Vol. 5(3), 22-27

Journal of Energy & Environmental Policy Options

Integrating Antifragility into Sustainability Strategies for Long-Term Success

Vitaliy Zheka[a], David Vishnevsky[b]

Abstract

This article explores the conceptual relevance of antifragility for sustainable development and organizational sustainability, proposing a shift from the traditional focus on resilience towards a more robust framework centered on antifragility. The discussion is grounded in the general research hypothesis that antifragility, rather than resilience alone, is essential for achieving both intra- and intergenerational sustainability, as well as ensuring long-term survival in the face of unpredictable challenges. While resilience emphasizes the capacity of systems and organizations to recover from shocks, antifragility goes beyond this by suggesting that systems can actually benefit and grow stronger from such disruptions. The article argues that current sustainability strategies should evolve from merely enabling recovery to actively preventing or eliminating unsustainable practices and fragilities. When necessary, these unsustainable activities should be replaced with alternatives that are less harmful and more robust. The concept of antifragility offers a paradigm shift that could better equip organizations and systems to not only withstand but also thrive in the face of unforeseen future events that might otherwise threaten their existence. This approach requires a fundamental reassessment of sustainability strategies, moving towards proactive measures that enhance the ability of systems to adapt and improve through adversity. The article serves as a foundational discussion for future research, which will further explore how antifragility can be integrated into sustainability frameworks. By addressing the limitations of resilience-focused strategies, it aims to contribute to the development of more comprehensive approaches that ensure long-term sustainability and organizational success in an increasingly volatile world. The article highlights the necessity of adopting antifragility as a core principle in sustainability efforts, advocating for strategies that not only mitigate risks but also capitalize on them to drive growth and innovation within organizations and systems.

Keywords: Antifragility, Sustainable Development, Organizational Sustainability, Resilience

JEL Codes: Q01, M14, D81

1. INTRODUCTION

When assessing sustainability, the emphasis is frequently placed on output indicators, as noted by the Commission (2005) and Borys (2005). These indicators typically focus on sustainable economic growth that meets societal needs without adversely affecting the environment and ecosystems. The core idea is that economic development should be balanced with environmental preservation, ensuring that growth is not achieved at the expense of natural resources or ecological stability. As Rao (2000) points out, sustainable development entails fostering economic progress that not only supports social well-being but also minimizes environmental degradation, ensuring long-term viability for both the economy and the planet. This approach underscores the importance of measuring sustainability through tangible outcomes, such as reduced carbon emissions, conservation of biodiversity, and equitable access to resources, all while maintaining economic growth. By focusing on these output indicators, policymakers and businesses can better evaluate whether their efforts are leading to sustainable practices that align with global environmental and social objectives. While the feasibility of sustainable economic growth has been a topic of debate (Smith, 2013), much of the current focus is on identifying strategies that can lead societies in the right direction. This includes efforts to develop win-win solutions that address both economic and environmental concerns, as emphasized by Leal et al. (2016), Will et al. (2015), and Lambrechts et al. (2015). These win-win approaches aim to balance economic development with sustainability by fostering innovation, creating jobs, and reducing environmental harm simultaneously.

Another critical aspect of sustainable development is the pursuit of efficiency improvements, which has been highlighted by Słupik (2015), Burchard-Dziubińska (2015), and Zepada Quintana et al. (2015). These improvements often focus on optimizing resource use, reducing waste, and increasing the effectiveness of energy consumption. By achieving greater efficiency, businesses and economies can continue to grow while minimizing their environmental footprint, which is essential for the long-term sustainability of both economic systems and the planet. This focus on innovation and efficiency underscores the ongoing effort to reconcile economic growth with environmental stewardship, even amidst challenges and skepticism about the sustainability of continuous growth. However, since the fundamental goal of sustainability is survival (Costanza et al., 1991), an equally critical research focus lies in identifying what **not** to do in order to prevent development

[a] Department of Economic and Finances, East-Ukrainian Volodymyr Dahl National University, Lugansk, Ukraine
[b] Department of Economic and Finances, East-Ukrainian Volodymyr Dahl National University, Lugansk, Ukraine

from moving in the wrong direction—towards the collapse of ecosystems, economic systems, or social systems. This involves understanding the detrimental practices that could lead to long-term instability or degradation, such as overexploitation of natural resources, unsustainable industrial practices, and unchecked environmental pollution.

