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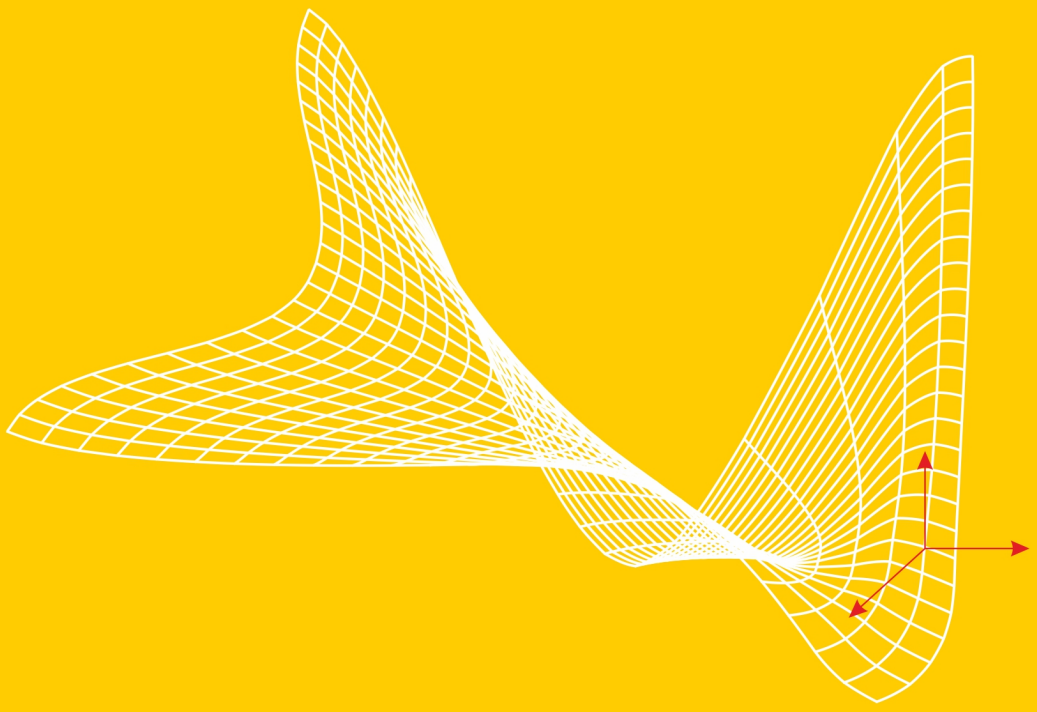

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Contact: Tomasz Rólczyński, Tomasz.rolczynski@wsb.wroclaw.pl, +48 71 376 23 43, ul. Fabryczna 29-31, 53-609 Wrocław, Poland

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Editorial

Johannes (Joost) PLATJE

This issue is the result of co-operation with the International Society for Intercommunication of New Ideas (ISINI, www.isini.info). The aims of ISINI fit very well in the focus and scope of CEREM, which is (see: https://www.cerem-review.eu/focus-and-scope/):

„The Central European Review of Economics and Management (CEREM, formerly WSB Research Journal) focuses on state-of-the-art empirical and theoretical studies in the field of economics and management. It aims to create a platform for exchange of knowledge and ideas between research, business, governmental and other actors. Besides more traditional scientific papers, the journal welcomes conceptual papers, opinion papers and policy discussions from academic, corporate, governmental and civil society representatives.

An important aim of CEREM is to stimulate open-minded discussion of new ideas, new applications of old ideas as well as development of interdisciplinary approaches to current challenges in economics and management. This is of particular importance in the substantial changes that have taken place and are expected to take place in the world. Topical economics and management focus areas are interdisciplinary, non-unified and on the move by nature. They include, but are

Correspondence address: Johannes (Joost) PLATJE, WSB University in Wrocław, ul. Fabryczna 29-31, 53-609 Wrocław, Poland. E-mail: johannes,platje@wsb.wroclaw.pl
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not limited to issues regarding: sustainable development, emerging economies, European strategies, value chains, financial intermediation and managerial designs.“

ISINI (see: www.isini.info) „... seeks to create or recreate alternative paradigms that can help to formulate adequate policies to solve those problems. ... the purpose of the society is threefold:

1. To foster and support the discovery and dissemination of new ideas, in particular in economics and other social sciences and to arrange for their testing (logical and/or empirical) in the realm of various possible social, economic and political systems, as far as analysis can go.
2. To initiate and cultivate contact and consultation not only among economists, financial economists, sociologists and political scientist but also between social and natural scientists including men of arts and letters.
3. To study systematically (using both theoretical and practical reason) the application of new ideas to problems of the real world of today and tomorrow in various existing social regimes and considering the diverse levels of development and historical circumstances. A priority goal is to elaborate development, stabilization, and transitional plans for the various countries where the Society is represented.“

We express the hope on fruitful co-operation in the future.

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The Legacy of Andries Nentjes

Edwin WOERDMAN

Groningen University, The Netherlands

Yoram KROZER

Sustainable Innovations Academy, Amsterdam, The Netherlands

Johannes (Joost) PLATJE

WSB University in Wrocław, Poland

Abstract:

Aim: The aim of this paper is to provide a brief overview of the life and work of Professor Andries Nentjes, who passed away early 2019. As one of the founding fathers of environmental economics in the Netherlands, he contributed in particular to the international literature on market-based pollution control. We wish to honour the legacy of Andries Nentjes by outlining some highlights of his impressive academic research and by showcasing his active contributions to a more sustainable society.

Professor Andries Nentjes

Andries Nentjes was Professor of Economics and Public Finance at the University of Groningen in the Netherlands, during more than thirty years. Professor Nentjes, who preferred to be called 'Andries', passed away in Roden in the Netherlands on the 15th of March 2019, at the age of 80. He is one of the pioneers of environmental economics in the Netherlands. Nentjes published on a wide range of subjects, varying from Keynes to social security to emissions trading, while his genuine kindness made him a much-appreciated colleague and friend.

Correspondence address: Edwin WOERDMAN, Groningen University, The Netherlands. E-mail: e.woerdman@rug.nl (Edwin WOERDMAN), krozer@xs4all.nl (Yoram KROZER), Johannes (Joost) PLATJE (Johannes.platje@wsb.wroclaw.pl.
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Economist at the University of Groningen

Andries Nentjes was born in Ommen, a small Hanseatic city in the eastern Netherlands, on the 9th of July 1938. After growing up in a Protestant family, he married to Hendrikje ('Hennie') Frijlink with whom he spent his entire life, mostly in Roden, a small village close to the city of Groningen. Andries and Hennie had three children (Marijne, Ide and Andrea) and they were blessed with five grandchildren.

The University of Groningen in the Netherlands is the home and heart of Andries Nentjes' academic career. After studying economics in Groningen, Nentjes published a dissertation in 1977 on Keynes' theory of employment, which had been supervised by the renowned Professor Jan Pen. Nentjes became Professor of Economics in Groningen in 1979, focusing on social security issues at the Faculty of Social Sciences. In 1985 he was appointed Professor of Economics and Public Finance at the Faculty of Law, where he would stay until his retirement.

Keynes, growth and the environment

His celebrated academic work encompasses the history of economic thought, macroeconomics, post-Keynesian theories and his favorite subject: environmental economics. Andries Nentjes is considered to be a founding father of environmental economics in the Netherlands.

Professor Nentjes made several novel and important contributions to the literature. His paper with Simon Kuipers (1973), that elaborated the relation between increasing costs of pollution and limits to economic growth, triggered new research. This innovative paper on sustainable growth showed that specific conditions need to be fulfilled regarding technical progress in order to prevent economic stagnation. Andries Nentjes (1990) also contributed to the literature with his non-linear model of international environmental cooperation, which generates a Pareto-efficient exchange of emission reduction commitments between countries. Much of his subsequent research would be devoted to the economic analysis of instruments for environmental policy, including emissions taxation and tradable emission rights. In

the early nineties, there was very limited experience with emissions trading. Nentjes performed numerous studies on emissions trading design, applied to the European legal context. An early example of this is his paper with Paul Koutstaal (1995) on tradable carbon permits in Europe, which includes a comparison with carbon taxes. Next to that, Nentjes also contributed to analyses of policies on acid rain, environmental innovation and water management, just to name a few examples.

At the Faculty of Law in Groningen, Professor Nentjes supervised several PhD candidates who wrote dissertations in the field of environmental economics, including Paul Koutstaal, Ger Klaassen, Yoram Krozer, Bouwe Dijkstra, Frans de Vries, Edwin Woerdman and many others. All former PhD candidates of Andries share a warm feeling about his supervision, which was friendly, supportive and intellectually sharp. Together with these and other scholars, Nentjes published in various renowned journals such as Environmental and Resource Economics, the Journal of Institutional and Theoretical Economics, the Review of Law and Economics, the European Journal of Law and Economics, and Public Choice. This tactile legacy underlines the outstanding quality of his academic work.

Nentjes could excel in research because of his above-average intelligence, his superb mastery of economics and his much-appreciated organization and communication skills. His ability to attract funding for PhD candidates also helped him to advance his own research, not only by publishing together with them but also by dividing the more mundane tasks, such as checking exams, over more people.

Another relevant but less well-known explanation for his success is that he had very little teaching duties at the Faculty of Law as well as limited household tasks at home. While his wife Hennie ran the household and shouldered most caring responsibilities of their children, Pierre Eijgelshoven agreed with Andries to do most of the lecturing in law and economics. Pierre was Associate Professor and a talented teacher, while Andries was a strong researcher. As an efficient form of Coasean bargaining, Pierre agreed to focus almost solely on teaching so that Andries could spend more time on research. A win-win deal that would be almost unimaginable in today's academia, where both professors, associates and assistants are pressured to publish regularly in international peer-reviewed journals and to increase the number of contact hours with their students, against the backdrop of (at least somewhat)

more equally divided caring duties at home. Andries realized that he was in a fortunate position which helped him to thrive as an academic.

Environmental activist with royal distinction

Next to his genuine interest in science and academia, Andries Nentjes also wanted to use his knowledge to protect ecosystems and combat pollution, both in the Netherlands and beyond (as shown in a nice overview in Dutch made by Frans Oosterhuis, 2018). Andries Nentjes was, among others, an active board member of the Landelijke Vereniging tot Behoud van de Waddenzee (1972-1987), a member of the Centrale Raad voor het Milieubeheer (1979-1985), co-founder and chair of the Economenwerkgroep Landelijk Milieu Overleg (1980-1992), and member of the Algemene Energie Raad (1985-1991). As an environmental voluntarist in front of the European Parliament and the Dutch government, Andries fostered environmental organizations, green business development and low-carbon policymaking.

Even at home he preferred to protect the environment and enjoy nature by working in his own garden, which was one of his major hobbies. As a consequence, Andries could show up at the university in a nice suit, but still wearing wool socks with his hands showing traces of work in the garden.

Andries Nentjes described himself as “de economist, die in zijn hart milieuactivist bleef” (Nentjes, 2017), which can be translated as ‘the economist, who remained an environmentalist at heart’. Because of his contributions to science and society, Professor Nentjes was honoured with a royal distinction in 2004, when he was appointed Officer in the Order of Orange Nassau (Orde van Oranje Nassau).

Energetic emeritus professor

Also after his retirement, when he received emeritus status, Andries Nentjes stayed active in environmental economics with various publications and conference presentations. In fact, as he felt relieved from the burdensome administrative tasks he had to perform at the Faculty, he enjoyed his scientific work in economic science even more, next to gardening.

This is exemplified by the fact that the fruits of his post-retirement labour are still being published, even after his death. Examples are his recent work on hybrid forms of emissions trading (together with Edwin Woerdman, 2019), and his work on Pareto-efficient solutions for the shared provision of public goods (together with Bouwe Dijkstra, 2020).

