SUSTAINABILITY MANAGEMENT IN THE LIGHT OF QUANTUM PHYSICS

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Abstract The purpose of the conceptual study focuses on the sustainability management in the light of philosophical, managerial and ethical implications of the basic findings of quantum physics. The methodology follows the current impetus of sustainability as a complex challenge related to economic, environmental and societal crises. The common denominator for the topic is a contextual perspective and comprehensive solutions in time. The older concept of CSR, for example, offered a concrete forms for the management of companies and organizations, while the newer concept of PRME and SDGs requires a deeper and broader background that provides better tools for educating of managerial responsibility for younger generation at business schools. The findings build on the managerial and teaching experience of the author and existing studies summarizing the current challenges of quantum physics in four dimensions: economic, social (anthropological), environmental and long term. The applications make use of the hitherto almost untapped concept of quantum physics, which formulates several essential philosophical, managerial, and ethical pillars for universal responsibility and sustainable Business and Management. The limitations are due to the wide range of discussion of quantum physics among physicists themselves, but the implications of the study point to obvious implications for sustainability management.

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SDG,
PRME

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A12, A20, QO1

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1 Introduction

The emphasis on sustainability management in the 20th century is based on a conscious existential need for survival in modern crises and in the present and future. This paper demonstrates an overlooked correspondence with the natural philosophical and ethical implications of quantum physics. The philosophy of quantum physics has fundamental implications for sustainability management: to free modern science, and therefore economics and management, from the modern fragmentation of science, the reduction of social disciplines to isolated objects, deterministic and strictly causal analysis using mathematical formulas. Natural scientific approaches in economics and management have created the impression that the disciplines are capable of predicting future developments. These hopes, using economic models and experiments, have demonstrated only minimal evidence for the world's complexity and unpredictable future.

The field of management has started to use the term "sustainability" since the 1992 UN Conference in Rio de Janeiro (UN, 1992). The contribution of quantum physics is the current emphasis on universal context, interconnectedness and complexity of processes.

Some specific direction of sustainability management has found some specific CSR concepts, which have been transformed into specific PRME initiatives and reinforced by the recent emphasis on SDGs (SD, 2015) All this has shown in the last decades a completely new perspective to the classical concept of management, which business schools are still learning to cope with and to integrate the strategy adequately into their curricula and academic work. Even the EU developments show that some schools and countries have not understood and exploited the challenges. Especially the post-communist CEE countries even like to relativize them (Kučera, 2022). This is due to an overly entrenched emphasis on capitalism's utilitarian approach, profit and market economy, which sees consideration of the human and natural context more as a brake on the private interests of investors and owners of companies or shares. Moreover, the transformation economies in CEE are marked by the centuries-old influence of Marxism as a materialist starting point, which is in direct conflict with the idea of comprehensiveness, as well as the responsibility of management and government in all the aforementioned dimensions of sustainability.

In the following chapters, therefore, we will briefly introduce the philosophical impetus of quantum physics and its fundamental relevance to sustainability management.

2 Theoretical Background

2.1 The path to quantum physics

Among the main fathers of quantum physics are well-known figures such as Max Planck, Niels Bohr, Erwin Schrödinger, Max Born, Louis de Broglie, Wolfgang Pauli, Werner Heisenberg, and others. Quantum physics represented a departure from classical physics, whose representatives were, for example, Isaac Newton and Blaise Pascal. The discoveries and the subsequent scientific debate also gave rise to the philosophical treatment of quantum physics to which we will refer in the context of management reality (Omnès, 1999; Baggott, 2004).

For the purpose of the present study, we will only touch on some examples and relevant historical steps that we select to understand the basic differences and lessons for sustainability management.

2.2 Loss of versatility and complexity

We refer to the necessary overview of the historical development of sustainability strategy (Kučera, 2020) The ancient philosophy developed the sciences in the context of universality and universitas. The modern science changed the perspective reducing on strict rational, mathematical, and statistical methods (Galileo Galilei, Francis Bacon, etc.) Isaac Newton began to speak of "exact science". Francis Bacon (1561-1626) declared that such knowledge based on mathematics constituted a kind of “power”.