Preventing negative outcomes requires the avoidance of activities that deplete essential resources, disrupt ecosystems, or widen social and economic inequalities. For example, pursuing short-term economic gains at the expense of environmental health can lead to irreversible damage to ecosystems, which in turn can threaten both biodiversity and human livelihoods. Similarly, ignoring social disparities can foster unrest and destabilize economies. Thus, identifying and avoiding harmful actions is just as important as promoting positive actions to ensure the long-term viability of ecological, economic, and social systems. This "what not to do" approach offers a complementary perspective to the pursuit of efficiency and win-win solutions, as it helps create boundaries and safeguards to avoid critical thresholds that could trigger irreversible damage to the planet's systems. It emphasizes the need for preventative measures and a more cautious approach to development to ensure that progress does not come at the cost of future sustainability. The concept of removing unsustainable practices that threaten survival can be linked to antifragility, a concept that has yet to be widely applied to sustainable development (Taleb, 2012; Bullen, 2015; Platje, 2015). Antifragility refers to systems or entities that do not just withstand shocks or disruptions, but actually become stronger and more resilient in the face of challenges and stressors. In contrast to systems that are fragile (which break down under stress) or merely robust (which resist stress without changing), antifragile systems thrive and improve under pressure. Though this concept is relatively new and has not been extensively integrated into sustainability discourse, it presents a valuable framework for understanding how to build resilient ecological, economic, and social systems that can not only survive crises but also emerge stronger from them. By removing unsustainable elements that weaken systems—whether it's overconsumption of resources, polluting industrial practices, or unequal social structures—antifragility offers a strategy to ensure that systems are more adaptable, flexible, and better equipped to face future uncertainties.

As Taleb (2012) notes, there is no direct translation of antifragility in many non-English languages, which highlights the novelty of the concept and its potential for new applications. In the context of sustainable development, integrating antifragility means not only focusing on sustainability as a way to prevent collapse but also actively designing systems that can benefit from volatility, change, and uncertainty—ultimately making them more resilient and better positioned to thrive in the long term. Sustainability is frequently framed within the concept of resilience (Rao, 2000), which refers to a system's ability to recover from external shocks or disturbances. While resilience is essential for maintaining stability in the face of adversity, it focuses primarily on bouncing back to a pre-existing state. This raises an important question: Is merely recovering enough to prepare a system for unexpected and unknown challenges that may arise in the future, potentially threatening its existence? In an increasingly complex and unpredictable world, relying solely on resilience may not suffice. The assumption that we live in a world of imperfect information (Akerlof, 1970) complicates matters further, as it implies that we cannot foresee all potential threats or accurately gauge their impact. This uncertainty calls for systems that are not just resilient but capable of adapting, evolving, and even thriving in the face of unforeseen challenges.

Thus, while resilience ensures a system's ability to withstand shocks, it does not necessarily prepare it for future unknowns. The concept of antifragility, as previously mentioned, addresses this gap by promoting systems that grow stronger through disruption. In contrast to resilient systems, which aim to return to equilibrium, antifragile systems use volatility and stress as opportunities for improvement, equipping them to handle unpredictable, imperfectly understood challenges that lie ahead. Integrating antifragility into sustainability strategies could help create systems that are not only able to recover but also better prepared for future uncertainties, ensuring long-term viability. Mankind has acquired an incredible amount of knowledge, which can sometimes give the illusion that we understand more than we actually do. However, the skeptical and humble scientist must acknowledge that our understanding of the world is still limited, and the complexity of our environment, with its countless unknowns, far exceeds what many people have ever imagined (Taleb, 2012). In essence, we live in a world of fundamental uncertainty. While most economic theories view uncertainty as a negative phenomenon, an important question arises: If we seek to protect ourselves from uncertainty, how can we be adequately prepared for surprising and unforeseen events that may threaten our existence? If we do not engage in trial-and-error processes to discover what works and what doesn't, we limit our ability to learn and adapt. Without this experimental approach, we remain unprepared to handle new information or unexpected challenges. This line of thinking is well-established in fields like evolutionary economics and New Institutional Economics (see Furubotn and Richter, 1997), and it underpins principles such as subsidiarity and critiques of the feasibility of centralized government planning (Hayek, 1935, 1937, 1945). These perspectives emphasize the limitations of top-down control and the value of decentralized, adaptive decision-making in complex systems.