The revival of ISINI

Andries Nentjes also helped to revive the International Society for the intercommunication of New Ideas (ISINI). After a couple of years when ISINI conferences were no longer being organized, his then-ill friend and ISINI Board Member Professor Gerrit Meijer asked Andries to help with organizing the 12th International Meeting of ISINI in Groningen. Andries willingly agreed to fulfil Meijer's wish and the Groningen conference placed ISINI back on the academic map, after which fruitful conferences would follow in Wroclaw, Poland, organized by Professor Joost Platje with the support of long-term active ISINI members, such as Francisco Vargas (former President) and secretary Johan van Ophem

Much to the liking of Andries Nentjes, as stated on its website (www.isini.info), ISINI is an international society composed of scholars and humanists in the areas of economics and the social sciences in general. It is devoted to the study of economic and financial thought, as well as current economic problems, such as economic and financial globalization, climate change, economic development, sustainable growth, structural change in resource distribution, capital and ideology, poverty, and the future of work (both paid and unpaid). Through the interaction and exchange of ideas and information among its members, as well as with non-attached scholars, it seeks to create or recreate alternative paradigms that can help to formulate adequate policies to solve those problems. The concept of intercommunication is preparing the ground for more interdisciplinarity and even for transdisciplinarity. ISINI stresses that all economic phenomena have their cultural, social, individual, political and moral dimensions, but the fundamental ones seem to be those that are intimately linked with human ends and the adequate means for fulfilling them. With this vision, Andries felt much at home at ISINI.

The memory remains

Andries Nentjes was buried on the 22nd of March 2019 in Roden, after a memorial service in the local Catherina Church, where his wife, his children and Edwin Woerdman said a few warm words about his life, character and work. His sincere dedication to science, his seminal publications, his warm personality and his sense of humor will never be forgotten.

With the 14th International Meeting of ISINI held online in 2020 from Wroclaw, Poland, we honoured Professor Andries Nentjes by doing exactly what he always loved: fostering academic debate in a critical but friendly and supportive atmosphere.

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Sustainable development from an evolutionary perspective

Bastiaan (Bas) SCHRAUWEN

Independent scholar, Germany

Abstract:

Aim: awareness of the inherent unsustainability of past economic development, the magnitude and multidimensionality of the resulting environmental problems and the urgency of a paradigm shift in politics and economics.

Design / Research methods: reflection on Matthias Glaubrecht´s book "Das Ende der Evolution" (The End of Evolution). Additionally Yuval Harari´s book "Sapiens" and some online sources were used.

Conclusions / findings: An evolutionary developed cognitive superiority has made Homo sapiens not only to the most successful but also the most destructive species ever, which makes a drastic shift towards sustainable development is overdue in the 21st century.

Originality / value of the article: highlighting the slow and merciless mechanisms of evolution and its big cycles, raising more awareness of the vulnerability of mankind and the necessity for a paradigm shift.

Implications of the research (if applicable): urgency of sustainable development in politics, economics and research.

Keywords: sustainable development, evolution, environmental economics, politics
JEL: B52, Q01, Q59

Correspondence address: Bastiaan (Bas) Schrauwen, independent scholar, Carlstrasse 13, 17235 Neustrelitz, Germany E-mail: bastiaan.schrauwen@gmail.com
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1. Introduction

Sustainable development and evolution are two things that at first glance do not seem to have much in common. Evolution is the basic theory of biology; sustainable development is a concept that should reconcile protection of the environment and economic development. The concept of sustainable development was coined by a UN Commission on environment and development. This so-called Brundtland report defined sustainable development as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987: 16).

In this Brundtland report sustainable development was meant as sustainable human development. However, it is possible to see sustainable development in nature as well: Sustainable development of plants and animals and whole ecosystems, over millions of years, in the course of evolution. It is a development that leads to more abundance of life and more resilience of ecosystems.

I will discuss these tenacious and diversifying aspects of sustainable development in natural evolution first. Then I will highlight the unsustainable development in human evolution so far, and I will conclude with the thesis that our evolutionary developed ability to think rationally still may enable us humans to restore damage done to the ecosystems of the earth, just like it enabled us to inflict this damage in the first place.

2. Sustainable and unsustainable development in human evolution

In 1859 Charles Darwin published his world-changing book „On the Origin of Species By Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life" (Darwin 1859), postulating that evolution, and not divine creation, is the origin of life. We now know that a set of DNA molecules, identical in every cell of a specific organism, is a blueprint of the organism as a whole. In these molecules random mutations may occur, resulting in slightly different characteristics of the organism. Mostly these changes are not profitable at all and the slightly different organism will not survive in the struggle for life. However, sometimes

these changes are profitable and the slightly different organism will win in the struggle for life and its DNA will be passed on to the next generations. A small step of evolution, which eventually may lead to a new species. But it will take a long time, a really long time: millions of years. Extinction of species is a normal process as well For that reason it takes a very long time until a new species really appears. And a long time, again, really means a long time: millions of years. From time to time some species disappear from the scene and go extinct as well, because of changes in microclimate, natural disasters and competition with new species. This appearance and disappearance of species is part of the normal process of evolution but in the last two hundred years, at an accelerating rate, we humans cause millions of species to disappear and go extinct (Glaubrecht 2019 - 417) and we cannot expect nature to repair the damage sometime soon. Of course nature will repair the damage, but it will do so in its own pace. It may take ten million years for natural evolution to develop a world as abundant as our grandparents used to know it. However, it would be a different world with different plants and animals and most probably without us.

Last time, after the dinosaur extinction, it took about ten million years before nature regained its previous abundance, its previous biodiversity. Sixty five million years ago a big meteorite crashed into the Gulf of Mexico, causing a layer of dust darkening the sky worldwide for a long time. Temperatures suddenly fell, plants died without light, animals died for cold and lack of food: 70% of all species disappeared. The world of the dinosaurs was lost and about ten million years later a new world of mammals, birds and other creatures, the world we are familiar with today, had appeared (Lowery, Fraass 2019). This aspect of evolution shows its large time scales but also its tenacity.

This is sustainability: nature´s evolution never gives up. Massive climate changes caused mass extinctions at least five times in earth´s history. But never all life disappeared, and always evolution accelerated after a mass extinction event because of the many free ecological niches and low pressure of competitors and enemies. Evolution of the surviving plants and animals was ten times faster after the extinction of the dinosaurs than before, a recent study showed. But still: ten million years to develop the previous diversity (Halliday 2016). This diversity is an

enormous abundance of specialized species. Many different food relationships develop: “to eat and to be eaten” is a basic principle of life. But many forms of mutual dependency or mutual assistance, if you prefer, develop as well. Flying insects looking for nectar in flowers are essential for pollination of most plants; the underground mouldy network of mushrooms gets its energy-rich nutrition from trees and helps them to better absorb water and minerals; certain small fish clean the teeth of bigger fish and get nutrition in return. Diversity is essential for sustainability, because it guarantees every role in the ecosystem to be played. If an organism disappears from the system, for whatever reason, another one will take its place. And even more important: diversity makes a system resilient. An intact, diverse ecosystem, like a primeval forest, is much more resilient than a poor one, like a commercial monoculture forest. One species of beetle will not be a real threat to a primeval forest, like it is currently to our monoculture pine forests, because younger trees and other tree species would not be affected as severely. Rather the beetle would bring about the regeneration of many species and the rejuvenation of the forest. A study on the population dynamics of the bark beetle points out that “these outbreaks have strong negative consequences on ecosystem services like provisioning of clean water and timber, and the regulation of climate and carbon storage, but paradoxically facilitate local biodiversity” (Biedermann et al. 2019).

Man is part of nature as we know it, too. We are primates, animals adapted to life in the trees of tropical forests. We belong to a subgroup called the dry-nosed primates (Glaubrecht 2019: 75). The taxonomical group of the dry-nosed primates consists of two monkey families on both sides of the Atlantic Ocean, and the tailless family of the great apes. This is our taxonomical family, which we share with orangutans, gorillas and chimpanzees. For some reason, our ancestors one day decided or were forced to leave the trees of the tropical forests in central Africa and make a living on the savanna. They had learned to use sticks and stones as tools and weapons and were clever enough to make them sharper, and more effective. They evolved into a new evolutionary branch of species, humans, Homo in Latin, great apes adapted to life in an open landscape. About a dozen species of Homo developed in the course of the following millions of years (Glaubrecht 2019: 80): a diversity that optimized the chance for this new kind of apes to find its role in the

new environment. Some went upright and lost most of their fur, which enabled them to run after prey animals and cool their bodies by sweating (Lieberman, Bramble 2007). About 1,900,000 years ago some of them left Africa. Bit by bit, in the course of many generations, they spread over the whole world. Their life still was sustainable, like that of the animals around them. They were hunter-gatherers. When hunting, they hunted like other hunting animals and usually caught young, weak and sick individuals that are easiest to get.

We are not one of these early species of man, though, we are Homo sapiens. Homo sapiens left Africa about 70.000 years ago, 1,780,000 years after earlier species of Homo (Glaubrecht 2019: 175, 190). We have been the only human species for a long time now, so apparently we killed the other ones anywhere we met them. Not only other human species but nature in general suffered massively wherever Homo sapiens entered the scene. Competing predators like wolves, bears and lions as well as big animals like elephants, mastodonts, rhinoceroses, aurochses and bison either were exterminated or decimated. It is nothing new, it was like that since the first Homo sapiens left Africa (Glaubrecht 2019: 194). We are the deadliest species that ever existed on earth; Tyrannosaurus Rex was a harmless creature compared to us.

What made us so much more dangerous than other species of man? It was an evolutionary change in the brain of early Homo sapiens (Glaubrecht 2019: 136)). It enabled him to think beyond the here and now, to think abstractly, to imagine non-existent or not yet existing things and situations. This was a new layer of consciousness, so to say. It was this Cognitive Revolution, about 70,000 years ago, that made the difference (Harari 2014: 368). It allowed rational thinking and this led to an incredible acceleration of man´s evolution. Not an evolution in the biological sense of the word, no mutational changes in the DNA, no changes in our physical constitution, but big changes in our abilities. We developed more sophisticated languages, which enabled us to communicate much better, which enabled us to cooperate much more effectively. We developed cultures and we developed agriculture. We achieved an Agricultural Revolution about 10,000 years ago and another one, the Industrial Revolution about 220 years ago. Both the Agricultural and the Industrial Revolution provided food and wealth for more people. The world

population began to grow, fist slowly, but ever faster and faster. We were a relatively constant number of about 4 million people until about 4,000 BC. Then an exponential growth started: 190 million people at the beginning of the Christian era, 600 million in 1700, 1.65 billion in 1900, 3 billion in 1960, 7.6 billion now (Glaubrecht 2019: 243).

In modern times, with fire weapons, chain saws, agricultural machinery, artificial fertilisers and pesticides, man has become almighty on earth. If evolution is a contest, we won the cup. We are the crown of creation, the crown of evolution, we think. But we might as well be the stupidest creature in the world, digging its own grave. It wasn´t until the 1970s that we started to become aware of the fact that we still are part of nature, depending on its ecosystems for our survival, and nevertheless on the very best way to destroy it all. It may not seem so relevant to us that there haven´t been any aurochses, elephants, lions and wolves around in most of Europe for ages already, we survived very well without them. But we have not only been decimating big animals everywhere. Very many smaller animal species and plants have been undergoing the same fate, at a still accelerating rate. The destruction of their natural habitats to create more room for cattle and agricultural lands and more intensive fishery, too, have been the main reason for the loss of so many species of plants and animals. Of course, the need for us to do so is the relentless growth of the human world population. Can we secure food, fresh water and clean air for a world population of ten billion people by the end of the century, while fish disappear, soils degrade, glaciers melt and forests burn? It is a challenge, to say the least. Overpopulation, environmental pollution, mass extinction and climate change are four big scary monsters that are standing right in front of us. No wonder we are paralyzed when we look them in the face. They are mighty boomerangs that could make the human world population collapse. But as long as we still can feed most people, do not feel the consequences of mass extinction all too harsh yet, and climate change did not escalate right away, it is still easy to look the other way and to believe the monsters are not so big at all. The cognitive revolution, that inspired us 70.000 years ago to embark on a conquest of the world, has shown how fast our cognition, our rational understanding, can change who we are. We developed sophisticated languages, script, agriculture, towns, countries, multiple

transport systems, companies, industry, science, medicine and information technology. What takes millions of years for natural evolution, takes a hundred years or less for us. Unfortunately, it brought us on the brink of extinction in this 21st century. "Pride goes before destruction, and a haughty spirit before a fall", the biblical book of Proverbs reads (New International Version, Pr. 16.18).

