability which is to preserve resources from generation to generation is always an indispensable approach for systems stability, however it has to be questioned if sustainability can still maintain stability when there comes an unexpected condition. In this case, often, the concept is coupled with resilience. Resilience stresses a new way of thinking by providing the uncertainty and dynamism based perspective and guiding in terms of orientation in the face of uncertainties. Even if there is an increasing attention in literature to address the “sustainability-resilience relation”, there is not a clear unique scheme about how to bind two concepts.

Based on this realization, this paper aims to address what has to be clarified to draw attention to the link between resilience and sustainability through in-depth literature review, focusing on the basic attributes of sustainability which have to be continuously updated in this complex unpredictable epoch and the basic attributes of resilience which provides this required upgrade. It can be summarized that the paper fundamentally; 1. emphasizes the fact that sustainability has to be updated and upgraded considering uncertainty based challenges; 2. points out that the main argument between sustainability and resilience is the passage from stability to dynamism; 3. highlights the connection between resilience and sustainability through the relation between the principal attributes of two concepts; 4. underlines that resilience helps to rearrange the basic principles of sustainability.

Keywords

Attributes of resilience, Attributes of sustainability, Dynamism, Stability.



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1. Introduction

In 1987, the World Commission on Environment and Development attempted to draw up the concept of “sustainability” as the conflicts arose between environment and development ends. Commission’s definition of sustainability emphasizes three key concepts as needs, development and the provision of equity among generations. Those components support sustainability in a normative concept by referring to the necessity to live within our economic, ecological or social means to obtain inter and intra-generational justice. The core idea of sustainability is to keep desirable systems’ stability for long term. Although sustainability became popular after the World Conference on Environment and Development in 1987, from sustainable development perspective, somehow, it has been under discussion since 1960s depending on the basic aim of development. In 1960s and 1970s, the core aim was the provision of the economic growth and development which could be evaluated as “early community development”. This perspective was supporting the idea of studying environment, society and economy as separate disciplines. Then in 1980s and 1990s, especially after the Brundtland Report, “popular sustainability theory” has been adopted which mentions the links between environment, society and economy jointly. Moreover, by the early 1990s, more than 70 definitions of “sustainable development” were created (Elliott, 2006). In this period, sustainability related with the concept of “development” gained more attention. Therefore, “sustainable development” covered all the crucial concepts about sustainability. In 1992, the World Bank described sustainable development as a development that continues (World Development Report, 1992). From another perspective, as Doğru (2006) clarified, sustainability refers to infinity, constant revival and an unlimited system, while development infers change, growth, expansion, production and movement. Consequently, as those two concepts are used together, it means balancing economic and social conditions against environmental requirements such as resource conser-

vation and renewal for the future. On the other hand, according to Holling (2001) sustainability is the capacity to create, test, and maintain adaptive capability and development is the process of creating, testing, and maintaining opportunity. Subsequently, he interpreted sustainable development as the target to nurture adaptive capabilities and creating opportunities.

Another discussion came out in this period was the concept of “sustainable growth” which was often used as a synonym for sustainable development. However, there raises a division between sustainable growth and sustainable development. For instance, as Ulhøi and Henning (1999) pointed out, replacing development with growth creates confusion since nothing physical can grow indefinitely. Moreover, from another perspective, as Ulhøi and Henning (1999) quoted Goodland (1992) expressed quantitative growth doesn’t help to obtain sustainability and society can only hope to grow sustainably if the present trajectory can be changed to develop the path to sustainability.

Parallel to those interpretations, after 1990s, the “three pillar model” has been focused through the “ideal scientific model”, however, there was more emphasis on the dynamism and complexity arguments (Elliott, 2006; Allen & Ervin, 2007) (Figure 1.).

It is clear that this transition of sustainability basically followed the devastating irreversible damages of the ecological systems and its relation between social, economic issues. Furthermore, in the report of UN “Planning Sustainable Cities” (2009), the environmental challenges are listed as the first factors shaping 21st century. Jeanrenaud (2007) presents the results of the IUCN (The World Conservation Union) e-discussion (entitled “*The Future of Sustainability: Have Your Say! (2006)*” hosting 460 registered participants from over 70 countries) as the traditional three pillar model of sustainability should refer to new models that theorize ecosystems by means of the foundation stone or life support systems of the economy and society.

Autin and Holbrook (2012) quote Crutzen and Stoermer (2000) where

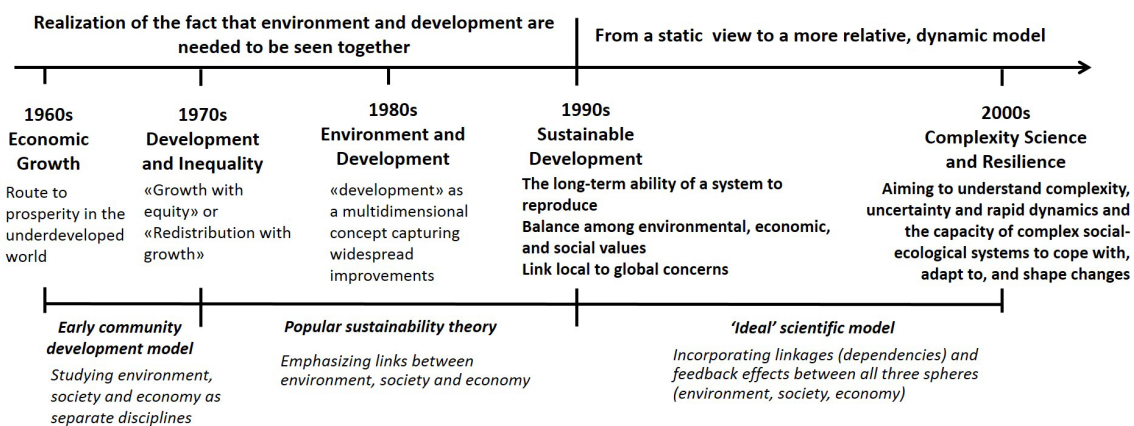


Figure 1. Changing concepts of sustainability¹.

they mention that modern technology launched the transformation of Earth-system behavior and reformed the environmental processes. This period of human domination to shape Earth called as “Anthropocene Era” and as Autin and Holbrook (2012) determine it forces us to deal with the consequences of turning the Earth system into an entirely new field driven by human actions. Thus in this period, it is not surprising that climate change, radical reductions of natural resources, species loss, poverty, migration or economic crisis exist and they are generating complex processes in multiple scales. However, those problems came out even if sustainability was already the main target for every aspect of life and it has risen expecting to provide the stability. Nevertheless, radical changes in the current trajectory are toughly needed. Since it is impossible to lock the systems in a steady state forever, or to manage it for stability and security in a command-and-control fashion (Folke et al., 2003), this long term stability content of sustainability is insufficient in the face of uncertainty (Cascio, 2009) or in the form of Anthropocene Era. As Novotny et al. (2010) also mentioned, there is the rising role of change, dynamics and uncertainty play in sustainability as a different perception. In this sense, is it proper to say that sustainability is an old-fashioned concept? Does it lose its focus/importance because it doesn't address today's complex challenges? Or should it be replaced with another paradigm? Certainly sustainability is never old-fashioned or it never loses its importance since it is a term referring

to the maintenance of basic resources for future generations equally which supports the continuity of life.

The key issue to discuss here should be whether maintaining sustainability based on the primary idea to preserve resources from generation to generation is still sufficient considering the global challenges. Namely, the question that has to be answered is what sustainability doesn't address or what it should refer in this epoch.

From this point of view, so as Holling (2001) explains, it is crucial to be dynamic and prescriptive rather than static and descriptive to embrace uncertainty and unpredictability since surprise and structural change are inevitable in systems of people and nature as well. Parallel to this definition, Berke and Conroy (2000) updated the definition of “sustainability” as it should “refer to a dynamic process in which communities anticipate and accommodate the needs of current and future generations in ways that reproduce and balance local social, economic, and ecological systems, and link local actions to global concerns”. The Millennium Ecosystem Assessment (2003) also portrayed sustainability as a process and suggests paying more attention to issues such as robustness, vulnerability, resilience, risk and uncertainty, which will determine the ability of a system to adapt to and take advantage from the change. Therefore, there rises the necessity to manage the provision of continuity and dynamics in change paved the path to resilience. Berkes et al. (2003) define resilience as a concept which requires an active adaptation to change by responding to it, creating

¹Developed from WCED, 1987; Berke and Conroy, 2000; Elliott, 2006; Allen and Ervin, 2007; Lang, 2011; Powell, 2012; Yaman-Galantini and Tezer, 2014.