Despite the relevance of these ideas in economics and other fields, the question of whether individuals, organizations, industries, or societies can become stronger and more resilient in the face of future unknown threats has not been adequately explored within the sustainability discourse. This gap in research suggests the need for a deeper investigation into how systems can not only survive but thrive under uncertainty. Can we build systems that grow stronger from disruption and better prepare us for unforeseen challenges? This leads to a general research hypothesis, which should form the basis for future studies in sustainability: How can systems be designed to become more adaptive, resilient, and antifragile in the face of fundamental uncertainty, allowing them to better cope with, and even benefit from, future unexpected threats. Antifragility is a crucial foundation for both intra- and intergenerational sustainability, as well as long-term survival. While resilience emphasizes the ability of a system to recover from disruptions, antifragility goes further by promoting the capacity to grow

stronger from uncertainties and challenges. A system that is merely resilient may become unsustainable in the long run, particularly if it lacks an institutional framework that encourages continuous learning from uncertainties. Without this framework, systems may fail to adapt to changing conditions and unforeseen risks, increasing the likelihood of collapse. The focus on resilience can inadvertently lead to unsustainability if there are no mechanisms in place that reduce the transaction costs associated with learning from disruptions and uncertainties. Antifragility, by contrast, provides a strategy for not only absorbing shocks but also using them as opportunities to innovate, improve, and strengthen the system. This requires institutions that incentivize learning, experimentation, and adaptation, while also minimizing the costs and barriers to these processes. By fostering an antifragile approach, systems are better equipped to reduce the probability of collapse and ensure sustainability across generations. This approach encourages proactive strategies that embrace uncertainty as a tool for evolution, rather than simply trying to maintain equilibrium in the face of disruption. Therefore, integrating antifragility into sustainability strategies offers a more robust pathway to long-term survival and adaptability in an unpredictable world.

2. DISCUSSION

While the concept of sustainable development is widely regarded as crucial for society and serves as the foundation for developmental policies in many countries, there remains a lack of consensus on its precise definition. Despite the absence of an agreed-upon working definition, there is general agreement on the core principle: ensuring a high quality of life for present generations without compromising the opportunities for future generations to meet their own needs (WCED, 1987). This flexibility is one of the strengths of the notion of sustainable development, as it allows diverse stakeholders to align with its overarching goals while still accommodating varying interpretations of how these principles should be implemented in practice. However, this lack of agreement on specific policy implications and the consequences for human economic activity can also be seen as a limitation. Without clear guidelines, any policy or action intended to promote sustainable development can be subject to criticism, particularly for potential negative side effects. This ambiguity often leads to debates about the trade-offs between economic growth, environmental preservation, and social equity.

Many existing approaches to sustainable development concentrate on identifying what needs to be done to follow a sustainable path (e.g., Szołtysek, 2015; Gądek-Hawlena and Wróbel, 2015; Piasecka-Głuszak, 2015). Yet, given the ongoing disagreement over the precise meaning of sustainability, it is often easier to identify unsustainable practices than to define what truly constitutes sustainable activity (Van Dam and De Jong, 2015; Taleb, 2012). Recognizing what is unsustainable, such as resource depletion, environmental degradation, and unequal access to opportunities, provides a clearer lens through which to view current challenges. In light of these complexities, a more innovative and pragmatic approach to sustainable development might involve focusing on the elimination or reduction of unsustainable activities, or fragilities, rather than trying to define an ideal state of sustainability. A working definition of sustainable activity could then be framed as: "the prevention or elimination of unsustainable practices, and when necessary, replacing them with activities that are less unsustainable." This approach acknowledges that the path toward full sustainability may be gradual and iterative, and that progress can often be achieved by reducing harm, even if complete sustainability is not immediately attainable.