3. Concluding remarks

Since the Cognitive Revolution Homo sapiens has been going through a kind of highspeed evolution, accelerating exponentially. We had one blind spot though, all the way from prehistoric times through the industrial era, but especially in these last two hundred years: we depend on intact ecosystems to stabilize the climate and secure food, clean water and clean air. If we do not want our cultures and our populations to collapse in the coming centuries, we need another leap of highspeed evolution right now.

In fact we did start this revolution in the second half of the 20th century already. An awareness of environmental problems came up in the 1970s, ever more scientific research on the topic deepened our understanding, green political parties appeared and protection of the environment became a general political point of interest. The United Nations organized summits, international declarations were drawn up and accepted; environmental laws were put in place. We are able to realize a sustainability revolution in fishery, agriculture and forestry, and manage a zero carbon revolution simultaneously in this 21st century.

Society is like a large, heavy vessel that can change its course only slowly though. Now we understand which technical and agricultural changes are necessary and have the knowledge to realise them, economic, political, cultural and psychological hurdles must be overcome in order to keep the vessel of society turning away from the iceberg in front of us. Grand narratives paved the way for such big societal changes in the past. Stories about kings being appointed by the gods were the basis for the acceptance of their rule and the resulting efficient cooperation of thousands or even millions of people (Harari 2014: 106), stories

about the American dream inspired a mass migration to the New World and stories about work and wealth in industrial towns lead and still leads to urbanization.

What we may need now is a new "grander narrative" (Zehner 2012 - epilogue), one that can be stronger than the narratives that are misguiding our current industrial societies. The story of Sustainable Development can be a story that remains inspiring and hopeful even in disasters that may come. A light at the horizon, something to fight for.

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The emerging threats and opportunities for implementing nationally determined contributions (NDCs) and sustainable development goal 7: policy insights from sub-Saharan Africa and Malawi

Dumisani CHIRAMBO

Seeds of Opportunity, Malawi

Abstract:

Aim: Despite the implementation of the Sustainable Development Goals (SDGs) and Nationally Determined Contributions (NDCs) to reduce climate change vulnerability and inequality particularly in the Global South, it is probable that the SDGs and NDCs might not achieve their objectives. The aim of this article is to identify how countries in Sub-Saharan Africa (SSA) can address their climate change governance and cross-sector coordination challenges in order to reduce climate change vulnerability and augment SDG 7 (universal energy access) implementation.

Design / Research methods: A qualitative content analysis was undertaken using research articles, project reports, a case study and policy briefs exploring the nexus of climate change governance, SDG 7 implementation and SDG 13 implementation in the context of SSA and Malawi.

Conclusions / findings: The study suggests that climate change governance and attaining SDG 7 in the Global South might be improved by harmonising NDC activities so that NDC activities can be aggregated and monitored from a regional perspective similar to the case of the Clean Development Mechanism (CDM) Programmes of Activities (PoAs).

Originality / value of the article: The paper is of value to global policy makers as it shows that increasing climate change ambitions and ratcheting-up in the context of SSA should include increasing the deployment of renewable energy technologies as well as initiating new international institutional arrangements for climate change governance through South-South Climate Change Cooperation modalities.

Keywords: Clean Development Mechanism (CDM), climate finance, renewable energy, South-South Climate Change Cooperation, Sustainable Development, Malawi.
JEL: G38, O13, O55, Q01, Q28, Q54, Q56.

Correspondence address: Dumisani CHIRAMBO, Seeds of Opportunity, P.O. Box 1423, Blantyre, Malawi. E-mail: sofopportunity@gmail.com
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1. Introduction

The Sustainable Development Goals (SDGs) are calling for State and Non-State Actors in both developing and developed countries to implement effective climate change policies and programmes that can also end poverty and reduce inequality within and across countries (Northrop et al. 2016). However, climate change is still considered as one of the greatest development challenges of the World and as it is compounding the socio-economic constraints to development in the Global South (Partey et al. 2018; Berchin et al. 2017). One of the factors that make managing climate change problematic is that an individual country, company or citizen has little impact on the climate. Furthermore, individual action is costly, while the benefits are felt by all countries and inhabitants of the world. This creates the well-known problem of collective action (Ostrom 2008; Brechin 2016). Consequently, policy maker have implemented various global treaties and mechanisms such as the United Nations Framework Convention on Climate Change (UNFCCC), SDG 13 (manage climate change and its impacts) and Paris Agreement as a means for simultaneously regulating the amount of greenhouse gases that are emitted into the atmosphere and providing incentives to promote sustainable development. Added to this, the main international climate change governance architecture comprises of voluntary commitments by governments in the form of Nationally Determined Contributions (NDCs). Unlike other previous international governance architectures for environmental management and climate change management such as the Montreal Protocol and Kyoto Protocol, which were top-down and prescriptive in nature (Kaku 2011; Woodcock 2009), the NDC framework is a bottom-up, country led approach for improving climate change governance (Mbeva et al. 2015; Jiang et al. 2017).

However, since the NDC framework does not encompass legally binding emission reduction targets for any country, some authors consider this new model for climate change governance to be less stringent since it gives national governments the opportunity to formulate their climate change pledges with more emphasis on maintaining their own rights, interests and economic development space (Zhang, Pan 2016), rather than formulating pledges based on drastically reducing greenhouse gas emissions and promoting transitions towards the

sustainable utilisation of resources. Unfortunately, the NDC framework has failed to galvanise commitments for limiting greenhouse gas emissions sufficient enough to reach the Paris Agreement's target of limiting global temperature increase to 2 °C (Röser et al. 2016). Without innovations in NDC development and implementation, Sustainable Development Goals (SDGs) are unlikely to be achieved and the existing inequality in development and growth can be expected to continue (Bak et al. 2017).

Global South countries such as those in sub-Saharan Africa (SSA) face a dilemma since they are the most vulnerable to the impacts of climate change as they have inadequate resources for adaptation and coping. Moreover, since such SSA countries were not major emitters of greenhouse gases their precarious position and dilemma might be considered a "double injustice" (Weiler et al. 2018). Accordingly, it has been suggested that climate change will not only impede economic development in the Global South and cause social unrest in the region but it will also slow down progress on attaining the SDGs since it will exacerbate the rates of migration, forced displacements and extreme poverty. Some estimates therefore point out that by 2030 the number of poor people whose poverty will be attributable to climate change will be 100 million and by 2050 the forcibly displaced people in the regions of SSA, South Asia and Latin America will be more than 140 million (Rigaud et al. 2018; Dowla 2018). To further compound these issues, attaining sustainable development will be constrained even further as the use of natural resources and environmental stress will increase due to rapid population growth and economic growth demands (Berchin et al. 2017), hence the SDGs aspirations of ensuring that no-one is left behind in accessing modern energy, education, health services, etc. will become more challenging.

NDCs may be considered as climate change policy instruments that can initiate societal and institutional changes to minimise the adverse impacts of climate change. Accordingly, various studies on NDC development and implementation have been undertaken globally. Most of these studies have primarily focused on providing insights into aspects that can enable different countries to increase their greenhouse gas mitigation commitments. For example, Jiang and Hanaoka (2017) looked at actions that could be undertaken within the NDC framework to reach the global target of limiting the global temperature increase to 2°C above pre-industrial levels.

Jiang and Hanaoka (2017) concluded that there was space for four regions to undertake more mitigation actions than given in their NDCs in order to put the world on a trajectory to meet the 2 °C target. Zhang and Pan (2016) undertook an analysis of 160 NDC reports (covering 188 Parties) submitted to the UNFCCC Secretariat in order to determine the financial demand, mitigation cost and priority investment areas for developing countries. Their results indicated that among 160 NDC reports, 122 reports clearly included the finance content and 64 reports proposed specific amounts of financial demand for greenhouse gas mitigation in 2030, hence they pegged US$ 474 billion as the approximate amount of financing that Global South countries will need for various climate change programmes in 2030. Kissinger et al. (2019) explored the potential of climate finance to support developing country efforts to shift away from unsustainable land use patterns in the context of the 2015 Paris Climate Agreement. Kissinger et al. (2019) concluded that while much attention is directed to the inadequate quantities of international climate finance, agriculture, forestry, land use, etc. have significant impacts on climate change mitigation and adaptation actions but yet in the absence fiscal reform there will be no transformative change for improved climate action. Abramskiehn et al. (2017) undertook an assessment of how National Development Banks can drive investment in the NDCs of South American countries. Abramskiehn et al. (2017) concluded that National Development Banks can mobilise climate investments that can help to meet NDC objectives but their full potential is yet to be realised as they lack the technical abilities to identify and undertake climate change adaptation projects.

Nonetheless, contemporary studies are now arguing that climate change will continue to impede progress towards attaining the SDGs if existing climate change governance architectures are not improved (Alves et al. 2020; Mpaire et al. 2017; Pardoe et al. 2018). On one hand, this means that the NDC framework has two great challenges to overcome, that is to increase climate change mitigation actions to a level commensurate with reaching the Paris Agreement's 2°C target and to establish institutional arrangements that can enable the NDC framework to foster successful low carbon development transitions. On the other hand, this suggests that there are knowledge gaps on how policymakers in SSA can improve NDC development and implementation to augment sustainable development, more particularly the

simultaneous implementation of SDG 7 (ensure universal energy access) and SDG 13 in SSA. Accordingly, to address this knowledge gap, an exploratory study focusing on NDC implementation in the context of SSA and Malawi was undertaken in order to determine the innovations that can be incorporated in NDCs to enable NDC governance architectures to accelerate inclusive growth and renewable energy deployment in SSA and Malawi.

The paper is arranged as follows: section 2 follows with a narration of the paper's methodology and research framework. Section 3 provides an analysis of the challenges related to achieving SDG 7 in SSA. In section 4, insights into NDC and climate change policy implementation in Malawi and SSA are provided. The discussion in section 5 argues that the development and implementation of NDCs and improving climate change governance could be improved by instituting new protocols that can replace public communication with public participation as the main public engagement strategy for policies. The paper concludes in section 6 with suggestions on how the harmonised implementation of NDCs at SSA region level can strengthen South-South Climate Change Cooperation and augment SDG 7 implementation.

2. Methodology and research framework

In order to achieve the aim of this paper (i.e. to determine the NDCs innovations that can address climate change governance and cross-sector coordination challenges in SSA), an exploratory study based on analyses of research articles, project reports, a case study and policy briefs exploring the nexus of climate change governance, SDG 7 implementation and SDG 13 implementation in the context of SSA and Malawi was undertaken. SSA was selected as the region of study as SSA is amongst the regions that will be the most adversely affected by climate change. SDG 7 implementation was chosen as a focus area because many Global South countries have low access to electricity and it has been emphasised that in the context of SSA priority should be given to ensuring that SDG 7 is attained before 2030 for the countries to stand a better chance of attaining the SDGs by 2030 (AfDB

2016a). The paper has also used Malawi as a case study on NDC implementation, climate change policy implementation and climate change governance as Malawi is a Least Developed Country (LDC) that is considered to be very vulnerable to the impacts of climate change because of a lack of resources for adaptation and influence of weather hazards (Olson et al. 2017; GoM 2015). Malawi is also reported as one of the least electrified countries in the world as country's electrification rate stands at 9% (Hancock 2015).

Since the research was exploratory in nature, the documents analysed were identified through internet searches on NDCs in the region and they were selected through purposive sampling. The data used in the research was not intended to provide a representative or statistical sample of how all the NDCs in SSA are trying to integrate and coordinate climate change issues with other development priorities such as renewable energy deployment, but rather to provide an indication of how NDC priorities and institutional arrangements in NDCs can potentially constrain the potential of NDCs to have the dual roles of promoting climate change actions and sustainable development. The methodology and research framework adopted therefore bears resemblance to some secondary data based studies such as England et al. (2018) and Alves et al. (2020). In the research by England et al. (2018), the study sought to determine how national governments can harmonise their national policies in order to maximize their potential to move towards Climate Compatible Development. The methodology used in the study included undertaking a cross-sectoral comparison of government policy documents in the Southern Africa Development Community (SADC) region and undertaking a qualitative content analysis of SADC countries' national sector policies to determine their priority approaches for water, agriculture, forestry and energy. In this research internet searches were conducted in order to locate the sector policies on government and other relevant websites. Additionally, for policies that could not be located online, staff members working for relevant government departments were contacted by email in order to obtain the policies (England et al. 2018). In the study by Alves et al. (2020), the study sought to analyse the status of climate change policies by using a sample of 13 countries to understand how such countries were developing their National Adaptation Plans (NAPs) to overcome the observed climate adaptation

limitations and guide their responses. The methodology in this paper included analyses and comparisons of public policies on climate change (e.g. objectives, stakeholders, participatory mechanisms) by looking at both NAPs and complementary plans and measures (Alves et al. 2020).