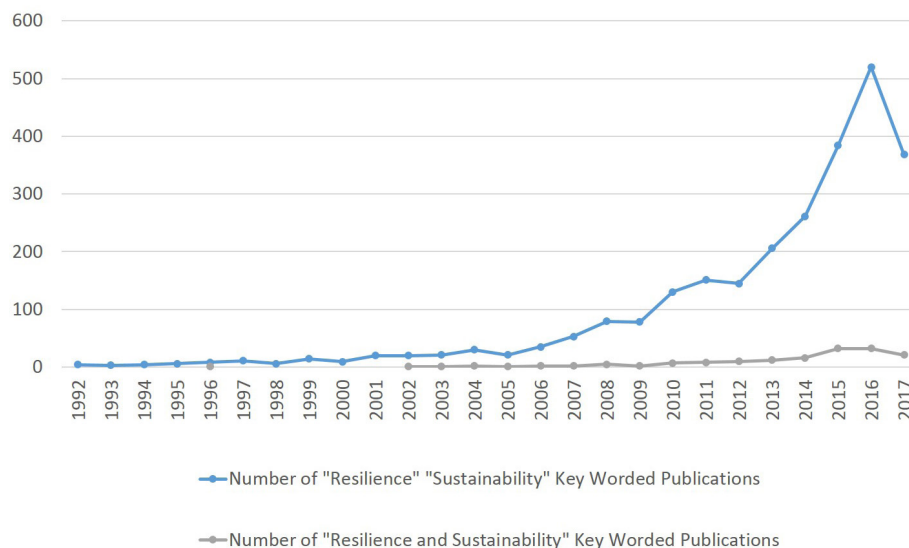


Figure 2. “Sustainability” “Resilience”; “Sustainability and Resilience” key worded publications.

and shaping it. So now, is sustainability out and resilience in?

Resilience thinking has been increasingly infusing sustainability debates and it has become a central discussion in urban related issues since 1970s starting with ecological concerns and it seems to have become the new catchword of our times (Müller, 2010) to understand how to address the challenges of the dynamic world where change and crisis are inevitable. At the 2002 World Summit on Sustainable Development in Johannesburg, resilience was discussed firstly in the context of global environmental change as a companion of sustainability (Olazabal et al., 2012). The main assertion that have been discussed was sustainability and resilience both follow the preventive principles of resource use and emerging risks, avoidance of vulnerability and the enhancing ecological integrity into the future (Olazabal, 2010). Since then, resilience studies have been appearing in the sustainability debates and becoming an issue for comparison and contribution. Thomson Reuters Web of Science Data Base shows that “Sustainability”, “Resilience” and “Sustainability and Resilience” key worded publications have been increasing especially in the last ten years (Figure 2).

The “Sustainability and Resilience” key worded publications in Thomson Reuters Web of Knowledge Data Base are basically about climate change, governance, infrastructure or ecology.

There are two prominent publications in this list (Ahern, 2011 and Redman, 2014). Ahern (2011) defines resilience as a possible solution for sustainability’s stability paradox and he proposes urban planning and design strategies for building urban resilience as well as emphasizing the necessity of innovation and inter/trans disciplinary research for resilience and sustainability. In the meanwhile, Redman (2014) suggests three areas of research to pursue resilience and sustainability which are the extent to control outcomes of system change, stakeholder incorporation and community input, and integration of lessons of the past and diverse cultural traditions into future problem-solving approaches.

Besides, among the other discussions in literature about the relationship between resilience and sustainability, the most remarkable are; Perrings (2006) quoted Levin et al. (1998) reported that resilience is the preferred way to think about sustainability in social as well as natural systems. Additionally, he assesses that basically resilience and sustainability are equivalent. Holling and Walker (2003) showed how a resilient socio-ecological system is synonymous with a region that is ecologically, economically, and socially sustainable, while Lélé (1998) stated that resilience is one of the contributing concepts of sustainability, but on the other side, emphasizing sustainability as a broader concept. On the other hand, Holling

Table 1. Comparison between sustainability and resilience.

Main argument		List of authors
Sustainability as a broader term	Resilience is the indicator/subset/attribute of sustainability	Pearce et al., 1996 Lélé, 1998 López-Ridaur et al., 2002 Bastianoni et al., 2004 Tainter, 2006 Stirling, 2007; 2008 Mortimer, 2010 Colucci, 2012 Moore, 2013
	Sustainability is still the overall aim	
Resilience as a broader term	Resilience is a necessary precondition/ key concept for sustainability	Holling, 1973 Wildavsky, 1988 Holling, 2004 Fiksel, 2006 Lebel et al., 2006 Walker and Salt, 2006 Callaghan and Colton, 2008 Adger, 2000 Thapa et al., 2010 Novotny et al., 2010 Ahern, 2011 Pierce et al., 2011 Christmann et al., 2012 MacKinnon and Derickson, 2012 Crowe and Foley, 2013
	Resilience is more comprehensive	
Equivalence of the terms	Both terms are almost same	Levin et al., 1998 Perrings, 2006 Du Plessis, 2009
	They are interchangeable	

(1973) claimed that resilience should be a more laudable goal and Pierce et al. (2011) described resilience as a major theoretical contribution to the understanding of the sources of sustainability. As it is seen, there is not a clear consensus on how to relate sustainability and resilience. Derissen et al. (2010) actually evaluate this incongruity with the assessments that: resilience of the system is both necessary and sufficient for sustainable development; resilience of the system is sufficient, but not necessary; resilience of the system is necessary, but not sufficient; and resilience of the system is neither necessary nor sufficient for sustainable development.

Table 1 classifies the different approaches about the relation between sustainability and resilience into three groups as; 1. sustainability is the overall aim so resilience is sustainability's subset, 2. resilience is a more comprehensive concept and it is necessary precondition/key concept for sustainability, 3. both terms comprehend almost the same meaning and they can be used interchangeably.

Besides the emphasis on the relation between resilience and sustainability, there is also a literature on the sustainability concept, more about its weakness, disappointments, insufficiency and the necessity of its upgrade especially in the face of unexpected changes. For instance, Von Detten (2011) quoted Brand and Fürst (2002)

mentions the limited ability of sustainability as a guiding principle since it doesn't provide clear problem analysis and management. Furthermore Hultman (2012) explains that sustainability is a useful principle, however, it is inadequate to face the future global challenges which requires to understand how the world has changed since 1992 Earth Summit. Even if early clarifications of sustainability intended to transform from an existing unsustainable state to a sustainable state through specific rules and then to reach an optimal state, such an optimal state can't be seen as a stable state allowing no additional change (Du Plessis, 2009). Considering the complexity of this era, it is not sufficient to obtain an optimal state, however, not to resist or adapt to change. Correspondingly, Sneddon et al. (2006) describe that since Brundtland, the world has changed due to the unexpected changes which were hard to identify at the time of Our Common Future was produced. In this sense, sustainability has to convert into a dynamic perspective and update with resilience concept. From this point of view, the basic reasons why sustainability has to be enhanced with resilience can be grouped as shown in Figure 3.

First reason why it is declared that sustainability has to be updated was because of the fact that it "lacks dynamism". It is a fact that this period is particularly uncertain, complex and it

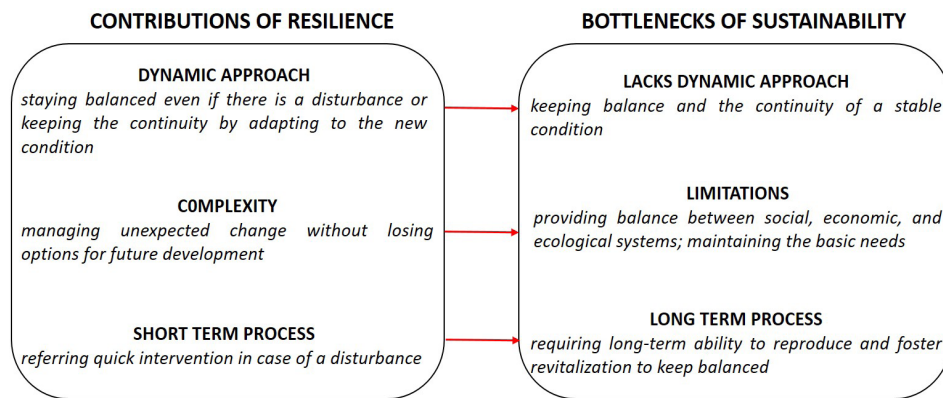


Figure 3. Potentials of resilience to upgrade bottlenecks of sustainability.

requires dynamism. From sustainability point of view, the main responsibility is to maintain the ability for future generations to meet their own needs. If it is not possible to anticipate the future needs, it is required to determine whether or not those needs are compromised for future generations (Egger, 2006). In this sense, as Flint (2004) expresses, sustainability needs to follow an evolving process which it evaluates the current and emerging trends. Moreover, it is essential to keep in mind the social-ecological systems as integrated systems in which their domains are strongly inter-linked and they are complex adaptive systems (Thapa et al., 2010). Consequently, considering the complexity, dynamics and nonlinear nature of these systems, sustainability should not be a steady-state. Therefore, achieving sustainability necessitates the dynamism notion of resilient systems.