By focusing on eliminating unsustainability in stages, this approach allows for practical progress without being hindered by debates over a perfect definition of sustainability. It also encourages continuous improvement, ensuring that efforts are made to replace the most damaging activities with practices that, while perhaps not fully sustainable, are less harmful to the environment, society, and future generations. Resilience may indeed be insufficient for achieving true sustainability. Taleb (2012) argues that in the face of uncertainty, randomness, and disorder, a system or organization may need to become antifragile to effectively manage the unpredictable threats it encounters. According to Taleb, fragility is defined as the susceptibility to harm from uncertain events. Fragile systems, much like a glass that shatters when dropped, face irreversible consequences when exposed to random shocks. These random events often have disproportionate negative effects, meaning that the potential for loss is greater than the chance for gain, leading to non-linear outcomes. As a result, a fragile system can be deemed unsustainable, since it cannot withstand shocks without serious damage.

In contrast, resilience—a commonly discussed concept in the sustainability discourse (e.g., Rao, 2000)—refers to the ability of a system to absorb shocks and recover from disruption. Taleb likens resilient systems to the mythological phoenix, which rises from its ashes after being destroyed. While resilience is an important feature, it may only maintain systems in a steady state, suitable when challenges are predictable or repeatable. However, the increasingly interconnected nature of modern systems—such as IT networks (Castells, 1998), the global banking system (Akerlof and Shiller, 2009; Admati and Hellwig, 2013), and international trade and transport—exposes them to more complex and unforeseen disruptions. For instance, during the banking crisis of the 1990s in Sweden, the government was able to nationalize and rescue failing banks, preventing a collapse (Admati and Hellwig, 2013). Similarly, in more recent financial crises, individual banks absorbed failing institutions to avert disaster. However, the 2008 global financial crisis, triggered by the collapse of Lehman Brothers, demonstrated that the failure of even one major bank could pose an existential threat to the global financial system. The subsequent bailouts, intended to stabilize the system, significantly increased government debt as a percentage of GDP, highlighting the fragility of the system.

This fragility is compounded by the fact that some financial institutions have grown to the point of being "too big to fail" (Stiglitz, 2010; Admati and Hellwig, 2013). Such banks, by virtue of their size, fragilize the entire banking and financial

system (Taleb, 2012). When these institutions operate with the implicit understanding that they will be bailed out if they fail, they face no real downside risk, but their potential gains are unlimited. This dynamic creates a serious moral hazard problem, where excessive risks are taken, and financial innovations are designed to create products based on promises of future repayment (Akerlof and Shiller, 2009). As long as confidence in the system persists, it continues to expand, but the underlying fragility remains. In this context, antifragility becomes essential. Antifragile systems, unlike resilient ones, benefit from uncertainty and disorder. They evolve and grow stronger when exposed to shocks, rather than merely recovering. In the case of the global financial system, antifragile institutions would learn from failures and adapt to emerging risks, instead of being insulated from them through bailouts. Thus, while resilience is about maintaining stability, antifragility is about thriving in volatility and using crises as opportunities for growth. For sustainability to be achieved in a world of increasing complexity and unpredictability, systems and institutions may need to adopt antifragile principles to ensure long-term viability and success in the face of ongoing uncertainty. Efficiency improvements, while offering significant gains, can paradoxically introduce new system vulnerabilities. For example, as more informational systems depend on GPS for navigation, communication, and logistics, a disruption caused by a solar storm or satellite failure could paralyze these systems. Similarly, the proposal to eliminate physical currency in favor of digital transactions, as has been suggested in Denmark, could yield efficiency gains by cutting production, transport, and security costs. However, the complete elimination of cash would expose the entire financial system to unpredictable risks in the event of an unforeseen power outage or technological failure. While many may consider such events improbable, history has repeatedly shown that highly unlikely scenarios can and do occur. Few people in the 1970s, for instance, foresaw the fall of Communism, Belgium's EU membership in 2004, or the transformative impact of IT and the Internet on global economies.

These examples illustrate how increased complexity in modern systems, while enabling significant advancements, also poses heightened risks to long-term sustainability. Complex systems tend to become less tolerant of uncertainty, yet uncertainty is bound to grow as systems become more interconnected and intricate. This is where the concept of *antifragility* becomes particularly relevant to the sustainability discourse. Unlike fragile systems that break under pressure or resilient systems that merely withstand stress, antifragile systems benefit from uncertainty, randomness, and disorder. They evolve, improve, and innovate through trial and error, learning from small mistakes and emerging stronger in the face of challenges. Taleb uses the Greek mythological figure Hydra to explain this concept—when one head is cut off, two grow in its place. In antifragile systems, mistakes lead to growth rather than destruction.