The countries that have implemented NDCs vary widely in national circumstances and domestic policies hence NDCs across different countries have no standardised format meaning that countries are at liberty to choose different methods to describe and quantify their greenhouse gas offsets. This also means that not all NDCs can be directly compared in terms of scope and ambition (Hedger, Nakhooda 2015; Mbeva et al. 2015). Consequently, rather than attempting to formulate a standardised methodology and research framework for assessing climate change governance and cross-sector coordination challenges in the NDCs for all countries, the research methodology for this paper focuses on theorising and conceptualising how policy makers can identify energy sector institutional and governance weaknesses related to their NDCs and identify how modifications to NDC institutional arrangements can influence the governance of SDG 7 and SDG 13 implementation.

3. Sustainable Development Goal (SDG) 7: the elusive ambition?

3.1. SDG 7 Implementation in the Global South

A lack of access to electricity and modern energy services is often cited as a factor that perpetuates poverty and inequality in the Global South (Urban 2018; McCollum 2018). SSA with an electrification rate of 35% is arguably the least electrified region in the World (Sweerts et al. 2019; Newell, Bulkeley 2016) and also the region with the most number of LDCs. SSA's energy deficit is so dire and retrogressive to the extent that the current low rates of electrification in many African countries is considered as the most pressing obstacle to economic growth, more important than access to finance, red tape or corruption (IEA 2016). With SSA's electricity access rates hovering around 35%, it can be argued that ensuring that investments in renewable energy technologies and infrastructure are to be

successfully undertaken in SSA will require new innovations in technology, policies, institutions and financing models as project developers and utilities in the region have historically failed to facilitate the wide-scale deployment of renewable energy technologies let alone improve electrification rates with fossil fuel energy supply systems.

Between 2010 and 2035, energy-related greenhouse emissions could rise by 20% globally in absence of substantial investments in renewable energy. Currently two thirds of all anthropogenic gas emissions are roughly contributed by the energy sector (Northrop et al. 2016). This therefore means that whilst increasing access to electricity and modern energy services is desirable, what is even more desirable is ensuring that developing countries leapfrog from low electrification rates to universal energy access through renewable energy sources (Amankwah-Amoah 2015; van Gevelt et al. 2018). In the energy sector, there are possibilities for developing countries to directly invest in advanced technologies rather than pursue environmentally damaging pathways that most to industrialised countries pursued. This process is aptly termed "technological leapfrogging" and its advantages in the energy sector include that it can use technology which is fit for the level of economic development, without posing threats to, e.g., employment or draining capital resources (Amankwah-Amoah 2015). Currently, technological leapfrogging is associated with the newly industrialised economies in Asia (ibid), hence SSA's challenge in the energy sector is to ensure that the region becomes the next frontier for technological leapfrogging.

SSA has various renewable energy resources and fossil fuel resources spread across the continent that can enable the continent to easily achieve universal energy access (Lior 2012). However, factors such as lack of finance, lack of appropriate legal and regulatory frameworks and lack of appropriate business models have been highlighted as the issues that have constrained efforts to increase access to electricity in the region through renewable and non-renewable energy sources (Johnson et al. 2017; Chirambo 2018). With regard to financing, some estimates have pointed out that for Africa to attain universal energy access, it has to drastically improve its capabilities to mobilise financial resources for energy sector investments from the current spending of US$ 8–11 billion per year to approximately US$ 40–55 billion

per year (Schwerhoff, Sy 2017). Notwithstanding the aforementioned, there will be a further need for various countries to develop private and public finance for SDGs implementation by an estimated US$ 1.3 trillion annually in developing countries and US$ 342–355 billion in low income countries (UNDP 2015). Additionally, since various countries in SSA have various energy resource endowments, regulatory frameworks, socio-economic profiles, climate change vulnerabilities and demographics, the rates to which investments in renewable energy deployment occur varies from country to country. Consequently, even though attaining universal energy access is desirable to augment economic growth, the grim reality is that not all countries in SSA can be envisaged to be able to achieve universal energy access by 2030. In this regard, projections by Sanoh et al. (2014) showed that 100% electrification by 2030 is unattainable in most SSA countries but a likely scenario is that by 2050 100% electrification will be attained by countries with a current electrification rate of 60% and countries with a current electrification rate of less than 60% may be up to 80% electrified in 2050.

3.2 Accelerating rural electrification through NDCs and climate action

Many developing countries face insurmountable challenges in their efforts to attract investments in the renewable energy and climate change action sectors. However, some reports have indicated that SSA, South Asia, and East Asia & Pacific are arguably the three regions that present the most significant investment opportunities in both energy access and climate change mitigation. For example, high climate efficiency of investment can be achieved in India, South Africa, Mozambique, Cambodia, Mongolia, Uganda, Kenya and Rwanda by using its investment potential of US$ 360 billion for renewable energy by 2030. This investment supports economic development as well as climate change mitigation (Tonkonogy et al. 2018). Outside the scope of these countries it might therefore be argued that more efforts will need to go into building strong institutions and favourable policy environments so as to improve the financing and technology transfer of renewable energy technologies. This follows that the two critical obstacles for the deployment of renewable energy technologies in Africa include the difficulty of attracting sufficient and affordable finance (Sweerts et al. 2019), and

developing business models that can promote renewable energy technology transfers. Since the costs of various renewable energy technologies are drastically decreasing, it also means that the cost-competitiveness of renewables with fossil fuel alternatives will keep on improving (Tonkonogy et al. 2018). For example, technological development seems to proceed faster than predicted, leading to an increased capacity growth of solar photovoltaic (Tonkonogy et al. 2018). This therefore means that the potential and prospects for utilising renewable energy deployment for improving electricity are continuing to improve since the technologies are relatively getting cheaper and more affordable with time.

It might be anticipated that African countries would be in the forefront in enacting transformative policies to mitigate greenhouse gas emissions and increase investments in renewable energy because they are the most vulnerable to future climate change and there have been decreases in the cost of renewable energy technologies. Unfortunately, that is not the case. In actual fact, some research has pointed out that many climate change vulnerable African countries such as Malawi, Tanzania and Mozambique are not accelerating their deployment of renewable energy technologies but rather increasing their investments in fossil fuel power supply systems (GoM 2015; Pardoe et al. 2018; Mahumane, Mulder 2019). Arguably, one area in which NDCs can facilitate transitions to enable current development paradigms to succeed in attaining sustainable inclusive growth is by facilitating increased investments in renewable energy in SSA. Furthermore, NDCs should not only aim to accelerate the deployment of renewable energy technologies but should actually focus on directing renewable energy investments to rural areas. Such an approach in NDCs will therefore promote climate change mitigation and also ensure that there is equitable access to electricity in SSA since urban and rural electrification rates in SSA differ significantly as most electrification projects in the region favour urban electrification. To substantiate this assertion, an assessment by the African Development Bank (AfDB 2016b) and Hancock (2015) quantified the urban electrification bias and estimated that SSA had an electrification rate of 35% in 2012, an increase of 3% from the 2010 baseline of 32%. This therefore translated into SSA's urban electrification rate reaching 59% in 2012 and the rural electrification rate reaching 16% in 2012. In fact, it can be argued that during these

years urban areas witnessed energy access growth surpassing population increase by 25 million people whilst the opposite occurred in rural areas with rural population growth outpacing energy access rates. Arguably, this means that even though increasing rural electrification rates could reduce the urban-rural divide and create more employment opportunities in rural areas, energy sector project developers and utilities have a bias towards developing energy infrastructure for urban development. Additionally, this also suggests that SSA's current rural electrification modalities and policies are not providing sufficient incentives to promote the deployment of renewable energy in rural areas and ensure universal energy access.

Similarly, even though NDCs have facilitated the proliferation of various climate finance modalities that have objectives related to promoting renewable energy deployment, anecdotal evidence suggests that such climate finance modalities are not leading to energy sector transitions capable of promoting inclusive growth and wide-scale rural electrification in SSA. For example, even though the development of large renewable energy projects can increase electricity production, such large renewable energy projects have minimal benefits for sustainable economic development as they are mostly connected to the grid (Oji et al. 2016). However, aggregating small renewable energy projects within dispersed African communities does not only reduce energy poverty but also makes a positive contribution towards local economic development (Oji et al. 2016). On the other hand, Multilateral Development Banks, which are the main financing channels for climate finance are noted to provide access to finance for large scale renewable energy projects easier since they have lower managerial transaction costs and increased ability to obtain funding for investment (Soanes et al. 2017). So, despite the knowledge that small scale projects/decentralised energy programmes/mini-grid systems can provide poor communities with access to energy faster and often have various other benefits including (i) proportionally less regulatory approvals and investment costs, (ii) and cheaper and quicker deployment modalities (Kaijage et al. 2017; AfDB 2016b), most renewable energy investments in SSA are still likely to focus on the development of large grid connected infrastructure. Cumulatively, these issues suggest that policy makers should initiate deliberate interventions to direct project developers and investors towards the technologies and initiatives that can

augment small renewable energy projects in rural areas in order to promote inclusive access to renewable energy and electricity. Arguably, with the aforementioned factors in mind, it might be argued that NDCs can create synergies and institutional coordination modalities that can simultaneously foster inclusive growth and decrease greenhouse gas emission rates should they include specific clauses and institutional arrangements that mandate energy related climate change programmes and projects to have specified quotas for renewable energy deployment in rural areas.

3.3 Towards sustainable development and universal energy access in Malawi

Malawi is a land-locked country in southern Africa that is bordered to the north and northeast by the United Republic of Tanzania, to the west by the Republic of Zambia and to the southwest and east by Mozambique. In trying to understand the factors that influence development in Malawi, the Malawi National Climate Change Management Policy (GoM 2016: iii) lists a narrow economic base, dependence on rain-fed agriculture and low adaptive capacity at the community and national levels as factors that perpetuate climate change vulnerability in Malawi. Malawi's profile shows that the country's electrification rates are below those for SSA as the country has an electrification rate of 9%. The low electrification rate means that Malawi has 15 million people without access to electricity, a 33% urban electrification rate, a 5% rural electrification rate, 97% of the population relying on traditional use of biomass for energy and 15 million people relying on traditional use of biomass for energy (Hancock 2015). Malawi's emission rate of 1.4 t CO_2 per capita in 2015 is very low compared to other countries. (GoM 2015). None the less, Malawi as a Party to the UNFCCC intends to move the country's development pathways towards a green economy hence the country developed its NDC to contribute towards global sustainable development aspirations (GoM 2015).

In the NDC for Malawi, the country's unconditional mitigation commitments include: (i) produce 2,000 solar water heaters (SWH), (ii) install 20,000 solar photovoltaic systems, (iii) produce 351 megawatts (MW) of hydro electricity, and (iv) distribute energy saving cook stoves to 400,000 households. The country's conditional mitigation commitments include: (i) increase SWH from 2,000 to 20,000

by 2030, (ii) increase solar photovoltaic systems from 20,000 to 50,000 by 2030, (iii) increase generation of hydro electricity by 800 MW by 2025, and (iv) increase the number of households adopting energy saving stoves to 2,000,000 by 2030 (GoM 2015). If reference is made to the preceding section where rural electrification and deployment of mini-grids are highlighted as strategies for creating synergies for simultaneously achieving climate change goals with development goals, then it might be argued that it could be beneficial for Malawi and similar countries to include both conditional and unconditional commitments related to installing and investing in mini-grids in their NDCs. By incorporating specific mini-grid commitments in NDCs, the NDCs framework might therefore be able to mobilise and direct domestic and international financial and technical resources towards electrifying rural areas and this will not only increase rural electrification rates at a pace that might not have been feasible without the NDCs but they will also be providing support to reduce the risks associated with mini-grid development to enable many private enterprises to scale-up mini-grid deployment.