The second reason of the sustainability's compulsion to be updated is the fact that sustainability refers to more concrete and clear notions; such as the "limitations" or the "balance" issues. Sustainability has an important aspect of satisfaction of basic needs and for that, it refers to limitations and balance state. Sustainability considers that natural resources are restricted and in order to avoid the results of the depletion of them, it has to draw limitations. Accordingly, Ciegis et al. (2009) indicate that sustainability specifies the restraints applied to resources of the existing capabilities of absorbing the effects of human activity. Additionally, another core element is balance. Along with the limitations, the fact that sus-

tainability suggests keeping the balance of resource production and consumption is also crucial. In addition to this, balance has to be constructed to bridge the gap between economy and environment. Thus, to do so, as Callaghan and Colton (2008) mention, sustainable systems are in balance within themselves and the systems they are surrounded. Consequently, as Gallopín (2003) emphasized, sustainability can't be regulated by reference to constant limits and the idea of balance between the various dimensions.

The third reason is the fact that sustainability refers to a long term process. Berke and Conroy (2000) quoted Campbell (1996) imply "the long-term ability of a system to reproduce" by means of a fostering of revitalization as one of the characteristics of sustainability concept. Hence, identifying the needs, improving the conditions for equitably distribution and shaping future development needs a long term process. However, as Van der Leeuw and Aschan-Leygonie (2005) suggest, this long term process proposes an overall change in traditional approaches at all levels of most societies. This is indeed challenging and also taking into account the principal argument of this era which is related with the capability of the current global system to face the recent complex and vastly interconnected problems, discussing how to address them in a short term becomes inevitable.

Brundtland Report (1987) was proposing "the provision of needs, development and inter and intra-generational equity-justice in terms of resource maintenance" as the main characteris-

tics of sustainability based on linearity in a stable/equilibrium state. It is clear that, today those features should be updated based on non-linearity. Therefore, sustainability should be updated and upgraded based on today's "needs", "development" and "equity" approaches with notion of resilience.

Briefly the literature reviews so far have proved the fact that resilience is somehow associated with sustainability and vice versa, however, they are not the same. Nonetheless what is missing and has to be clarified in order to point out the connection between resilience and sustainability should be the relation between the attributes of the concepts which is the principal goal of this paper. From this viewpoint, the following parts aim to analyse resilience to understand and interpret its basic attributes and to clarify how resilience can contribute to what sustainability doesn't address in this complex epoch through the evaluation of the basic attributes.

2. Understanding resilience:

Conceptual analysis

The College Dictionary (1975) and The Oxford English Dictionary define resilience as the ability 1. to return to the original form or position after being bent, compressed or stretched; elasticity, and 2. to recover readily from illness, depression, adversity, or the like; buoyancy (Schroll et al., 2009; Blackmore and Plant, 2008; Klein et al., 2003). However, resilience is an old rooted word. Originally, the etymology of the word "resilience" is rooted in the Latin words (Alexander, 2013) "resilire", "resalire", "resilio", meaning to jump back, rebound, walk or leap back and bounce back (Klein et al., 2003; Manyena, 2006; Gunderson, 2009; Rose, 2009).

It is crucial to emphasize that the origins of resilience explained broadly by Alexander (2013) is fundamental, because it considers how mechanics passed the word to ecology and psychology and how from there it was adopted by social research and sustainability science. The paper titled "*Resilience and disaster risk reduction: an etymological journey*" by Alexander (2013) explained that the first known

dictionary definition of resilience comes from the Glossographia compiled by the lawyer and antiquarian Thomas Blount (1618–79) with a dual meaning: to rebound and to go back on one's word (as in resilement, an obsolete derivative). Sir Francis Bacon did the first known scientific use of resilience in English during the period 1616–26.

In the first half of the 19th century, resilience was still used in the sense of rebounding and significantly from 1839 the term was used to signify the ability to recover from adversity, in the sense of strength. In the city of Shimoda, southwest of Tokyo, after two major seismic catastrophes in December 1854, resilience was used in the sense of the ability to withstand the effects of earthquakes. Then the first serious use of the term resilience in mechanics appeared in 1858 (Alexander, 2013). The so called "engineering resilience" was in fact too narrow and as Pisano (2012) explained it was focusing on maintaining efficiency of function, constancy of the system and a predictable world near a single steady state. Then later, further applications of the term were being made in coronary surgery, anatomy and watchmaking in this period (Alexander, 2013).

The term resilience started to be used in psychology in the 1950s and it finally became popular in this field in the late 1980s. The transition from natural ecology to human ecology (i.e. social sciences) dates back to the end of 1990s (Alexander, 2013). Following the 1973 release of Holling's seminal work, entitled "*Resilience and Stability of Ecological Systems*", as Manyena (2006) mentioned, resilience gained currency in the sphere of ecology. C.S. Holling defined resilience as "*a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables*" (Holling, 1973). This period can also be interpreted as the rise of resilience in urban related issues.

In 1986, Holling defined resilience as "*the ability of a system to maintain its structure and patterns of behavior in the face of disturbance*" (Holling, 1986). Then Holling improved this definition

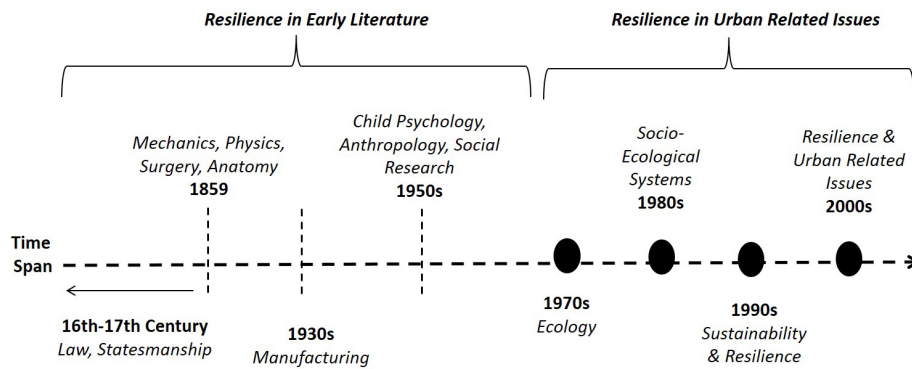


Figure 4. Resilience in literature (Yaman-Galantini & Tezer, 2014).

in “*Barriers and Bridges to the Renewal of Ecosystems and Institutions*” in 1995, stating that resilience is the buffer capacity or the ability of a system to absorb perturbations or the magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables and processes that control behavior (Holling, 1995; Pisano, 2012).

Moreover, in 1990s, literature on social-ecological resilience as related to communities began to appear and resilience has since been applied to local-level systems as well as other spatial and temporal domains (Powell, 2012). Moreover, in 1990s several scholars adopted this approach as an important tool to measure sustainability (Levin et al., 1998; Brand & Jax, 2007; Yaman & Tezer, 2012). Therefore, likewise Mitchell et al. (2014) quoted Duit et al. (2010) suggest, contemporary resilience thinking is breaking free from its ecological roots and is incorporating perspectives offered by the social sciences. At this point, resilience is defined through ecological, social, socio-ecological, spatial and economic perspectives. “Ecological resilience” is related to the development of territorial systems (Colucci, 2012) and “social resilience” is the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change (Abesamis et al., 2006; Adger, 2000; Keck & Sakdapolrak, 2013). In the meanwhile, “social-ecological resilience” evaluates people and nature as interdependent systems (Folke et al., 2010). “Economic resilience” refers to the policy-induced ability of an economy to recover from or adjust

to the negative impacts of adverse exogenous shocks and to benefit from positive shocks (Briguglio et al., 2008). Finally, “spatial resilience” refers to the provision of infrastructural necessities for built structures including property, buildings and transportation systems (Gibberd, 2011). Eventually all these perspectives relate to the different aspects of “urban resilience”.