Antifragile systems exhibit non-linear gains; small, reversible mistakes lead to improvements, while positive outcomes may arise unexpectedly. For instance, a breakthrough in solar energy technology could result in abundant and sustainable energy, providing significant upside gains. This potential for non-linear benefits makes antifragile systems essential for long-term sustainability. They are better equipped to handle uncertainties and capitalize on the opportunities that emerge from disorder.

Taleb (2012) also introduces the idea of "subtractive epistemology" in the context of antifragility—an approach that emphasizes removing what we believe to be wrong or fragile. If eliminating something results in improvement, it indicates a source of fragility. This concept aligns with the idea of evolutionary tinkering, where processes are allowed to evolve through trial and error, strengthening themselves over time. Because complex systems are often too intricate to fully model or predict, interventions can sometimes introduce unintended negative effects, creating new sources of fragility. This does not imply that interventions are inherently useless but highlights the need for caution. The goal should be to identify and eliminate factors that cause disturbances and fragilities, reducing the risk of systemic collapse.

Sustainability efforts must incorporate antifragility, recognizing that uncertainty is unavoidable in an increasingly complex world. By embracing trial-and-error learning, focusing on removing fragilities, and carefully managing interventions, systems and organizations can become more adaptive, innovative, and better equipped to thrive in the face of future uncertainties. When identifying fragilities within a system, what is effectively being developed are indicators of unsustainability. These indicators tend to be more easily identifiable and less subjective compared to sustainability indicators, which are often more outcome-oriented and thus harder to define. Much like in health care, it’s difficult to determine the optimal diet for every individual, as personal needs and environments vary. However, it is relatively straightforward to identify harmful behaviors, such as smoking or excessive alcohol consumption, and recognize that eliminating these habits will likely improve a person’s health. Similarly, in sustainability, identifying and removing sources of fragility—unsustainable practices—can strengthen the overall system, even if defining what is "ideal" for sustainability is more subjective and complex.

As Borys (2005) points out, what is considered development or progress for one person or group can be seen as decline for another. For instance, modern technology may be viewed as a hallmark of advanced civilization, but it can also be interpreted as a symbol of decadence or moral decline. The impact of new technology on sustainability is particularly difficult to predict because of rebound effects. For example, energy-saving technologies may lead to an increase in energy consumption in other areas, thereby undermining the overall sustainability goal. Economic growth, often viewed as a positive development because it enables the fulfillment of more human wants, can also introduce unsustainable practices. While growth can drive innovation and improve standards of living, it may simultaneously contribute to environmental degradation and fragilize social systems. This growth can reduce people's incentives to adapt to unexpected challenges, as modern conveniences may erode traditional skills and resilience. For example, the loss of basic skills like growing food or cooking, which is especially prevalent in urban areas, increases dependency on large-scale food producers and processors. This dependency introduces

fragility into the system, making society more vulnerable to potential shocks, such as supply chain disruptions or food shortages.

In essence, while economic growth and technological progress can offer short-term benefits, they may also introduce long-term vulnerabilities by eroding self-sufficiency and reducing a system's ability to withstand or adapt to future uncertainties. As Taleb suggests, this fragilization—where societies become overly reliant on fragile systems—undermines sustainability. Identifying and eliminating these fragilities can help to build more robust, adaptable systems that are better equipped to handle both known and unknown challenges. Thus, the focus on fragilities, rather than an idealized version of sustainability, provides a more actionable and practical approach to achieving long-term sustainability. The fundamental goal of sustainability is survival—preventing system collapse. This survival is constantly threatened by what Taleb (2007) refers to as "Black Swans," which are unexpected, low-probability events that have an extremely high impact. These events challenge the assumptions we make based on historical data and observed trends. Taleb uses the "Turkey Problem," a concept borrowed from Bertrand Russell, to illustrate the risks inherent in relying on inductive reasoning. The turkey, based on its daily observations of being well-fed and cared for by the farmer, concludes that life is secure and the farmer is benevolent. However, the turkey's assumption is shattered when Thanksgiving arrives, and the once-unexpected fate unfolds. The challenge, therefore, is to avoid being the "turkey"—to be prepared for both the expected and the unexpected events that could threaten the sustainability of an organization or system.