4 NDCs and Climate Change Policy Implementation in Malawi and SSA

4.1 NDCs as Agents of Transformative Climate Change Governance

The Government of Malawi enacted the Malawi National Climate Change Management Policy in 2016 (GoM 2016) with a goal to harmonise and enhance the planning, development, coordination, financing and monitoring of climate change initiatives and programmes. The Malawi National Climate Change Management Policy (GoM 2016) lists Malawi's six priority areas for climate change management as:

(i) climate change adaptation; (ii) climate change mitigation; (iii) climate change capacity building, education, training and awareness; (iv) climate change research, technology development and transfer, and systematic observation; (v) climate change financing; and (vi) cross-cutting issues (i.e. gender consideration, population dynamics and HIV and AIDS) (GoM 2016: 10-13).

The development and implementation of climate change policies can provide countries with various advantages. In this regard, Bird et al. (2016: 101) considered climate change policies as tools for (i) augmenting climate change resource mobilisation, accelerating the pace of development planning and climate resilience interventions, (ii) installing new institutional coordination mechanisms, and (iii) strengthening institutional capacities. Arguably, since Malawi has both a climate change policy and NDC, it might be expected that Malawi will be in a better position to be able to implement comprehensive climate change and sustainable development programs. However, in the context of Malawi, the presence of a climate change policy and NDC might not entail enhanced climate change action and management as other environmental challenges such as pollution and deforestation have continued to worsen in the country regardless of the existence of various environmental legislation (i.e. Forestry Act (1997), Environmental Management Act (1996), National Environmental Action Plan (2002), etc.). Malawi therefore has similar challenges like other SSA countries such as Uganda and Tanzania where researchers such as Mpaire et al. (2017) and Pardoe et al. (2018) highlight that even when pertinent policies are in place there are still chances that the policies might not be implemented effectively. In this regard, aspects that require special consideration to ensure effective policy implementation include increasing awareness and the level of knowledge on the importance of separate environmental administrative units; increasing budgetary allocations; increasing consultation processes with stakeholders; enhancing coordination and cooperation between different administrative units; and improving communication channels between different players at the local, regional and national level. Building the capacity of regulators to improve their capabilities for environmental and climate change policy implementation is therefore arguably more vital than ensuring that policies are developed since in the status quo the actual actions of State and Non-State Actors do not always comply with policies and best practices for environmental governance and sustainable development.

In their analysis, Adenle et al. (2017) considered that a lack of institutional capacity has various implications on the implementation of climate change policies and transitions to low-carbon development pathways since a lack of institutional

capacity has led to Africa's low access to and use of climate finance and a lack of climate change mitigation programmes. Adenle et al. (2017) therefore suggested that improving the development and implementation of climate change programmes could be achieved by creating a regional institution, or a Climate Change Mitigation Institution (CCMI), that specialised in building local capacity and facilitating the integration of African countries into global climate change mitigation efforts. Similarly, with the environmental and climate change policy implementation challenges highlighted in the preceding sections, it might be argued that one way of ensuring the successful implementation of the NDCs framework in the Global South would be for African governments to create regional institutions within their various economic blocks to specialise on building local capacity on NDC development and improving the coordination on NDC activities. Using this approach, the implementation and coordination of NDCs will therefore be monitored at national and regional levels thereby increasing the opportunities of building capacity and transparency on climate change action through South-South Climate Change Cooperation.

Moreover, this is quite ideal when consideration is made to the assertions that in the context of Africa, regional initiatives yield better results than national initiatives by a factor of 8, whilst continental initiatives yield better results than national initiatives by a factor of 6.51 and international initiatives yield better results than national initiatives by a factor of 3.99 (Faiyetole, Adesina 2017). Secondly, a contributing factor to the increasing climate change mitigation cost at global level is arguably a consequence of a combination of limited cooperation between regions in terms of technology diffusion and climate change policy analysis (Leimbach et al. 2018). These aspects therefore suggest that by establishing a regional NDCs implementation strategy for Africa that is based on South-South Climate Change Cooperation, African countries will stand a better chance of successfully achieving their NDC commitments whilst at a global level the actual costs for implementing climate change programmes could be reduced.

4.2 Supporting climate finance through NDCs in Malawi

The global development finance landscape is arguably in transition as such development cooperation and development finance will favour countries that can mobilise domestic resources rather than the status quo where developing countries have a high dependence on Official Development Assistance (ODA) and external debt (Nnadozie et al. 2017). Accordingly, the National Climate Change Management Policy (2016) encompasses measures to promote domestic resource mobilisation by incorporating the establishment of a domestic Climate Change Management Fund to augment the mobilisation and utilisation of domestic resources for climate change activities in Malawi. The intention to establish a Climate Change Management Fund may be considered as a timely addition to Malawi's environmental management framework for three main reasons. Firstly, ODA and climate finance disbursements from developed countries to developing countries are not necessarily determined by various factors to different extents. In this regard, a combination of (i) the governance and accountability history of the recipient country, (ii) the personal interests of donors, and (iii) the climate change need/vulnerability of the country may influence ODA and climate finance flows to a country (Weiler et al. 2018). Secondly, official financial pledges from developed countries to developing countries through multilateral or bilateral channels are not always guaranteed to be honoured hence various countries have experienced funding deficits because of such unfulfilled pledges (Musah-Surugu et al. 2018). Thirdly, Barnard (2015) and Butcher-Gollach (2015) argued that less than 10% (approximately US$ 1.5 billion) of the total climate finance mobilised globally is disbursed to local level actors; and vulnerable households and businesses are amongst the sectors that planning systems and international climate change programmes overlook in their programming and funding. Cumulatively, these issues demonstrate that not only are ODA and international climate finance modalities unpredictable but there are also gaps in the total amount of climate funds mobilised at international level and the total amount of funds accessed and utilised at local level. Since Malawi's Climate Change Management Fund will aggregate funds from various domestic resources it can be envisioned that Malawi's climate finance

landscape will improve in terms of predictability and reliability of financing sources as well as in providing support to the most vulnerable local communities.

In theory, Malawi's Climate Change Management Fund can easily accomplish its objectives, but in practice achieving its objectives could prove challenging. For example, when reference is made to the Malawi Environmental Management Act (1996), it can be seen that the regulatory provisions for a Fund do not necessarily guarantee improved mobilisation and disbursement of resources for environmental action. For example, section 53 of the Malawi Environmental Management Act (1996) (GoM 1996: 22) establishes the Environmental Fund whose main objectives include facilitating the financing of environmental protection and management initiatives, and natural resources conservation initiatives. However, according to Yaron et al. (2011), despite the presence of the Environmental Fund and other accompanying legislation, deforestation, over-fishing, etc. continue to make Malawi to use its natural resources unsustainably to the extent that US$ 191 million annually (in 2007 prices) is the cost to the country attributed to the over-exploitation of natural resources such as soil, forest, fishery and wildlife. To put it in another way, Malawi loses an equivalent of 5.3% of Gross Domestic Product each year due to the over-exploitation of natural resources (Yaron et al. 2011). The continued unsustainable use of natural resources in the country therefore signifies that the institutional and financial arrangements of the Environmental Fund might not be commensurate with the country's challenges. Similarly, it is plausible that there is a likelihood that the country will not be in a position to establish an effective Climate Change Management Fund that will be able to mobilise significant climate finance and this might exacerbate climate change vulnerability since many local actors will continue to have limited access to financial and technical resources to support the implementation of their climate change initiatives. Arguably, whilst mainstreaming domestic mobilisation is a commendable strategy to limit volatility in international climate finance flows, the successful implementation of Malawi's climate change policy programmes and NDC will still principally depend on the three factors that determine ODA and climate finance disbursements (i.e. good governance, country vulnerability and donor interest) unless the country develops new legislation and incentives to improve domestic tax collection and private sector funding through

channels such as Corporate Social Responsibly (CSR). For example, in India, the provisions in the Indian Companies Act 2013 to mandate businesses with annual revenues of over 10 billion rupees (US$ 156 million) to spend 2% of their average net profits on CSR activities led to private sector charitable spend on social activities to increase from 33.67 billion Rupees (US$ 524 million) in 2013 to around 250 billion Rupees (US$ 3.89 billion) after an amendment on CSR contributions in the Companies Act (Prasad 2014; Jain, Gopalan 2017; Balch 2016). Similarly, an approach that can be taken in Malawi to increase private sector funding contributions to the Climate Change Management Fund and augment NDC implementation would be for some NDC activities be to linked to the country's fiscal policies and incentives so that there could be mandates for certain businesses and industries based on revenues or emission levels to have mandatory contributions of money towards the Fund annually. Such an approach can equally be implemented by other similar countries in SSA to increase domestic climate finance mobilisation.

4.3 Climate change impacts – the unintended responses

Climatic phenomena such as rainfall, floods, droughts and prolonged dry spells are anticipated to become erratic and unpredictable due to climate change hence climate change will impact the livelihoods of communities in the Global South differently (Munang, Nkem 2011). Understandably, various water systems in many African countries that are used for energy supply through hydropower will be adversely impacted by such changes. For example, the countries that have a high dependence on hydropower for electricity include Ethiopia, Malawi, Mozambique, Namibia, Zambia where hydropower provides over 90% of the electricity produced. Nonetheless, at regional level the contribution of hydropower to the electricity produced is at 21% but this can be increased as only 8% of Africa's hydropower potential has been used to date (Pardoe et al. 2018; Schwerhoff, Sy 2017). However, climate change and variability is already causing energy security issues as countries such as Tanzania, Kenya and Malawi have already experience reduced hydropower generation capacity due to low water levels and this has reduced the productivity of households and industries. The framing of the Renewable Energy vs Fossil Energy academic and policy debate is therefore changing from the old discourse where

renewable energy was not the preferred energy supply choice due to perceived high costs (Polzin et al. 2019) to a new discourse where some renewable energy technologies are considered as providing lower levels of energy security than fossil fuel systems. In this regard, reference can be made to Malawi's energy sector as Malawi currently has over 90% electricity supply through hydropower but has now developed plans to construct coal fired power plants to ensure energy security. In order to reflect this new energy policy stance, reference can be made to the carbon emission projections given in the country's NDC. These estimates show that Malawi will witness a 38% increase in annual greenhouse gas emissions between 2015 and 2040 (i.e. approximately 42,000 Gg CO_2 equivalent in 2040 from approximately 29,000 Gg CO_2 equivalent 2015) (GoM 2015). The rise in greenhouse gas emissions are attributed in part due to the addition of coal power plants in the energy supply mix. Climate change is therefore perpetuating policy conflicts as it is causing contradictions in some countries whereby countries will actually increase their greenhouse gas emissions regardless of the knowledge that this can exacerbate climate change and increase their vulnerability to climate change. Addressing this issue might therefore call for closer coordination and collaborations between actors and stakeholders from different sectors and ministries when developing policies and strategies that can influence electricity access and economic development. This follows that ordinarily, stakeholders in the environmental sector are likely to promote a mix of various renewable energy technologies (solar, wind, etc.) as a solution to energy security whilst stakeholders from the energy sector and economic planning sectors are likely to promote the least cost option for electrification. These scenarios can therefore lead to preference being given to fossil powered electricity solutions in developing countries where economic priorities are likely to override environmental considerations. However, through better coordination and collaboration between these stakeholders that have divergent interests, a balance between using a mix of renewable energy technologies and fossil powered energy systems can be achieved, and hence avert a situation where fossil powered energy systems could be considered as the number one solution for averting electricity supply gaps that are caused by climate change induced low hydropower generation capacity. In this regard, NDCs in countries that have a high dependence on

hydropower for electricity generation should therefore ensure that their NDCs promote the deployment of a mix of various renewable energy technologies (solar, wind, etc.) so that a country's energy security can be enhanced.

5. Discussion

The SDGs will provide a framework that can help African countries to eradicate poverty. The SDGs will also help contribute towards Africa's development by also advocating for equitable growth, job creation, infrastructure development and sound environmental management. These aspects therefore make the SDGs more holistic than the Millennium Development Goals (MDGs) (Besharati, Rawhani 2016). The SDGs therefore provide a new development paradigm that is novel in that it has various fundamental differences to the MDGs and as such SDGs implementation is bound to bring forth its own new challenges and opportunities related to creating trade-offs and synergies amongst various priorities such as climate change and renewable energy deployment. Unlike the MDGs, the SDGs have placed responsibilities on State and Non-State Actors from both developed and developing countries to contribute towards the implementation of various development actions in various ways. In contrast, one of the shortfalls of the MDGS was that the role of the private sector was not well defined and as such the MDGs mostly had appeal within the circles of the United Nations, state actors and aid- and civil society organisations (Pedersen 2018). Not surprisingly, many developed countries did not fulfil all their financing pledges and most countries in SSA did not attain all the MDGs. Learning from this experience, it is imperative that climate change actions through the SDGs and NDCs in SSA forge new partnerships, private investments and market-based solutions.