Considering “urban resilience” literature, Ernston et al. (2009) identified the distinction between “resilience in cities” and “resilience of cities”. “Resilience in cities” addresses the continuity of ecosystem services in cities provided by locally and regionally; on the other “resilience of cities” means the functioning of cities which is a concept borrowed from geography meaning as a set of cities linked with each other through relations of exchange in the form of trade, migration or others that sustain the flow of energy, matter and information among them. Additionally, Gleeson (2008) suggests the “resilient urbanism” via three principal branches; 1. the acceptance of the inevitability of evolution and the necessity of adaptation, 2. composition of activities for urban well-being and 3. promoting equity. Respectively, cities and regions are supposed to adapt into multi-purpose planning and design strategies as well as to be able to foresee the economic, social, and physical stresses that they may face in order to become more resilient (Müller, 2010). To sum up, since 16th century, resilience has been absorbing new perspectives and it has become a broader theoretical framework through years (Figure 4).

Accordingly, as Pisano (2012) ex-

plained, it is inevitable to explain resilience as “systems thinking”, for the reason that it covers the systems of humans and nature, so called, social-ecological systems as a whole. At this point, Walker and Salt (2006) identify three concepts to keep in mind while considering the alignment with resilience and systems thinking as;

1. social systems are inseparably linked with the ecological systems,
2. social-ecological systems are complex adaptive systems which can change unpredictably and
3. resilience provides a framework to consider social-ecological systems as one system functioning over many related scales of time and space.

Additionally, it has to be emphasized that resilience has a positive perception since it refers to recover from hardship immediately, adapt to unexpected changes, respond to a widespread sense of uncertainty and find formulas for adaptation and survival (Müller, 2010). Moreover, as Pendall et al. (2010) define it is a dynamic feature associated with a process of continual adjustment. Today even though resilience has many definitions based on different perspectives, most usually it is defined as; (1) *the amount of disturbance a system can absorb and still remain within the same state or domain of attraction*; (2) *the degree to which the system is capable of self-organization*; and (3) *the ability to build and increase the capacity for learning and adaptation* (e.g. Carpenter et al., 2001; Folke et al., 2002; Berkes et al., 2003; Armitage & Johnson, 2006; Tidball & Krasny, 2007; CSIRO, 2007; Schroll et al., 2009).

This common definition is surely related to the “adaptive cycle” which is introduced as “panarchy” by Gunderson and Holling (2002). It suggests the necessity to understand the characteristics of systems and the interdependencies between different components of systems in every scale; know how to respond in the face of change; learn lessons from the experiences and, anticipate potential threats and their consequences repetitively. From this point of view, that is to say, resilience introduces knowing what to do; knowing what to look for; knowing what

has happened, knowing what to expect (Hollnagel, 2014) and knowing how to provide what is needed in a specific time, place and case, especially during times of crises and uncertainty.

Under the light of literature assessments, resilience concept can be defined as a dynamic process indicating to a process-oriented and non-linear “state”. It means that, resilience has a perspective of systems stability in terms of regaining its functionality. This view includes constant stability/linearity of systems through the continual response to the disturbances. Therefore, the fundamental characteristics of resilience that has to be stressed can be called “*dynamic and non-equilibrium*” perspective, raising the notion of managing and adjusting to the unexpected changes, uncertainties and challenges continuously. Since it is obvious that changes are unavoidable in both goals and methods of the development concept, with this regard, resilience adds a new and a required perspective to the concept of development which helps to guide to orient in the face of uncertainties. This “dynamic” character is the sine qua non crucial aspect of resilience creating the greatest difference from the concept of sustainability which assumes a static view of the future: the obligatory passage from stability to dynamism approach in this era. That is to say resilience acknowledges the “dynamism” that sustainability doesn’t.

Literature supports this argument with several references such as Tainter (2006) expresses sustainability which proposes the balance and the continuity of a stable condition or Cascio (2009) asserts sustainability as inherently static and it prevents a probable disturbance, but continues to be on the cliff till the next threat. Therefore, it means sustainability is about survival and it points out a fragile stable state that any threat can simply cause its collapse. Hence in this concern learning to live within limits is the solution. As a result, the most important deficiency of sustainability has to be interpreted as it lacks the dynamic and non-equilibrium perspective, ever since it used to be a concept proposing durability and stability. Thus, it generates the debate about the reliability and rational-

ity of a stable system's sustainability in the context of unexpected disturbances and changes.

Actually, it is not possible to avoid considering a new agenda for this new era which has to focus on how to maintain sustainability while ignoring uncertainties and complexity. Brundtland Report (1987) was proposing "the provision of needs, development and inter and intra-generational equity-justice in terms of resource maintenance" as the main characteristics of sustainability based on linearity in a stable/equilibrium state. Today those features are updated based on non-linearity. Therefore, sustainability should be updated and upgraded based on today's "needs", "development" and "equity" approaches under the viewpoint of resilience. To survive is the overall target for the provision and the right to reach basic needs for today and for the future are still the fundamental aspirations, yet the capacity to manage "how" to maintain this long term vision has to be resolved through resilience understanding. From this perspective, paper offers that resilience which promises more than survival should accompany sustainability to broaden "needs", "development" and "equity" attributes and to upgrade its scope through its "*dynamic and non-equilibrium*" view.

In this sense, surely some basic attributes related to this need to be mentioned. In literature many publications define the resilience attributes (e.g. Folke et al., 2002; Bruneau et al., 2003; Fiksel, 2003; Walker et al., 2004; Walker & Salt, 2006; Birkmann et al., 2012) however, they don't provide an expansion about how those attributes are coupled with sustainability. The important aspect here is to clarify how sustainability has to be defined involving a dynamic perspective which is parallel with the evolution of the needs and development tendencies. So, herein which attributes of resilience be can rearranged from the basic principles of sustainability in order to provide not only the maintenance of basic needs but also the transmission of them? The key issue is to meet the sustainability attributes while providing the response for uncertainties.

In this sense, first and foremost, as

Bagheri and Hjorth (2007) mention, it has to be considered that the process of a continuous adaptive learning and the possibility to initiate new development trajectories addressing changing conditions are the basic obligations. Subsequently, it is not possible to mention any best state, a stable equilibrium, or an optimal development path in an evolutionary system accompanying continual development. Consequently, it can be subtracted that, the basic attributes of resilience to provide the required appraisal of sustainability should refer to a continuous process of learning, adapting and adjusting. This condition gives the "dynamism" to sustainability or as Novotny et al. (2010) also express, this makes it "inherently moving target" accounting for a process of persistent improvement.

3. Discussion: Is sustainability out resilience in?-How to bind

"Change he called a pathway up and down, and this determines the birth of the world."

"Everything changes and nothing stands still."

Heraclitus (535 BC – 475 BC)

The Brundtland Report established the essential grounds for future's development and today those grounds need to be transformed based on uncertainty. The target to save the planet, accomplish fairness, equity and human rights as well as ending poverty and enhancing economic development are still hot issues. However, the conditions that paved the path to take these decisions as the main goal are already different and more diverse after almost thirty years. 21st century as regards to sustainability is surely more complicated, demanding and uncertain; but also there are more varied methods in developing new concepts and tools. Therefore, considering the changing community dynamics and development paths, there has to be a new interpretation for the overall progress in every facet of sustainable life. So, in this complex epoch what needs to be considered is to conceive the characteristics and needs of the systems; learn the possible action to respond any disturbance, and learn from the experiences. Then sustainability should evolve while adding

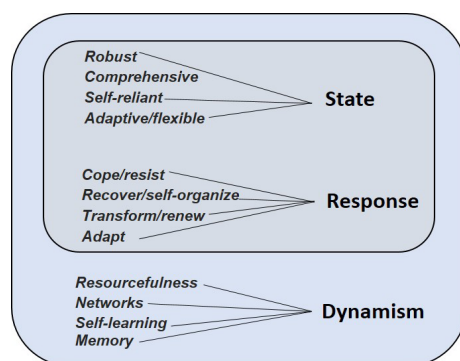


Figure 5. Prominent attributes of resilience and their content².

new features to integrate new notions. This is exactly related with the rationality of resilience particularly during times of crises and uncertainty. In this respect, resilience can address sustainability as a dynamic and multi-dimensional concept which raises the notion of the capacity to manage change constantly through understanding complex, unexpected and rapid dynamics, strengthening the response capacity and enhancing for learning, adapting and surviving. This actually shows the passage from static, equilibrium perspective toward a dynamic, non-equilibrium one.