The reliance on historical data—such as customer numbers or cost trends—often assumes linear relationships between cause and effect. However, such assumptions can lead to surprises when reality deviates from predictable patterns. This is why applying a systems approach and developing indicators of fragility or unsustainability is crucial. These indicators can help organizations recognize potential Black Swans and take steps to mitigate the risk of such events. While most sustainability discussions tend to focus on the dangers posed by negative Black Swans, the possibility of positive Black Swans must also be considered. Positive Black Swans are unexpected events that result in significant beneficial impacts. While negative Black Swans, such as the Fukushima disaster—where there were no historical records of an earthquake and tsunami of that magnitude—highlight the importance of preparation, organizations must also remain open to the possibility that unforeseeable events can bring opportunities. For instance, in business, a positive Black Swan might be the sudden emergence of a new technology or market shift that creates a demand for products or services that were previously not anticipated. In contrast, for companies unprepared for disruptive events, negative Black Swans can manifest as sudden shifts in demand, the unexpected arrival of competing substitutes, or technological changes that render a currently successful product obsolete. These kinds of Black Swans can catch organizations off-guard, threatening their long-term survival if they are not adaptable and prepared for such eventualities. Incorporating a balance of both positive and negative Black Swans in theoretical frameworks and empirical research is essential. This holistic approach enables organizations and systems to not only prepare for potential disasters but also seize opportunities that may arise from unpredictability. Understanding and preparing for these unpredictable, high-impact events through the development of antifragility—growing stronger from disruption—can make the difference between an organization's collapse and its survival, or even flourishing, in an uncertain world.

3. CONCLUSIONS

In this article, a general conceptual framework was presented to explore the relevance of antifragility for sustainable development and organizational sustainability. The ideas discussed offer a foundational understanding of how antifragility can enhance the ability of systems and organizations to thrive amid uncertainty and unpredictable events. However, the concepts covered here represent only a small fraction of the broader and more complex issues surrounding sustainability. This framework serves as a starting point for deeper exploration into how subtractive epistemology—focused on identifying and eliminating unsustainable practices or fragilities—can provide a practical basis for sustainable development. By prioritizing the prevention or removal of unsustainable activities and replacing them, when necessary, with less unsustainable alternatives, organizations and systems can reduce their exposure to fragility and, in turn, increase their capacity for long-term survival. This approach highlights the need for continuous adaptation, learning from mistakes, and evolving in response to changing conditions. Future research and discussion are needed to further elaborate on these ideas and to apply them more concretely to various aspects of sustainability, from environmental management to economic development and organizational strategy. In this context, the foundation of risk management becomes twofold: first, reduce the threats of collapse by eliminating fragilities, and second, ensure that organizations or systems remain open to opportunities for "catching the positive Black Swan." This approach represents a fundamental shift in thinking, as it balances the reduction of vulnerabilities with the pursuit of unforeseen beneficial events. It marks the first step toward enabling organizations and systems to effectively navigate unpredictable future events that could potentially threaten their existence. In conclusion, a paradigm shift must be considered in the field of system stability and sustainability, moving from a resilience-based approach to one centered on antifragility. While resilience focuses on reducing positive feedback loops that may lead to explosive dynamics and potential system collapse (associated with fragilities and non-linear negative Black Swans), antifragility goes further. It involves organizations or systems becoming stronger through trial-and-error, learning-by-doing, and actively engaging with uncertainty. This shift recognizes that instead of merely surviving challenges, systems can thrive and grow by leveraging randomness, uncertainty, and disorder to their advantage, ultimately fostering long-term sustainability.

REFERENCES

Admati, A., & Hellwig, M. (2013). *The Bankers' New Clothes - what is wrong with banking and what to do about it.* Princeton: Princeton University Press.

Akerlof, G.A. (1970). The Market for "Lemons": quality, uncertainty and the market mechanism. *Quarterly Journal of Economics*, 84, 488-500.