NDCs are a new policy innovation in the climate change domain hence their implementation is likely to face new unforeseeable challenges. Moreover, with the NDCs and SDGs both calling for more input from business and industry, there is a probability that there will be a need to enhance the governance of environmental activities and climate change because of the possibilities of 'green washing' and the

prioritisation of the needs of business and industry (i.e. profit) over community needs (social development) (Banga 2019). Green washing is the practice where project proponents promote green-based projects in order to raise funds, but actually operate in a way that damages the environment. For example, the experience of the Clean Development Mechanism (CDM) shows that even though the CDM was meant to incentivise the private sector into investing in renewable energy technologies in the Global South, some CDM projects have been criticised for perpetuating inequality by among other things having a strong focus on investments in particular countries and regions thereby adversely affecting the livelihoods of local communities. In this regard, Benites-Lazaro et al. (2018) highlighted that some hydropower projects developed with the intention of promoting sustainable development and renewable energy development through the CDM had adverse impacts on the socio-economic wellbeing of local communities. In this instance, it is not unheard of for CDM hydropower projects in South America to be associated with the destruction of indigenous and traditional communities, forced relocation of local populations, dynamiting of indigenous sacred sites and harming biodiversity and fisheries. Similarly, the NDCs framework as a compliment to the implementation of SDG 7 and SDG 13 will require the actions of business and industry to promote investments in renewable energy using market-based and non-market-based solutions that are novel to certain areas and regions. In this case, NDCs monitoring and evaluating mechanisms should be enhanced to not only consider how successful certain renewable energy deployment models and projects are in providing tangible greenhouse gas emission benefits but should also have a focus on mitigating the potential for NDC activities to create new social and environmental problems to local communities.

The need to examine and understand how climate change governance frameworks and NDCs can promote and facilitate low carbon infrastructure development is of crucial importance in SSA as while combating climate change is itself one of the SDGs, climate change impacts have an effect on the long term prospects of reaching almost all of the other SDGs and in areas with very low energy access rates, attaining SDG 7 before 2030 is a precondition for the other SDGs to be achieved. However, since access to energy affects the levels to which

different communities, areas and regions can improve standards in health, education and gender equality, NDCs should not only be seen as instruments for merely promoting greenhouse gas emissions but should also be considered as policy documents that can ensure that renewable energy investments in SSA have a drastic impact on promoting inclusive development. Accordingly, Corrado and Corrado (2017) argue that there is a gap which needs to be filled urgently by formal and informal institutions in formulating policies that will promote growth and inclusion simultaneously by demonstrating how the poor can participate in and contribute to growth. This is particularly important in the context of SSA where factors such as youth unemployment, rampant poverty, gender inequality, ineffective policy implementation and a lack of appropriate legal and regulatory frameworks do not only engender climate change vulnerability but also make transitions towards the sustainable use of resources more challenging. Arguably, for NDCs to have a meaningful role in contributing towards the promotion of inclusion in climate change issues in SSA and Malawi in particular, there will be a need for changes in the way that stakeholders are consulted during the policy development and implementation cycle, and how climate change issues are framed and communicated to the public and private investors. To better understand this issue, on one hand, it has been suggested that many people and policy makers have ambiguous perceptions about climate change because both the public and private sector usually misinterpret climate policies and their respective impacts due to the tendency of scientists to use sophisticated terms (Rashidi et al. 2017). On the other hand, there are different typologies of public engagement which all lead to varying levels of power to which marginal groups are empowered to govern, influence decision-making processes and enable policy formation in environmental decision making or the level to which companies can prosper at the expense of communities, and affect a community's human rights (Benites-Lazaro, Mello-Théry 2019). Public engagement can be in the forms of: (i) public communication – where companies, regulators and governing bodies provide information and community members are anticipated to be passive recipients; (ii) Public consultation – where questionnaires and other tools are used to establish engagement between the public and project sponsors; and (iii) Public participation – where the public are engaged the

governance of projects through integration in the advisory committees (Benites-Lazaro, Mello-Théry 2019). However, it is not uncommon for renewable energy projects and environmental projects to use public communication as the main public engagement strategy and hence other project stakeholders end up being used to only 'rubber stamp' the policy documents and project details rather than contribute towards their development or understanding the issues that are being analysed (Mpaire et al. 2017). Accordingly, for NDCs to improve local level climate governance and coordination, there will initially be a need to consider how environmental departments can establish new protocols to have public participation as the only means to which public engagement occurs. Arguably, by mainstreaming public participation in local level NDC project implementation, local level power imbalances between State Actors, communities and private investors will be reduced leading to lower cases of green washing, and improvements in local governance and decision making.

6. Conclusion

The global development fora is arguably in a state of excitement and hope with the climate change governance architecture seeing the formalisation of the NDCs framework in 2015 and inclusive development efforts being buoyed up with the implementation of the SDGs. Developing countries in SSA such as Malawi are not only anticipated to be recipients of support from developed countries but they are also required to mobilise their own resources and implement policies and strategies that can ensure that all the targets and goals contained in the SDGs and Paris Agreement are attained. However, as opposed to developed countries, developing countries are anticipated to have greater challenges in achieving SDG 13 and the Paris Agreement. Reasons for this include their current status where they do not only have to consider how to increase their climate change mitigation ambitions so that the countries can be on a trajectory to reach the Paris Agreement's target of limiting global temperature increase to 2°C, but they also have to initiate new strategies to enhance the coordination and governance of climate change programmes at different

levels. This therefore means that rather than just considering what aspects and sectors are included in NDCs as a means of determining the level of a country's climate change ambitions, the level of a country's climate change ambitions should also be assessed by how well their NDCs consider how to improve climate change governance at all levels.

SSA has very low rates of access to electricity hence accelerating the pace and rate to which many SSA countries can deploy renewable energy technologies is arguably dependent on how well the partnerships and coordination of private sector and local government actors are aligned to global climate change and renewable energy targets in SDG 7 and SDG 13. To this effect, it is no longer sufficient for NDCs to only have targets related to the deployment of renewable energy but for NDCs to aim at also having quotas for rural electrification deployment through mini-grids and providing fiscal measures to incentivise more local stakeholders to implement and fund NDC activities. Since one the main research objectives of the paper was to determine how SSA countries can improve the implementations of their NDCs in spite of existing governance and cross-sector coordination challenges, the paper argues that there are now new prospects that these challenges can be addressed by making NDCs to initiate new institutional arrangements that can enable NDC implementation in Africa to be monitored from a regional perspective through such means as South-South Climate Change Cooperation modalities. Regional NDC monitoring is arguably an approach that can yield various economic and environmental benefits at national and regional level since regional climate change efforts are at least 8 times more effective than country-wide approaches and SSA NDCs will be supported with additional technical and financial support from emerging countries such as China, South Korea and Brazil through South-South Climate Change Cooperation modalities. With this in mind, it can be argued that should NDC implementation and monitoring transform to enable the regional monitoring of NDCs, then can it be posited that the climate change fraternity is getting closer to creating new climate change approaches and accountabilities that will be able to contend with the varied political and governance challenges that have hindered effective climate change actions in previous years.

The findings of this paper are similar to the findings of Hedger and Nakhooda (2015) and Antwi-Agyei et al. (2018). Hedger and Nakhooda (2015) looked at the aspects that could improve the implementation of NDCs and concluded that members of the global community need to pay more attention to the role of finance (alongside technology and capacity) in all countries if low emission and climate resilient prosperity is to be achieved. Similarly, Antwi-Agyei et al. (2018) assessed the alignment between NDCs and the SDGs for West Africa, and concluded that some countries can have challenges implementing SDGs and NDCs due to limitations in resources for moving towards integrated implementation of national planning priorities. The findings of this paper do not only support the conclusions from these two papers as the paper has highlighted the various financial and institutional challenges for NDC and SDG 7 implementation in SSA, but additionally suggest that since implementing climate change programmes regionally improves the implementation of programmes, and reduces climate change mitigation costs, there could be merit in African policy makers to consider harmonising NDCs targets and commitments so that NDCs implementation can be undertaken from a regional perspective. Arguably, by having such an approach, not only will South-South Climate Cooperation modalities be reinforced but the finance gaps and leapfrogging challenges that countries face individually could be significantly reduced through the improved transfer of technologies and aggregation of projects within the Global South as the case was with CDM Programmes of Activities (PoAs).

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A household waste stream analysis in a rural Mexican location

Luis VELAZQUEZ, Carlos ANAYA, Omar CONTRERAS-AGANZA, Nora MUNGUIA

University of Sonora, Mexico

Abstract:

Aim: This paper presents a waste stream analysis with the purpose of identifying opportunities to reduce environmental and health risks within a small rural population in Northwestern Mexico by following the Environmental Protection Agency's waste management hierarchy.

Design / Research methods: The study consisted of three phases. Firstly, a one-stage cluster sampling was conducted to characterize the household waste in this rural population. A cluster in this study was a block. There were 54 clusters, but only 40 with occupied houses. The clusters were selected by simple random sampling. During the second phase of this study, a survey was conducted to examine the waste management practices of the residents of sampled houses. Considering that 51 were the inhabited houses in the sampled clusters, a simple random sampling for finite populations was selected. Finally, a quadrant sampling method was conducted to characterize the waste material in a municipal landfill. The total area of the municipal landfill site was divided into black and white quadrants. The white color represented tails and the black color represented heads. The color of the sampled quadrants was selected after 50 virtual coin flips for true randomness.

Conclusions/findings: The findings from this study indicate a willingness of the inhabitants in this rural location to participate in source reduction initiatives. The findings also showed that organic waste was the predominant material in household waste composition. Therefore, there are opportunities to enhance composting at home or even implement a community composting program.

Contact details: Luis VELAZQUES. University of Sonora, Luis Encinas y Rosales S/N. Building 5M CP 83,000 Hermosillo, Sonora Mexico/ E-mail: luis.velazquez@unison.mx (Luis VELAZQUEZ), canaya@industrial.uson.mx (Carlos ANAYA), omarc92@gmail.com (Omar CONTRERAS-AGANZA, nora.munguia@unison.mx (Nora MUNGUIA).
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Originality/value of the article: Based on the waste stream analysis, there are opportunities to reduce the environmental and health risks at a small rural zone in Northwestern Mexico. In this regard, this study can serve as an example to analyze and compare sustainable opportunities in other rural zones around the world.

Keywords: Waste management, Rural Development, Landfill, Waste Stream Analysis.
JEL: Q510, Q530, R110

1. Introduction

The management of municipal solid waste is complex because it involves multiple environmental and socio-economic criteria (Soltani et al. 2015). Recognizing this complexity, the United States Environmental Protection Agency (EPA 2017) created the Waste Management inverted pyramid to help guide "greener" waste-management practices. In particular, it gives more priority to prevention over control practices.

An integrated household management program is an example of good practice that encompasses preventing, reducing, and eliminating environmental risks along the waste stream from the waste that is generated to its final disposal (Munguia et al. 2010). Similarly, alternatives to decrease the generation of waste at the source are considered as an essential element to "greener" waste management practices (Shamshiry et al. 2015). Source separation is also fundamental for proper transportation and final disposal. Waste separation at home increases the potential for recycling, creating potential economic benefits for members of society (Gu et al. 2015). Waste separation also allows for composting and material recovery, which has a better environmental performance than a landfill as a disposal strategy (Erses Yay 2015).

A landfill is a less preferred option in waste management because it is riskier than recycling, reusing, composting, and waste segregation. Specifically, the generation of greenhouse emissions in landfills is known to be a significant contributor to global warming and climate change (Zuberi, Ali 2015). Methane alone accounts for about 50% of the biogas naturally produced in a landfill (Broun, Sattler 2016). Waste to energy technologies in landfills is an alternative to traditional landfills in that they reduce the odds of polluting ecosystems and

decreasing climate warming by generating clean energy, mainly through controlling the generation of methane (Tozly et al. 2016).