In this sense, it is crucial to define the attributes of resilience both to identify its main dynamism/non-equilibrium related characteristics and to relate it with sustainability. Resilience is a positive concept addressing uncertainty, so, the attributes of resilience should support the capacity to manage change, respond to unexpected threats and surprises both from stability and dynamism point of view. Considering this two-fold character, the paper suggests three categories of resilience attributes which are “State” (the properties which explains what makes a system resilient); “Response” (the properties which refer to the actions oriented to a resilient state) and “Dynamism” (the attributes that a resilient system should generate against unexpected changes) (Figure 5).

From this point of view, these attributes of resilience can be emphasized to bind it with the three important features of sustainability: needs, development and equity in terms of resource maintenance (Table 2). “State” category of resilience attributes is composed

of the properties which explain what makes a system resilient. This can be interpreted both as a static or dynamic aspect. Developing the conditions to create a “resilient state” gets more and more significant, both in terms of functionality and reorganization of components within a system in response to stimulate new opportunities for development, along with the satisfaction of “basic needs” and efficient use of resources. The basic characteristics of a resilient state are summarized as “robust, comprehensive, self-reliant and adaptive/flexible”. Considering those characteristics of resilient state, “robustness” means sustaining and enhancing the capacity of systems by “resisting and coping” with uncertainties and surprises. A robust system is able to fight against the vulnerabilities, which bring about the capability to “recover/self-organize” or “adapt” in the unexpected circumstances. Moreover, “comprehensiveness” creates multi-functionality fostering innovation, diversity and redundancy, which provides to comply the responsibility and refers to “self-organization”. This also allow the system to “recover or transform” during unexpected circumstances. Furthermore, in “self-reliant” systems, there is satisfaction of basic needs, cross-scale interactions and efficient use of resources over time for “recovery”. Self-reliant systems meet their needs through extensive interactions between their components. Therefore, they have the competence to “cope, self-organize and adapt” in case of unexpected circumstances. Finally, “adaptive/flexible” systems can build capacity to “adapt” successfully the adversity or change. In adaptive/flexible systems, the effectiveness of capacity building helps to “transform” the system or “adapt” to the changing conditions and provide “recovery and self-organization” is achievable.

With this regard, resilient state provides the path for “resilient response” in order to manage change, create new development trajectories, maintain system functions and deliver the basic needs. This attribute category emphasizes the dynamic character more. The basic features of a resilient response are summarized as “cope/resist, recover/

²Developed from Maguire & Cartwright, 2008; Plodinec, 2009; Folke, 2006; Folke et al., 2002; Gunderson & Holling, 2002; Berkes et al., 2003; Gunderson et al., 2006; Bruneau et al., 2003; Fiksel, 2003; Walker & Salt, 2006; Walker et al., 2004; Powell, 2012; Folke et al., 2003; Newton & Bai, 2008; Lebel et al., 2006; Chuvarayan et al., 2006; Deppisch, 2012; Lu & Stead, 2013; Birkmann et al., 2012; Godschalk, 2003; Zautra et al., 2008; Surjan et al., 2011.

Table 2. Comparative assessment of resilience and sustainability.

SUSTAINABILITY			RESILIENCE			
Main concern	Survival by desirable systems stability and equilibrium		Survival by systems dynamic and non-equilibrium view			Main concern
Main attributes	Needs	Provision of basic needs	Capacity to provide basic needs in the turbulent environment		Robust Comprehensive Self-reliant Adaptive/flexible	Main attributes
			Sustaining systems functions and survival for long term			
	Equity	Maintaining right to reach basic resources for everybody	Adapting to crises, responding flexibly or transforming		Cope/resist Recover/self-organize Transform/renew Adapt	
			Capacity to respond and adjust to internal/external change to maintain equilibrium and equity			
	Development	Provision of intergenerational justice to reach basic resources	Developing new responses		Resourcefulness Networks Self-learning Memory	
			Knowing how to provide what is needed in a specific time, place and case			
Preserving knowledge and information						

self-organize, transform/renew and adapt". Resilient response is essential because it addresses such an intergenerational feature in terms of sustaining and enhancing the capacity of systems in the face of surprises. Here, it is necessary to stress two prominent attributes, which are to adapt and to transform/renew. Because, adapting maintains the system adjustment to changing conditions in a way that upholds essential system functioning (Redman, 2014), while, transforming is a radical reorganization of the systems reconfiguring it through a new set of dynamics. This can provide the conditions for "equity" in terms of the fact that fairness for all people to have access to all kinds of community resources has to be provided and maintained in needs and development strategies in the face of change.

On the other hand, likewise Brunetta and Baglione (2012) explain resilience guarantees future by absorbing present disturbances and looking back, "dynamism" should be an indispensable attribute category comprehending both the state and the response attribute categories. Accordingly, state and response categories can provide the input for this group of attributes. The basic characteristics can be listed as "resourcefulness, networks, self-learning and memory". Developing capacity to "identify problems, establish priorities, and mobilize resources when conditions exist that threaten to disrupt some element, system, or other unit of analysis" so called "resourcefulness" defined by Bruneau et al. (2003) gets more and

more noteworthy. "Networks" express systems that support functions by way of connectivity to prevent malfunction or failure of particular functions. "Self-learning" helps to bring together and incorporate different forms of knowledge (Colucci, 2012), whereas, "memory" helps to preserve knowledge and information which is a prerequisite for a systems ability to find their way back to its regular range after a disturbance (Chavarayan et al., 2006). Dynamism attributes of resilience can help to generate capacity to learn how to respond, to preserve and foster development paths. It prevents malfunction or failure of particular functions. From this point of view, considering the "development" component of sustainability, what has to come into prominence should be taking lessons from what has happened, what has been missing and what had to be done in order to enhance new development paths repetitively. Since nothing can stay stable, there is always necessity for maintaining systems sustainability and creating new development trajectories.

To conclude, the concept of sustainability blended with resilience is the pathway of the long-term persistence in this complex epoch. In this sense, certainly, it gets more important to distinguish sustainability from resilience rather than assume one more superior than the other. It can be summarized that resilience shifted sustainability from the early emphasis about how to accomplish and preserve stability, manage effectively resources, control change, pursue economic growth and

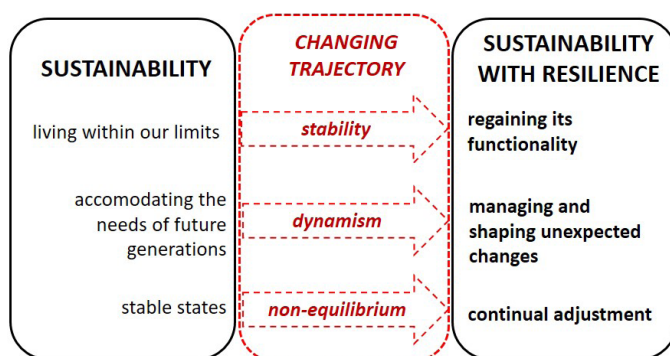


Figure 6. Contributions of resilience to sustainability.

increased human wellbeing, to how to deal with changes, disturbances and uncertainties (Berkes 2007; Ahern 2011; Xu, Marinova & Guo, 2014). With this regard, we come up with the result that resilience concept comprehends the necessary update for the sustainability concept.

4. Conclusion

Humanity needs endurance and today to preserve the endurance it is compulsory to adjust to changing conditions. Sustainability is not old fashioned and it is not “out”; however, it has to be transformative. The “stable” character of the concept is lacking considering the uncertain and unexpected challenges of this complex era. The “dynamic” character of resilience substitutes this missing part. Subsequently the basic arguments of the paper and the contributions of resilience to sustainability are listed in Figure 6.

As Christmann et al. (2012) also emphasized, thinking of sustainability without reference to the notion of resilience or thinking a conception of resilience without referring to sustainability would lack a long-term, future-oriented perspective. Clearly resilience is effective, under its uncertainty and dynamism based perspective, as a crucial tool for today’s development needs, not the least as a comprehensive strategy for sustainability, in sight of increasing working hypotheses about systems, but also widening the interest to the whole aspects of human life. So we can’t say that resilience or sustainability is broader but they can be more like complementary metaphors. Resilience doesn’t actually aim to replace or beat sustainability but it has the perspective of the change, uncertainty, un-

predictability and adaptability that are needed in the turbulent global systems sustainability.