What we are seeing is a loss of universal concepts that have led primarily to new discoveries in astronomy, physics, chemistry, and biology (especially in the 19th century starting with Darwin). Contextuality and the social sciences, however, have been left behind. Even worse, they were negatively influenced by so-called "social Darwinism" (H. Spencer). The grand conception of the world, society and man has been displaced by the exact sciences and precise expertise. Above all, let us recall the absolute claim of the paradigm of mathematics, or mathematization as a scientific

method also in management. And here also begins the critique from the perspective of quantum physics (Weizsäcker, 1985). Wenzl, (1960) writes about the tension between mathematical fiction and physical reality, subject and objectivity. For management, a space opens up for thinking, analyzing and strategic planning from a certain ideal through reality to a potential future at a higher level of thinking that does not let itself be bound by strictly isolated statistical data and managerial applications based primarily on the natural sciences (see Figure 1).

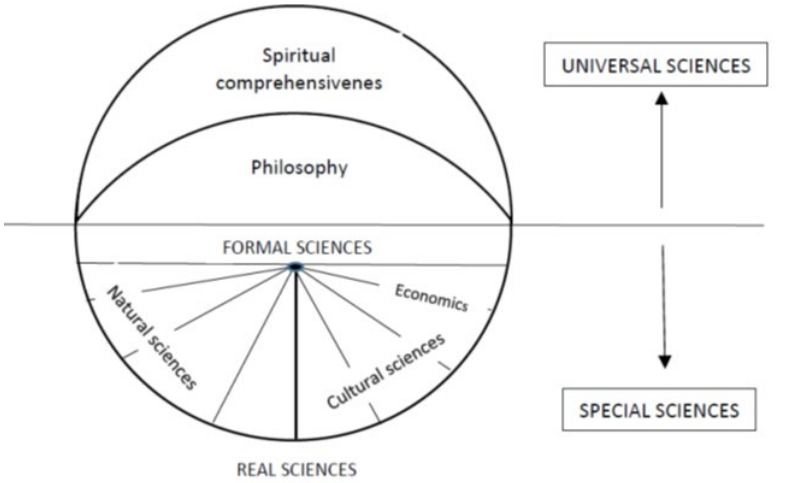

Figure 1: The division of scientific disciplines.
Source: Author's elaboration based on Anzenbacher (2002).

2.3 The emergence of the experience of the whole and the unity of the world

Classical physics introduced mechanical laws that found an adapted echo in economics and management: e.g. the laws of equilibrium, leverage, universal gravitation, inertia, force and interaction. Some originally purely physical laws have also influenced the social sciences and the concept of politics. Quantum physics has articulated the limits of any isolated mechanical phenomena in management in favor of a perspective of the whole, and sustainability.

The classical fragmentation of the sciences at the beginning of renaissance and modernism was replaced by the search for a "theory of everything". Classical theory was challenged by the theory of relativity and by reference to far more complex and

intricate processes in the cosmos and on Earth. Complexity, intricacy, and the need to account for various relationships, special conditions, quanta, waves, unpredictable motions, etc., entered simple models. Physics is discovering that at the microcosmic level, that is, at the level of elementary particles smaller than individual atoms, particles behave differently than in our everyday life. Finally: quantum physics demonstrates the limits of empiricism, determinism and statistics that management is so fond of using. Quantum phenomena are non-deterministic, non-deterministic, probabilistic and non-local (Schüz, 1986).

3 Methodology

The beginning of the study is the acquaintance with the works concerning first the foundations of quantum physics (Weizsäcker, 1985; Wenzl, 1960). We then focus on authors describing the implications of quantum physics. Finally, some references to the implications for management itself (Schüz, 1986). The sources used deal with chapters concerning the return to a unified conception of reality against the long-standing fragmentation and reduction of modern science - and also of management. Among the scholarly works, we find only isolated works in the field of management that relate to the connection with leadership and innovation (Zohar & Marshal, 2016), the importance of interdisciplinarity (Rigolot, 2020), the dimension of organization (Kilmann, 2011) and strategy (Messner, 2018), and computer science for distribution management (Gaily & Sándor, 2021).