Other serious environmental problems at landfill sites include leachate, which results from the liquids in waste, mainly organic wastes, getting in contact with other waste and polluting the soil or groundwater (Bhalla et al. 2013). Landfill leachate encompasses a wide variety of organic compounds like benzene, toluene, ethylbenzene, xylenes, chlorinated hydrocarbons, polycyclic aromatic hydrocarbons, and organochlorine pesticides that could be carcinogenic (Clarke et al. 2015). Toxic substances like lead and cadmium can also be present in streams surrounding landfills (Melnyk et al. 2014). Containment and attenuation strategies are often used to avoid damage to the environment from leachate (Regadío et al. 2015).

In a real-life decision-making process, most of the time, decision-makers adopt waste management practices based on the specific circumstances of their locale, so that it is likely that particular components of the waste management hierarchy are adopted. Likewise, the factors that may influence the adoption of particular waste management practices are those linked to individuals' culture, consumption, and living habits (Han et al. 2017).

There are also considerable differences in waste management practices between developed and developing countries and between urban and rural areas. Darban and Hajillo (2017) note that in rural zones, the most relevant factors that influence waste generation are: income, assets, age, and personal attitudes. The educational level of rural residents is another important factor where those with higher levels of education are more likely to adopt waste management practices (Wang et al. 2018).

In rural regions of developing countries, the lack of proper waste management practices increases the risk of harming health, biodiversity, and ecosystems, not to mention the economic loss related to not recycling or producing energy out of the waste (Mihai, Ingrao 2016). However, Boateng et al. (2016) notes that urban communities present worse waste management practices in streets and dumping sites than rural communities.

This paper is an exploratory study of a waste stream analysis. Using the waste management hierarchy as a guide, the purpose of this exploratory study is to identify

opportunities to reduce environmental and health risks within a household waste stream of a small rural population in Northwestern Mexico.

2. Research methods

The study consisted of three phases. Firstly, a one-stage cluster sampling was conducted to characterize the household waste in this rural population. A cluster in this study was a block; there were 54 clusters in total, but only 40 with occupied houses. The clusters were selected by simple random sampling; the following equation was used:

$$m = \left[A + \sqrt{\left(A^2 + \frac{n^*}{N} \right)} \right]^2 \quad [1]$$

Where:
$A = z_\alpha \, V_N / 2$
z_α = the 100xth percentile of the standard normal distribution.
$V_N = {}^{\sigma_N}/_{\overline{N}}$

$$\sigma_N = \sqrt{\left[\sum_{i=1}^{M} (N_i - \overline{N})^2 / M \right]} \quad [2]$$

M = The number of clusters in the population.
N_i = The number of individuals in cluster i; i = 1, . . . , M.
$\overline{N} = \sum_{i=1}^{M} N_i / M$ (the mean number of individuals per cluster).
A= estimation error of subject in the cluster
σ_N= Standard deviation
$V_{N=}$ Standard deviation of N_i

Equation solving:

A= (1.96*4.1683)/(2*6.1) = 0.6696 ; at least 100 inhabitants

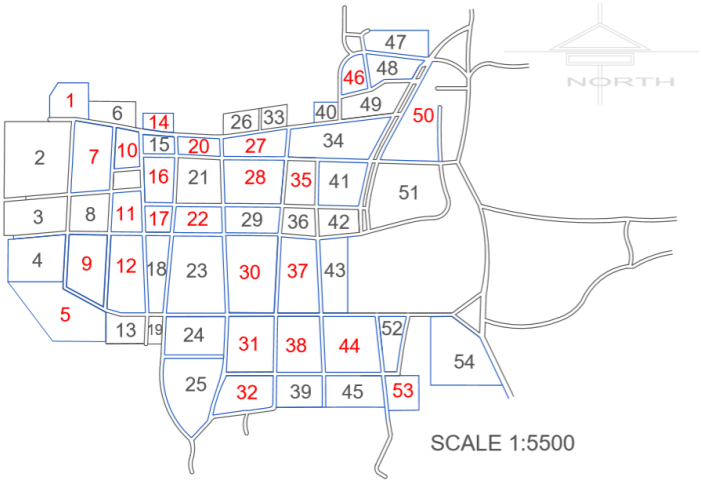
M= 40 $m = [0.6696 + \sqrt{\left(0.6696^2 + \frac{100}{6.1} \right)}\ ]^2$

N= 244
$\overline{N}$=6.1
σ_N = 4.1683 $m = 23$ clusters
Significance level (Alpha) = 0.025

One social demographic characteristic of this location was that blocks were composed of very few houses, sometimes just one or two houses. For this reason, the research team decided to characterize 24 clusters representing 51 houses with 119 occupants. This is justified by the Law of the larger numbers who states that as

the sample size grows, its mean gets closer to the average of the whole population. Figure 1, shown in red, represents the sampled clusters.

Figure 1. Cluster sampling on the rural area



The characterization of the household waste took place in each of the 51 occupied houses. A representative person in each house was asked to deposit their garbage in a plastic bin during a 24-hour period during the month of January. Then, a member of the research team picked up, separated, and weighed each type of waste. Finally, the amount of organic and inorganic household waste was computed.

During the second phase of the study, a survey was conducted to examine the waste management practices of the residents in the sampled houses. Considering that 51 were the inhabited houses in the sampled clusters, a simple random sampling for finite populations was selected. The proportion, p = .25, was based on responses from a pilot survey.

$$n = \frac{n_0}{1 + \frac{n_0}{N}} \quad \text{[Equation 3]}$$

Equation solving:

$$n_0 = \frac{z^2\, p\, q}{e^2}$$

$$n_0 = \frac{2^2 * 0.25 * 0.75}{0.1^2} = 75$$

$$n = \frac{75}{1 + \frac{75}{51}} = 31$$

Where:

P =estimated prevalence=.25

Q =1-p=.75

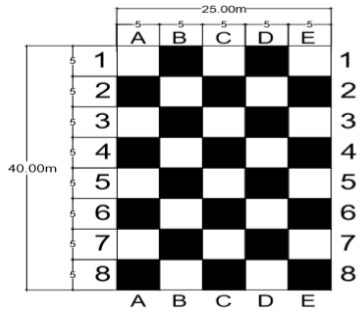
e Margin of error= 0.1

Z statistic value = 2 (rounded)

As thirty-one samples is a small sample size, the research team conducted the survey in each of the fifty-one occupied houses.

Finally, the third phase consisted of the characterization of the waste within the municipal landfill. For this purpose, a quadrant sampling method was conducted. The total area of the municipal landfill site was divided into black and white quadrants as shown in Figure 2. The white color is represented by tails while the black color is represented by heads. The color of the sampled quadrants was selected after 50 virtual coin flips for true randomness. The waste accumulated in the landfill for eight months.

Figure 2. Quadrat sampling draw on the landfill area



2. Results

In this section is presented the results for each of the phases where the characterization was performed. Firstly is given the results for the household waste, then the results for the survey, and finally, the characterization in the landfill site.

a) Household Waste Characterization

Organic household waste was more prominent than inorganic household waste. Table 1 shows 74% of the total household waste was organic while just twenty-six was inorganic. Table 2 shows that most of the organic waste came from leftover food, 79%, followed by paper and paperboard, 14%, and finally, foliage, accounting for 7%. On the other hand, inorganic household waste was mostly characterized by plastic, with 80% of the total. Table 3 shows the breakdown of inorganic waste.

Table 1. Household waste classification

Household Waste Classification	Percentage (%)	Kilos per day period
Organic	64	29.34
Inorganic	36	16.36

Table 2. Household organic waste characterization

Organic Household Waste Classification	Percentage (%)	Kilos per day
Leftover Food	92	26.9
Foliage	8	2.4

Table 3. Household inorganic waste characterization

Inorganic Household Waste Classification	Percentage (%)	Kilos per day
Paper and Cardboard	28.5	4.66
Plastic	57.1	9.35
Metals	9.2	1.51
Glass	4.5	0.73
Others	0.8	0.13

b) Survey

In total, 69% of the houses were occupied by one to three persons, 18% by four or five persons, and 14% by more than five. A majority of 88% of household waste was gathered in trash bins, 10% in plastic bags, and 2% use both garbage bins and plastic bags. All houses (100%) had a free service waste recollection hauler offered by the municipality. In 96% of the homes, the service is provided once per week and in 4% of the houses, twice per week.

The primary inorganic waste material in houses was plastic, 53%, followed by paper, 12%, and glass with, 6%. The mixture of several materials added up to 29%. Ninety-four percent of the participants claimed to know that the landfill was the final destination of their household waste. Only 14% of the respondents claimed to segregate organic and inorganic waste. The primary purpose of the segregation is for compost elaboration. Ninety-four percent of the participants claimed to know about the recycling of household waste. A majority of 88% of the respondents were willing to participate in a recycling or reuse program, if a program is implemented by their municipality. Eighty-two percent of the respondents claimed they were aware of some health problems related to deficient waste management practices in houses. Only 34% thought that deficient waste management practices could lead to a combination of health disorders like dermatitis, diarrhea, and respiratory illness. Fifty-seven percent of the respondents have already experienced at least one of these disorders.

c) Municipal Landfill Site and Disposal Waste Characterization

The municipal landfill is an open dumping site that was opened eight months before the waste characterization was conducted. The area of the landfill is 1,000 square meters, 40 meters in length and 25 meters in width. The municipality waste hauler picks garbage up from houses once per week and the trash is deposited at the site, with no practices of waste management. There is no restriction to get into the landfill; any person can dump any kind of waste into the property. During the waste characterization, cows and donkeys were present, as well as pets, that were entering the site looking for food.

Table 4 and Table 5 shows the percentages of organic and inorganic waste weighed at the landfill. Some organic waste could not be weighed because of its stage of decomposition. Foliage was the organic material that weighed the most, followed by wood and paper or paperboard. Used tires were the inorganic material that weighed the most , followed by plastic and fabrics.

Table 4. Organic waste characterization in the landfill

Organic Waste Classification	Percentage (%)	Kilos in eight months
Foliage	79	40.8
Paper and Paperboard	7	3.71
Wood	14	7.32

Table 5. Inorganic waste characterization in the landfill

Inorganic waste Classification	Percentage (%)	Kilos in eight months
Plastic	14	11.33
Metals	9	7.22
Glass	9	7.27
Tires	58	48.10
Fabrics	12	9.63

3. Concluding remarks

According to the inverted pyramid of non-hazardous materials management, source reduction practices are preferable over other methods. Source reduction practices relate to any initiative that could be conducted at homes by the occupants. The findings of this study highlight the willingness of the residents to participate in a reduction or recycling program. This finding is important because source reduction practices rely more on community involvement rather than on technology. Therefore, one opportunity to reduce environmental and health risks within the household waste stream at this small rural population is educating and training town residents to separate waste at home. Climate change is another hot topic that must be

included in educational/training efforts (Perkins et al. 2018). Universities and research centers might be ke allies to support small rural location while keeping the investment affordable (Velazquez et al. 2000).

Dhokhikah et al. (2015) states that environmental knowledge, information from mass media, education and training, the existence of a catalogue of environmental indicators, and the existence of a waste bank are five supporting factors in household solid waste reduction initiatives. It is unlikely that all factors could be incorporated into a novel program by municipalities, yet, it is possible to start by educating and training and then gradually incorporating more elements into a potential initiative.

After all, lack of awareness separation is one of the predominant barriers to enhance community involvement (Zeng et al. 2016). Unfortunately, this rural municipality has neither the necessary infrastructure nor a recycling facility to obtain economic benefits out of the household waste. There are opportunities to promote composting as the findings showed that organic waste was the predominant material in the household waste composition. This mirrors other Latin American countries like Ecuador (71,4%), Peru (54,5%) and Guatemala (63,3%) (Sáez et al. 2014). Countries in Asia, like China (55,8) (Mian et al. 2017), Malaysia (45%), Iran (72%), and Thailand (43%), and (Taghuipour et al. 2016). Similar waste characteristics are noted in Denmark (41%), Spain (56,2%), Sweden (33%), and Turkey (67%) (Edjabou et al. 2015).

As is noted in our waste stream analysis, the total amount of household waste was disposed of in this landfill where waste management practices are inadequate. According to Mihai (2017), this same situation in rural areas occurs due to the lack of formal waste collection services. Undoubtedly, this situation can potentially lead to the occurrence of diseases, have an impact on ecosystems, and contribute to climate change.