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References

- Abesamis, N.P, Corrigan, C., Drew, M., Campbell, S., Samonte, G. (2006). *Social Resilience: A literature review on building resilience into human marine communities in and around MPA networks*. MPA Networks Learning Partnership, Global Conservation Program, USAID, Retrieved from http://www.reefresilience.org/pdf/Social_Resilience_Literature_Review.pdf.
- Adger, W. N. (2000). Social and ecological resilience: Are they related. *Progress in Human Geography*, 24 (3), 347–364. doi: 10.1191/030913200701540465.
- Ahern, J. (2011). From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world. *Land-scape and Urban Planning*, 100 (4), 341–343. doi: 10.1016/j.landurbplan.2011.02.021.
- Alexander, D.E. (2013). Resilience and disaster risk reduction: an etymological journey. *Nat. Hazards Earth Syst. Sci.*, 13, 2707–2716. doi:10.5194/nhess-13-2707-2013.
- Allen, J., Ervin, D. (2007). *Introduction to Sustainability Concepts and Theories*, Center for Sustainable Processes and Practices PSU Academic Sustainability Programs, Retrieved from <https://docslide.us/documents/introduction-to-sustainability-concepts-and-theories-jennifer-allen-and-david.html>.
- Armitage, D.R., Johnson, D. (2006). Can resilience be reconciled with globalization and the increasingly complex conditions of resource degradation in Asian coastal regions?. *Ecology and Society* 11(1): 2. Retrieved from

- <http://www.ecologyandsociety.org/vol11/iss1/art2/>
- Autin, W. J., Holbrook, J.M. (2012). Is the Anthropocene an issue of stratigraphy or pop culture?. *GSA Today*, 22 (7). doi: 10.1130/G153GW.1
- Bagheri, A., Hjorth, P. (2007). Planning for Sustainable Development: a Paradigm Shift Towards a Process-Based Approach. *Sustainable Development*, 15, 83–96. doi: 10.1002/sd.310.
- Bastianoni, S., Pulselli, F.M., Tiezzi, E. (2004). The problem of assigning responsibility for greenhouse gas emissions, *Ecological Economics* Issue 3, 1 49, 253–257.
- Berke, P.R., Conroy, M.M. (2000). Are We Planning for Sustainable Development?. *Journal of the American Planning Association*, 66 (1), 21–33. doi: 10.1080/01944360008976081.
- Berkes, F. (2007). Understanding uncertainty and reducing vulnerability: lessons from resilience thinking, *Natural Hazards* 41, 283–295.
- Berkes, F., Colding, J., Folke, C. (2003), *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*. Cambridge University Press.
- Birkmann, J., Seng, D.C., Abeling, T., Huq, N., Wolfertz, J., Karanci, N., İlkizer, G., Kuhlicke, C., Pelling, M., Forrester, J., Fordham, M., Deeming, H., Kruse, S., Jülich, S. (2012). *Systematization of Different Concepts, Quality Criteria, and Indicators*. Deliverable 1.2. 7FP emBRACE project: Building resilience amongst communities in Europe. Retrieved from https://www.researchgate.net/publication/290445969_Systematization_of_Different_Concepts_Quality_Criteria_and_Indicators_of_Community_Resilience.
- Blackmore, J.M., Plant, R.A.J. (2008). Risk and Resilience to Enhance Sustainability with Application to Urban Water Systems, *Journal of Water Resources Planning and Management* May/June, 224–233.
- Brand K.W., Fürst V. (2002) Sondierungsstudie: Voraussetzungen und Probleme einer Politik der Nachhaltigkeit—Ein Exploration des Forschungsfelds. In: K. W. Brand (Eds.) *Politik der Nachhaltigkeit: Voraussetzungen, Probleme, Chancen—eine kritische Diskussion*. (pp 15–109). Berlin.
- Brand, F.S., Jax, K. (2007). Focusing the meaning(s) of resilience: resilience as a descriptive concept and a boundary object. *Ecology and Society*, 12(1), 23. Retrieved from <http://www.ecologyandsociety.org/vol12/iss1/art23/>.
- Briguglio, L., Cordina, G., Farrugia, N., Vella, S. (2008). Economic Vulnerability and Resilience: Concepts and Measurements, *Oxford Development Studies* 37 (3).
- Bruneau, M., Chang, S., Eguchi, R., Lee, G., O'Rourke, T., Reinhorn, A., Shinozuka, M., Tierney, K., Wallace, W., von Winterfeldt, D. (2003). A framework to quantitatively assess and enhance the seismic resilience of communities. *Earthquake Spectra*, 19 (4), 733–752. doi: <http://dx.doi.org/10.1193/1.1623497>.
- Brunetta, G., Baglione, V. (2012). *The Resilience Concept in the Transition Town Movement. Towards A New Territorial Governance In Urban Development And Spatial Planning?*. Paper presented at the 26th AESOP Annual Congress: Planning To Achieve / Planning To Avoid: The Need for New Discourses and Practices in Spatial Development and Planning, Ankara, Turkey.
- Callaghan, E.G. and Colton, J. (2008). Building sustainable & resilient communities: A balancing of community capital, *Environment, Development and Sustainability* 10 (6), 931–942.
- Campbell, S. (1996). Green cities, growing cities, just cities?. Urban planning and the contradictions of sustainable development, *Journal of the American Planning Association*, 62, 296–312.
- Carpenter, S., Walker, B., Anderies, J.M., Abel, N. (2001). From metaphor to measurement: resilience of what to what?. *Ecosystems*, 4 (8), 765–781. doi: 10.1007/s10021-001-0045-9.
- Cascio, J. (2009). The Next Big Thing: Resilience. *Foreign Policy*, 172, 2. Retrieved from <http://foreignpolicy.com/2009/09/28/the-next-big-thing-resilience/>
- Christmann, G., Ibert, O., Kilper, H., Moss, T. (2012). *Vulnerability and Resilience from a Socio-Spatial Perspective, Towards a Theoretical Framework* (Working Paper). Germany: Leibniz Institute for Regional Development

and Structural Planning.

Chuvarayan, A., Martel, I., Peterson, C. (2006). *A Strategic Approach for Sustainability and Resilience Planning within Municipalities* (Master of Strategic Leadership Towards Sustainability). Blekinge Institute of Technology, Karlskrona, Sweden. Retrieved from <http://www.bth.se/fou/cuppsats.nsf/all/b11fcfb6b29644afc1257259006bd213?OpenDocument>

Ciegis, R., Ramanauskienė, J., Martinkus, B. (2009). The Economic Conditions of Enterprise Functioning, The Concept of Sustainable Development and its Use for Sustainability Scenarios, *Inžinerinė Ekonomika-Engineering Economics* (2), 28-37.

Colucci, A. (2012). *Resilient Cities: Approaches/Strategies Comparison Towards Resilient Cities*. Paper presented at the 26th AESOP Annual Congress: Planning To Achieve / Planning To Avoid: The Need for New Discourses and Practices in Spatial Development and Planning, Ankara, Turkey.

Crowe, P., Foley, K. (2013). The Turas Project: Integrating Social-Ecological Resilience into Urban Planning, Paper presented at the AESOP- ACSP 5th Joint Congress, 15-19 July, Dublin, Retrieved from http://www.turas-cities.org/uploads/biblio/document/file/265/130531_AESOP_ACSP_Paper_Philip_Crowe_TURAS.pdf

Crutzen, P.J., Stoermer, E.F. (2000). The Anthropocene, *Global Change Newsletter* 41, 17-18.

Deppisch, S. (2012). Resilience thinking as potential leitmotif in spatial planning - gains and trade-offs., Paper presented at the 26th AESOP Annual Congress: Planning To Achieve / Planning To Avoid: The Need for New Discourses and Practices in Spatial Development and Planning, Ankara, Turkey.

Derissen, S., Quaas, M., Baumgärtner, S. (2010). The relationship between resilience and sustainable development of ecological-economic systems. *Ecological Economics*, 70(6), 1121-1128. doi: 10.1016/j.ecolecon.2011.01.003.

Doğru, E. (2006). *Issues of Sustainable Development in Local and Global Context: The Case of Muğla*. (Master of Science Thesis). METU, The Graduate School of Natural and Applied Sciences, Ankara.

Du Plessis, M.C. (2009). Urban sustainability science as a new paradigm for planning. Paper presented at the Smart and Sustainable Built Environments Conference, Delft, The Netherlands.

Duit, A., Galaza, V., Eckerberga K., Ebbessona, J. (2010). Governance, complexity, and resilience, *Global Environmental Change* 20, 363-368.

Egger, S. (2006). Determining a sustainable city model, *Environmental Modelling & Software* 21, 1235-1246.