3.1 Elements of quantum physics for management

Many quantum physics topics do not yet have a direct analogue in our everyday life and management. The term "quantum" refers to the smallest possible value of any physical quantity. In the microworld, the physicist observes the so-called corpuscular-wave dualism, according to which particles in the microworld have both particle and wave properties. For the sustainability management, this implies completely new challenges in the consequences for managerial philosophy.

According to quantum physics, for example, light can behave as both a particle (photon) and a wave. Light is not just a uniform stream that we perceive with the naked eye. Thus, it opens up completely different perspectives for perceiving the world and the philosophical consequences for sustainability management.

In quantum phenomena, for example, interference occurs, which describes a situation where two quantum particles with wave properties collide: the waves multiply. When the maxima with minimum waves collide, the waves cancel out. To make matters strange, there is a fundamental uncertainty relation in the microworld, it is referred to as the "Heisenberg uncertainty principle" (Ozawa, 2003). Its essence is that we cannot simultaneously measure the complementary properties of particles. Let us imagine, what it means for current management methods: The best known relation is the momentum (velocity) - position relation. If we make the measurement of position more precise, we make the measurement of momentum less precise (de facto impossible), and vice versa. For the claims of management, this implies a certain relativization of its expectations of precision and dominance through arguments and methods that do not take into account motion, time, changes in energy, conditions, and attitudes.

Other uncertainty relations include the time-energy relation, according to which we can never know both the time at which a particle was measured and its energy.

We know from quantum physics that every object in the universe has its own wave function. Using the square of the wave function, we can calculate the probability that a particle is in a particular state. Classical physics is deterministic, quantum physics is probabilistic. The nature of the reality of the microcosm is therefore random and open in quantum physics. The probability and the non-locality of quantum physics play a role. The question of what these phenomena mean for sustainability management will be the subject of further studies.

3.2 The new dimensions of reality

Max Planck opened the discoveries of quantum physics by showing that instead of individual parts, quanta play a role in reality. Light has been shown to be a flowing quantity in waves that have different inertial frequencies (like when we observe propagating circles on the surface of water after an object is thrown in). Even in reflection, light is quantum. Erwin Schrödinger (Mehra & Rechenberg, 1987) generalized: every particle has a wave function (position and time). Everywhere we find the probability of a wave, the location, its amplitude.

In the spirit of quantum physics, the German philosopher Georg Picht reminded us that we are responsible for everything within our range of possibility (Picht, 1985).

We are responsible for our thinking, decision-making and actions with implications for the near and distant future we do not know but influence. Whatever we do has an impact on people, the environment and also affects future generations. No statement or action is isolated.

Speaking of sustainability for the future, let us remind ourselves that physics also knows the negative role of time. Newly emerging orders abolish past ones. According to the first theorem of thermodynamics, the energy content of the universe is constant. Energy can neither be destroyed nor produced. We only change its form. Under the second theorem of thermodynamics, we know that some processes in nature are irreversible. It is impossible to recover heat from a cold reservoir without leaving noticeable changes in the surrounding environment. Entropy therefore increases with time and our actions. In management and economics we talk about resource limits. Entropy is universal! And we cannot turn back time. For management, this means an unimaginable increase in awareness of its responsibility and the importance of Business ethics (Schüz, 1986; 2001).

4 Results and Conclusions

The above-mentioned principles of quantum physics give rise to current suggestions for sustainability management context. It is primarily the problem of fragmentation of the modern sciences that management uses, which must be replaced by the concept of the whole and unity of the world. The knowledge of quantum physics about waves is in direct opposition to the inertia of classical management, which is still based on the concept of separate "particles" (fields, departments, disciplines, and specializations).

Applications in management must deal with the implications of new knowledge about complexity, context and continuity over time to the implications in the future in all areas. The quantum perspective on complexity leads us to a necessary rethinking of the long-standing narrow neoliberal focus on economic growth, individual data, empirical evidence and statistical methods that have overlooked the maintenance of existence and quality of life or social stability. In the perspective of quantum physics, the dimension of reality increases and opens up different probabilities and interdisciplinary interactions. Reality contains infinite possibilities of choice and combination. For management, this means a new level of tasks and ethical responsibility at all points of its activity over time and in various

transformations. The practical application of the theoretical understanding concerns the education of the young generation of managers and executive education. In this sense, the presented field awaits a lot of challenging scientific work.

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