Akerlof, G.A., & Shiller, R.J. (2009). *Animal Spirits – how human psychology drives the economy, and why it matters for global capitalism.* Princeton: Princeton University Press.

Borys, T. (2005). Indicators for Sustainable Development – a Polish experience. Warszawa-Białystok: Fundacja Ekonomistów Środowiska i Zasobów Naturalnych.

Bullen, G. (2015). Sustainable service – strategic perspective. In Liu, X., & Li, Y. (Eds.), *Green Services Engineering, Optimization, and Modeling in the Technological Age* (pp. 61-90). IGI Global, USA.

Burchard-Dziubińska, M. (2015). Social responsibility, consumption and production patterns in textile and cloth industry in Poland. *Economic and Environmental Studies,* 15(3), 257-270.

Castells, M. (1998). *End of Millennium.* Cambridge: Blackwell Publishers.

Commission of the European Communities (2005). Sustainable Development Indicators to Monitor the Implementation of the EU Sustainable Development Strategy. SEC(2005) 161final. Brussels: Commission of the European Communities.

Costanza, R., Daly, H.E., & Bartholomew, J.A. (1991). Goals, Agendas and Policy Recommendations for Ecological Economics. In Costanza, R. (Ed.), *Ecological Economics – the science and management of sustainability* (pp. 1-20). New York: Columbia University Press.

Furubotn, E.G., & Richter, R. (1997). *Institutions and Economic Theory – the contributions of the New Institutional Economics.* Ann Arbor: The University of Michigan Press.

Gądek-Hawlena, T., & Wróbel, M. (2015). The effects of innovative solutions implemented in the supply chain of the public postal operator in Poland. *Wrocław School of Banking Research Journal,* 15(1), 35-44.

Hayek, F.A. (1937). Economics and Knowledge. *Economica,* 4(13), 33-54.

Hayek, F.A. (1945). The Use of Knowledge in Society. *American Economic Review,* 35(4), 519-530.

Lambrechts, W., Van Liederkerke, W., & Rymenams, S. (2015). Connecting sustainability initiatives with efficiency measures: an opportunity for business schools. *Central and Eastern European Journal of Management and Economics,* 3(2), 161-173.

Leal Filho, W., Platje, J., Gerstlberger, W., Ciegis, R., Kääriäe, J., & Klavins, M. (2016). The Role of Governance in Realising the Transition towards Sustainable Societies. *Journal of Cleaner Production.*

Piasecka-Głuszak, A. (2015). The implementation of practical solutions in logistic processes in companies familiar with lean management by means of benchmarking methods. *Wrocław School of Banking Research Journal,* 15(1), 45-47.

Platje, J. (2015). Beyond resilience – new institutional economics, fragilities and indicators of unsustainability. *Central and Eastern European Journal of Management and Economics,* 3(4).

Rao, P.K. (2000). *Sustainable Development - economics and policy.* Oxford: Blackwell Publishers.

Słupik, S. (2015). Challenges and barriers to sustainable energy consumption in the Silesian Voivodeship. *Economic and Environmental Studies,* 15(3), 303-322.

Szołtysek, J. (2015). The city as a pretext for developing logistic concepts. *Wrocław School of Banking Research Journal,* 15(1), 25-34.

Taleb, N.M. (2007). *The Black Swan - the impact of the highly improbable.* London: Penguin Books.

Taleb, N.M. (2012). *Antifragile - things that gain from disorder.* London: Penguin Books.

Van Dam, Y.K., & De Jong, J. (2015). The positive side of negative labelling. *Journal of Consumer Policy.*

WCED (1987). *Our Common Future.* Oxford: Oxford University Press.

Will, M., Haidig, J., & Platje, J. (2015). Dysfunctional Leadership – Management in the CSR-case. *Central and Eastern European Journal of Management and Economics,* 3(2), 155-160.

Zepada Quintana, D.S., Mungia Vega, N.E., & Velazquez, L.E. (2015). The importance of Occupational Safety and Health in Management Systems in the Construction Industry: Case study of Construction in Hermosillo. *Central and Eastern European Journal of Management and Economics,* 3(1), 51-69.