Elliott, J.A. (2006). *An introduction to sustainable development, Routledge Perspectives on Development Series*, Third Edition, Routledge, New York.

Ernstson, H., van der Leeuw, S.E., Redman, C.L., Meffert, D.J., Davis, G., Alfsen, C., Elmqvist, T. (2009). Urban transitions: on urban resilience and human-dominated ecosystems, *Ambio* 39 (8), 531-545.

Fiksel, J. (2003). Designing resilient, sustainable systems. *Environmental Science and Technology*, 37(23), 5330-5339. doi: 10.1021/es0344819.

Fiksel, J. (2006). Sustainability and resilience: toward a systems approach, *Sustainability: Science, Practice, & Policy* 2 (2), 14-21.

Flint, R.W. (2004). Sustainable Development. What Does Sustainability Mean to Individuals in the Conduct of Their Lives and Business?. In: G. M. Mudacumura & M. S. Haque (Eds.) *Handbook of Development Policy Studies* (pp. 67-89). Routledge: New York.

Folke, C. (2006). Resilience: The emergence of a perspective for social-ecological systems analyses, *Global Environmental Change* 1, 253-267.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S., Walker, B., Bengtsson, J., Berkes, F., Colding, J., Danell, K., Falkenmark, M., Gordon, L., Kasperson, R., Kautsky, N., Kinzig, A., Levin, S., Mäler K.G., Moberg, F., Ohlsson, L., Olsson, P., Ostrom, E., Reid, W., Rockström, J., Savenije, H., Svedin, U. (2002). *Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations* (Report for the Swedish Environmental Advisory Council 2002:1). Ministry of the Environment: Stockholm and (ICSU Series on Science for Sustainable Development No. 3). International Coun-

cil for Science: Paris.

Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin, T., Rockström, J. (2010). Resilience thinking: integrating resilience, adaptability and transformability, *Ecology and Society* 15 (4), 20.

Folke, C., Colding, J., Berkes, F. (2003). Synthesis: Building Resilience and Adaptive Capacity in Social-Ecological Systems. In: F. Berkes, J. Colding, & C. Folke (Eds.) *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change* (pp. 352-387). Cambridge University Press.

Gallopín, G. (2003). *A systems approach to sustainability and sustainable development*. United Nations Publication, LC/L 1864-P, United Nations, New York, New York, USA.

Gibberd, J.T. (2011). Assessing and Intervening: Urban Resilience Indicators, *Academia*, Retrieved from

https://www.academia.edu/4400216/Assessing_and_Intervening_Urban_Resilience_Indicators.

Gleeson, B.J. (2008). Waking from the dream: towards urban resilience in the face of sudden threat, *Urban Studies* 45 (13), 2653-2668.

Godschalk, D.R. (2003). Urban Hazard Mitigation: Creating Resilient Cities. *The Natural Hazards Review*, 4(3), 136-143. doi: 10.1061/~ASCE!1527-6988~2003!4:3~136!.

Goodland, R. (1992). The Case That the World has Reached Limits. More Precisely That Current Throughput Growth in Global Economy Cannot Be Sustained. In: R. Goodland, H. Daly, S. E. Serafy, B. V. Droste (Eds) *Environmentally Sustainable Development: Building on Brundtland*. Paris: UNESCO.

Gunderson, L.H., Carpenter, S.R., Folke, C., Olsson, P., Peterson, G.D. (2006). Water RATs (resilience, adaptability, and transformability) in lake and wetland social-ecological systems. *Ecology and Society* 11 (1), 16.

Gunderson, L.H. (2009). *Comparing Ecological and Human Community Resilience*, CARRI Research Report 5. Retrieved from http://www.resilientus.org/wp-content/uploads/2013/03/Final_Gunderson_1-12-09_1231774754.pdf

Gunderson, L.H., Holling, C.S. (2002). *Panarchy: understanding trans-*

formations in human and natural systems. Island Press, Washington D.C. USA.

Holling, C.S. (1973). Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics*, 4, 1-23. doi: 10.1146/annurev.es.04.110173.000245.

Holling, C.S. (1986). The resilience of terrestrial ecosystems: local surprise and global change. In: W.C. Clark, R.E. Munn (Eds.), *Sustainable Development of the Biosphere* (pp. 292-317). Cambridge: Cambridge University Press.

Holling, C.S. (1995). What barriers? What bridges?. In: L.H. Gunderson, C.S. Holling, S.S. Light (Eds.), *Barriers and bridges to the renewal of ecosystems and institutions* (pp. 3-34). New York: Columbia University Press.

Holling, C.S. (2001). Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems*, 4, 390-405. doi: 10.1007/s10021-001-0101-5.

Holling, C.S. (2004). From complex regions to complex worlds, *Ecology and Society* 9 (1), 11.

Holling, C.S., Walker, B.H. (2003). Resilience Defined. *Entry Prepared for the Internet Encyclopedia of Ecological Economics*. Retrieved from http://www.ecoeco.org/education_encyclopedia.php.

Hollnagel, E. (2014). Resilience engineering and the built environment. *Building Research & Information*, 42, 2, 221-228. doi: 10.1080/09613218.2014.862607.

Hultman, N. (2012). *The Insufficiency of Sustainable Development*, OP-ED Tuesday, June 19, 2012, Retrieved from <https://www.brookings.edu/opinions/the-insufficiency-of-sustainable-development/>.

Jeanrenaud, S. (Ed.) (2007). *The Future of Sustainability: Have Your Say! Summary of the IUCN E-Discussion Forum 2006*. Gland, Switzerland: IUCN.

Keck, M., Sakdapolrak, P. (2013). What is Social Resilience? Lessons Learned and Ways Forward, *Erdkunde* Vol. 67 (1), 5-19.

Klein, R.J.T., Nicholls, R.J., Thomalla, F. (2003). Resilience to natural hazards: How useful is this concept?. *Environmental Hazards*, 5 (1), 35-45. doi: 10.1016/j.hazards.2004.02.001.

- Lang, T. (2011). Urban Resilience and New Institutional Theory- A Happy Couple for Urban and Regional Studies. In: B. Müller (Eds.), *Urban Regional Resilience: How do Cities and Regions Deal with Change?* (German Annual of Spatial Research and Policy). Berlin: Springer.
- Lebel, L., Anderies, J.M., Campbell, B., Folke, C., Hatfield-Dodds, S., Hughes, T.P., & Wilson, J. (2006). Governance and the capacity to manage resilience in regional social-ecological systems. *Ecology and Society*, 11(1), 19. Retrieved from <http://www.ecologyandsociety.org/vol11/iss1/art19/>
- Lélé, S. (1998). Resilience, Sustainability, and Environmentalism. *Environment and Development Economics*, 3(2), 251-255. doi: 10.1017/S1355770X98260128.
- Levin, S.A., Barret, S., Aniyar, S., Baumol, W. (1998). Resilience in natural and socioeconomic systems, *Environment and Development Economics* 3 (2), 222-234.
- López-Ridaura S., Masera O., Astier M. (2002). Evaluating the sustainability of complex socio-environmental systems, The MESMIS framework, *Ecological indicators* 2, 135-148.
- Lu, P. and Stead, D. (2013). Understanding the notion of resilience in spatial planning: A case study of Rotterdam, The Netherlands, *Cities* 35, 200-212.
- MacKinnon, D., Derickson, K.D. (2012). From resilience to resourcefulness: A critique of resilience policy and activism, *Progress in Human Geography* 37(2), 253-270.
- Maguire, B. and Cartwright, S. (2008), *Assessing a community's capacity to manage change: A resilience approach to social assessment*, Retrieved from http://www.cedarscenter.com/resources/Community_Capacity_to_manage_change--Resilience_approach_to_social_assessment.pdf.
- Manyena, S.B. (2006). The concept of resilience revisited. *Disasters*, 30(4), 433-450. doi: 10.1111/j.0361-3666.2006.00331.x.
- Mitchell, M. Griffith, R., Ryan, P., Walkerden, G., Walker, B., Brown, V.A., Robinson, S. (2014). Applying Resilience Thinking to Natural Resource Management through a "Planning-By-Doing" Framework, *Society & Natural Resources: An International Journal* 27(3), 299-314.
- Moore, J. (2013). Is a Focus on Resilience Side-Stepping the Important Question of Planning within Limits? Insights from Complexity Theory, Paper presented at the AESOP- ACSP 5th Joint Congress, Conference 15-19 July, Dublin.
- Mortimer, C. (2010). *Assessing urban resilience*, Retrieved from https://www.landcareresearch.co.nz/publications/researchpubs/Urban_resilience_assessment_mortimer_2010.pdf.
- Müller, B. (2010). Urban and Regional Resilience - A new catchword or a consistent concept for research and practice. In: B. Müller (Ed.) *German Annual of Spatial Research and Policy*. (pp. 1-13). Springer Berlin Heidelberg. doi: 0.1007/978-3-642-12785-4_1.
- Newton, P.W., Bai, X. (2008). Transitioning to sustainable urban development. In: P.W. Newton (Eds.), *Transitions: Pathways Towards Sustainable Urban Development in Australia*. Dordrecht: Springer.
- Novotny, V., Ahern, J., Brown, P. (2010). *Water Centric Sustainable Communities: Planning, Retrofitting and Building the Next Urban Environment*. J. Wiley, Hoboken, NJ. doi: 10.1002/9780470949962.
- Olazabal, M. (2010). Urban resilient sustainability transitions: a cause for action In: L. Chelleri and M. Olazabal (Eds.), *Multidisciplinary Perspectives On Urban Resilience* (pp. 35-43). Workshop Report, BC3, Basque Centre for Climate Change.
- Olazabal, M., Chelleri L., Waters, J.J., Kunath, A. (2012). *Urban resilience: towards an integrated approach*. Paper presented at 1st International Conference on Urban Sustainability & Resilience, London, UK, ISSN 2051-1361.
- Pearce, D., Hamilton, K., Atkinson, G. (1996). Measuring sustainable development: progress on indicators, *Environment and Development Economics* 1, 85-101.
- Pendall, R., Foster, K.A., Cowell M. (2010). Resilience and regions: building understanding of the metaphor. *Cambridge Journal of Regions, Economy and Society*, 3 (1), 71-84. doi: 10.1093/cjres/rsp028.

- Perrings, C. (2006). Resilience and sustainable development. *Environment and Development Economics*, 11(4), 417–427. doi: <http://dx.doi.org/10.1017/S1355770X06003020>.
- Pierce, J.C., Budd, W.W., Lovrich, N.P. (2011). Resilience and sustainability in US urban areas. *Environmental Politics*, 20 (4), 566–584. doi: 10.1080/09644016.2011.589580.
- Pisano, U., (2012), *Resilience and Sustainable Development: Theory of resilience, systems thinking and adaptive governance* (European Sustainable Development Network Resilience and Sustainable Development Quarterly Report No 26). Retrieved from http://www.sd-network.eu/quarterly%20reports/report%20files/pdf/2012-September-Resilience_and_Sustainable_Development.pdf.
- Plodinec, J.M. (2009). *Definitions of Resilience-An Analysis. Community and Regional Resilience Institute*. Retrieved from <http://www.resilientus.org/about-us/definition-of-community-resilience.html>.
- Powell, J.E. (2012). *Conditions For Effective Use Of Community Sustainability Indicators And Adaptive Learning*. (Doctor Of Philosophy Thesis). University of Alaska, Fairbanks.
- Redman, C.L. (2014). Should sustainability and resilience be combined or remain distinct pursuits? *Ecology and Society*, 19(2), 37. doi: 10.5751/ES-06390-190237.
- Rose, A. (2009). *Economic Resilience to Disasters*. CARRI Research Report 8. Retrieved from http://www.resilientus.org/wp-content/uploads/2013/03/Research_Report_8_Rose_1258138606.pdf
- Schroll, H., Thorn, P., Kjærgård, B. (2009). Resilience Is More Than an Elastic Jump. *The Journal of Transdisciplinary Environmental Studies*, 8 (1). ISSN:1602-2297.
- Sneddon, C., Howarth, R.B., Norgaard, R.B. (2006). Analysis: Sustainable development in a post-Brundtland world, *Ecological Economics* 57, 253 – 268.
- Stirling, A. (2007). Resilience, Robustness, Diversity: Dynamic strategies for sustainability. Paper presented at the 7th International Conference of the European Society for Ecological Economics, Leipzig, Germany.
- Stirling, A. (2008). The Dynamics of Sustainability durability, stability, resilience and robustness. In ESRC. Paper presented at the Environment Agency workshop on Complexity Economics for Sustainability, Oxford, England.
- Surjan, A., Sharma, A., Shaw, R. (2011). Understanding Urban Resilience. In: R. Shaw and A. Sharma (Eds.), *Climate and Disaster Resilience in Cities (Community, Environment and Disaster Risk Management, Volume 6*, pp.17-45). Bingley: Emerald Group Publishing Limited.
- Tainter, J.A. (2006). Social complexity and sustainability. *Ecological Complexity*, 3 (2), 91-103. doi: 10.1016/j.ecocom.2005.07.004.
- Thapa, S., Marshall, F., Stagl, S. (2010). *Understanding Peri-urban Sustainability: The Role of the Resilience Approach* (STEPS Working Paper 38), Brighton STEPS Centre, Retrieved from <http://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/2279/Understanding%20Peri-urban%20Sustainability.pdf?sequence=1>.
- Thomson Reuters Web of Science Data Base, <https://science.thomson-reuters.com/>, Accessed November 2017.
- The Commonwealth Scientific and Industrial Research Organization (CSIRO). (2007). *Urban Resilience: Research Prospectus. A Resilience Alliance Initiative for Transmitting Urban Systems towards Sustainable Futures*. Commonwealth Scientific and Industrial Research Organization, Canberra.
- The Millennium Ecosystem Assessment. (2003). *Ecosystems and human well-being*. Island Press, Washington, D.C. USA.
- Tidball, K.G., Krasny, M.E. (2007). From risk to resilience: What role for community greening and civic ecology in cities? In: A. Wals (Ed.). *Social Learning Towards a more Sustainable World* (pp 149-164). Wageningen Academic Press.
- Uhløi, J., Madsen, H. (1999). Sustainable Development and Sustainable Growth: Conceptual Plain or Points on a Conceptual Plain, Paper presented at the 17th International Conference

of the System Dynamics Society 5th Australian & New Zealand Systems Conference, Wellington, New Zealand, Retrieved from <http://www.system-dynamics.org/conferences/1999/PAPERS/PARA197.PDF>.

United Nations Human Settlements Programme (UN-Habitat) (2009), *Planning Sustainable Cities: Global Report on Human Settlements*. UK: Earthscan.

Van der Leeuw, S.E., Aschan-Leygonie, C. (2005). A Long-Term Perspective on Resilience In Socio-Natural Systems, In: H. Liljeström, U. Svedin (Eds), *In Micro, meso, macro: addressing complex systems couplings*. (pp. 227-264). World Scientific Publishing Co., doi: 10.1142/9789812701404_0013.

Von Detten, R. (2011). Sustainability as a guideline for strategic planning? The problem of long-term forest management in the face of uncertainty, *European Journal of Forest Research*, Volume 130 Issue 3, 451–465, <https://doi.org/10.1007/s10342-010-0433-9>.

Walker, B., Holling, C.S., Carpenter, S.R., Kinzig, A. (2004). Resilience, adaptability and transformability in social-ecological systems. *Ecology and Society*, 9(2), 5. Retrieved from <http://www.ecologyandsociety.org/vol9/iss2/art5/>

Walker, B.H., Salt, D. (2006). *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Island Press, Washington, D.C. USA.

Wildavsky, A. (1988). *Searching for Safety*. Berkeley: University of California Press.

World Commission on Environment and Development. (1987). *Our common future*. Oxford University Press, Oxford, New York.

World Bank (1992). *World Development Report (1992): Development and the Environment*, New York: Oxford University Press.

Xu, L., Marinova, D., Guo, X. (2014). Resilience thinking: a renewed system approach for Sustainability science, *Sustainability Science*. 10 (1), 123-138.

Yaman, Z.D., Tezer, A. (2012). *Urban Resilience; As A New Policy Paradigm For Achieving Sustainability In Istanbul*. Paper presented at the 26th AESOP Annual Congress: Planning To Achieve / Planning To Avoid: The Need for New Discourses and Practices in Spatial Development and Planning, Ankara, Turkey.

Yaman-Galantini, Z.D., Tezer, A. (2014). *From Urban Stability To Urban Dynamism: Comparison Between Sustainability and Resilience*. Paper presented at the 23rd SRA-Europe Conference Joint Special Symposium of SRAE & ERSAs, Istanbul, Turkey.

Zautra, A., Hall, J., Murray, K. (2008). Community Development and Community Resilience: An Integrative Approach, *Journal of Community Development* 39 (3), 130-147.