The riskier situation revealed by this waste stream analysis were observed at the landfill site. Preventing affectations to the health of the inhabitants surrounding the landfill area should be a priority for the municipality . Inhabitants close to the landfill may suffer health problems from air pollutants and odorants from uncontrolled emissions (Palmiotto et al. 2014).

As was shown in Table 5, tires were found among the waste within the landfill site. However, used tires were not characterized in houses. Rodseth et al. (2020) reports that illegal and not- recorded dumping is a limitation to improve waste management services in developing countries. Illegal dumping or un-recorded dumping occurred in this landfill. In the case of a fire, the presence of tires might pose a significant risk to the residents living close to the landfill because residents would be exposed to polluting emissions like particulates, carbon monoxide, sulfur oxides, oxides of nitrogen, volatile organic compounds, benzene, and others that can cause acute and chronic health hazards and affectations for the environment (Nadal et al. 2016).

Leachate was another problem detected at the landfill site that can be prevented, at least in part, by reducing the amount of organic waste in the landfill site. Since there is no technology to control leachate at the landfill, it is essential to adopt proper waste management practices like composting and source separation to prevent leachate polluting soil and surrounding streams.

This waste stream analysis provided here suggests that the most feasible opportunities to decrease environmental and health risks within the household waste stream are at the beginning of the waste stream. Municipalities should enhance waste separation at the source, in the houses, and implement composting techniques among residents. In this regard, the results from this study can serve as a starting point to analyze and compare sustainable opportunities in other rural zones around the world.

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Conflict management in university examination timetabling. A case study of summer school mid-terms

Mustafa Mehmet BAYAR

Ankara Hacı Bayram Veli University, Turkey

Irmak UZUN BAYAR

Hacettepe University, Ankara, Turkey

Abstract:

Aim: This study is on tackling Examination Timetabling Problem (ETP) of the Faculty of Economics And Administrative Sciences (FEAS) of the Ankara HBV University summer school, where the courses of fall and spring semesters are offered simultaneously and regulations on restricting enrollments in inter-department electives or in-department courses of distinct years are relaxed. Thus, the complexity of the nature of the ETP problem is exacerbated. The direct heuristics based on successive assignments that the university normally adopts was proven inadequate for assuming standard regulations hence, another approach we explain in this paper was needed.

Design / Research methods: The ETP was formulated as a Linear Mixed-Integer Program (LMIP) and decomposed into three stages; timetabling exams, room assignment, student allocation. To manage the conflict between the stakeholders of the examination procedure, a lexicographic optimization process based on the priority of the parties was undertaken.

Conclusions / findings: After a recursive timetabling process based on a trial-and-error method a clash-free timetable was generated and, a room assignment plan that minimizes the total number of proctoring duties, usage of higher floor rooms and total crowdedness of rooms respectively was put into action. Therefore no student group experienced any clashing exams, the faculty members saved time that can be spent on research instead, since the room usage was better planned the costs (elevator usage, lighting, air conditioning, the labor of the janitors) were assumed to be decreased.

Correspondence address: Mustafa Mehmet BAYAR, Ankara HBV University, Turkey. E-mail: mehmet.bayar@hbv.edu.tr (Mustafa Mehmet BAYAR), uzunirmak@hotmail.com (Irmak UZUN BAYAR).
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Originality / value of the article: Each examination period bares a different ETP due to its problem-specific nature (number of courses offered, the structure of student enrollments, availability of rooms, etc.). Summer schools provide a more irregular structure that demands special attention, a trial-and-error reformulation of the ETP in our case. In addition, the traditional formulations of the ETP, to the extent we have been able to scan, do not include the minimization of the crowdedness of the rooms. Thus, in creating a more comfortable environment, easier to monitor exams and, ability in handling unexpected dysfunctionalities (broken classroom equipment, etc.) this study is novel.

Limitations of the research: The algorithms to solve an ETP formulated as an LMIP are of high complexity therefore, we are not able to assert the optimality of our suggested solutions acquired within time limitations.

Keywords: examination timetabling, group decision making, lexicographic optimization, linear mixed integer programming

JEL: C44, C61, M12

1. Introduction

Summer school programs are exceptionally irregular for a number of reasons – offering courses of both fall and spring semesters, allowing enrollment in courses of any year simultaneously, the high volume of visiting students (students of universities that do not offer summer schools authorize their students to enroll in summer schools of other universities), etc. Due to the increased complexity and decreased predictability, more conventional approaches to examination timetabling problem (ETP) assuming regularities to eliminate conflicts was proven inadequate to Ankara HBV University's summer school and the 86 courses within offered by the Faculty of Economics and Administrative Sciences (FEAS). Therefore, a novel mixed-integer program formulation for solving the ETP at hand was demanded.

The idea of producing examination timetables using algorithms rather than manual effort dates back to 1964 (Broder 1964), where minimizing conflicts were based on a Monte Carlo procedure to generate a set of selection of assignments. Among the related family of problems on timetabling, Schaerf (1999) provided a classification in his review article (for more surveys on ETP see Carter et al. 1996; Qu et al. 2009 among others). He also defined ETP as "The scheduling for the exams of a set of university courses, avoiding overlap of exams of courses having common students, and spreading the exams for the students as much as possible." (Schaerf 1999).

Until the vertex coloring based heuristic HORHEC (Laporte, Desroches 1984) direct heuristics (successive assignment of exams) was the main course of action. The path we follow in this study – integer linear programming (IP) formulations of ETP – was first introduced by Lawrie (1969). Later, for a related problem – school timetabling – a large scale 0-1 IP formulation (Tripathy 1984) was presented where due to the complexity of the problem, the solution was based on lagrangian relaxation. By time, as the computational power of the computers was improved, an IP was formulated and exact solution was obtained for the related university course timetabling problem (Daskalaki et al. 2004). Daskalaki et al. (2004) also claimed their formulation could be solved even for large departments using solvers available of their time. Conventionally, ETP was based on the knowledge of the number of students enrolled in each course. In that case, the problem at hand is post-enrollment ETP. On the other hand, instructors of the courses as well as the students prefer having the examination timetable as soon as possible. For this reason, Cataldo et al. (2017) proposed an IP to tackle the curriculum-based ETP where the examination timetable was produced without complete information on student enrollments. Sancar Edis and Edis (2019) also studied the curriculum-based ETP and in addition, they introduced a set of constraints to increase the satisfaction of the instructors and the students. Another research (MirHassani 2006) on improving the well-being of the parties affected by the examination timetables focused on maximizing the study time each student has between examinations.

In this paper, we broaden the focus on the satisfaction of the parties – i.e., students, instructors, janitors, school administration, etc. – from a different point of view. That is, we focus on managing the conflict between parties while setting standards for achieving an adequate minimum level of pain for all. Furthermore, from the study of Daskalaki et al. (2004) until now, even more improvements are achieved both in the computational power of the CPUs and in the efficiency of algorithms to solve IPs. Thus, we believed an IP formulation and pursuing exact solutions are were plausible and we achieved verification.

Rest of this paper is organized as follows: Section 2 introduces the problem at hand and the three models formulated to tackle it. Then in Section 3, we summarize the output of the optimization process by illustrating samples from the examination

timetable and the proctor duties plan. Finally, in Section 4, we summarize the article, interpret the results, point out the novel features of our study and, discuss the limitations and future research.

2. Methods

FEAS holds nine departments and these departments may offer three BSc programs (English Education, 30% English Education, and Turkish Education). In the 2018-2019 Summer semester, FEAS organized a summer school and offered 86 courses that are instructed by 37 lecturers where a total of 2446 students were enrolled in. To illustrate the structure of the courses and the student enrollments please see Table1 and Table2.

Table 1. Number of courses offered by departments and programs

	ECON	BADM	PADM	ETCS	PFIN	IREL	LECO	HLTH	ITRD
Pr1		1				1			
Pr2	17	11	8	11	2	1	5	2	
Pr3		11	3			11			2

ETP is the scheduling for the exams of a set of university courses, avoiding exam conflicts, and spreading the exams for each student group as widely as possible (Schaerf 1999). The fashion we defined each course (thus, each exam) is by both subject and section therefore, we only allow a conflict of exams of the same subject. As for the detecting student groups to fit the ETP definition, summer schools are an exception to school regulations. I.e., students may enroll in courses of any year, elective courses of any department, courses normally offered in fall or spring semesters together. Consequently, identifying student groups and eliminating exam

conflicts is not a straightforward routine. Even more, the high volume of visiting students canceled out using the student database to detect the scattered micro-groups. Thus, we separated the date-time assignment phase of the ETP from the room and student allocation phase. So that, announcing a draft examination timetable stripped off the room allocation information to prevent confusion would be possible and then, we could collect conflict reports if there were any. The approach to tackle the aforementioned difficulty is discussed further in sections 2.1.1 and 4.

Table 2. Student enrollments by departments and programs

	ECON	BADM	PADM	ETCS	PFIN	IREL	LECO	HLTH	ITRD
Pr1		14				24			
Pr2	351	382	179	220	204	60	152	42	
Pr3		326	269			201			22

The examination timetable will affect mainly four groups: students, instructors & proctors, janitors, and the FEAS administration. These parties' have conflicting preferences. E.g., the instructors prefer their exams as soon as possible in order to maximize time for grading where the students prefer a timetable that has no clashing exams and provides a reasonable paper spread to maximize their success. In sections 2.1.1, 2.1.2 and, 2.1.3, the conflict between parties are managed via formulated constraints and adopted the goal programming approach.

2.1. Models

The formulation procedure of the ETP problem at hand is three-fold. In the first model, we assigned dates and times to each exam. In model 2, we specify in which room the examinations were to be held on its predetermined date and time. And finally, in model 3, we allocate the students enrolled in each course to the room

assigned and decide the minimum number of proctors needed in each room accordingly.

2.1.1. Model 1: Assigning dates and times

Sets and parameters

$C =: \{c \mid c = 1, \cdots, 86\}$	:	Set of the 86 courses offered by FEAS at the 2018-2019 Summer School.
$D =: \{d \mid d = 1, \cdots, 5\}$	:	Set of days. The examination period was spread over the working days of one week.
$S =: \{s \mid s = 1, \cdots, 12\}$	:	Set of time slots in each day that exams may be assigned to. Starting at 8.30a.m. and ending at 8.30p.m., there were 12 one-hour-periods in each day.
$I =: \{i \mid i = 1, \cdots, 9\}$	:	Set of the nine departments of FEAS
$P =: \{p \mid p = 1, \cdots, 3\}$	:	Set of programs offered by FEAS departments.
$L =: \{l \mid l = 1, \cdots, 4\}$	:	Set of years (levels) in the BSc education programs (Freshman, ⋯ , Senior).

$Cdep_c$	:	The department that offers course c
$Cprg_c$	:	The program course c is offered within
$Ccod_c$	:	The course code of course c
$Ctyp_c$	:	Type of course c (1 for electives and 0 for compulsory courses)
$Clvl_c$	:	The year course c is planned to be offered in the curriculum
$Cstu_c$	:	Number of students enrolled in course c

Variables

$\vec{\boldsymbol{\tau}} \epsilon \{0,1\}^{D \mathrm{x} S \mathrm{x} C}$	:	Binary integer variable for assigning date times for each exam (course)
$\overrightarrow{\mathbf{0}\boldsymbol{\gamma}} \epsilon \mathbb{R}^{D \mathrm{x} S}$	:	Auxiliary continuous variable, number of conflicting exams on day d and time slot s.
$\overrightarrow{\mathbf{1}\boldsymbol{\gamma}} \epsilon \mathbb{R}^{D \mathrm{x} S \mathrm{x} P}$	:	Auxiliary continuous variable, number of conflicting exams of courses of distinct subjects offered by department i within program p on day d and time slot s.

$\overrightarrow{\mathbf{2}\boldsymbol{\gamma}} \in \mathbb{R}^{DxSxPxL}$: Auxiliary continuous variable, number of conflicting exams of courses of distinct subjects offered by department i within program p for year l on day d and time slot s.

$\overrightarrow{\mathbf{3}\boldsymbol{\gamma}} \in \mathbb{R}^{DxSxP}$: Auxiliary continuous variable, number of conflicting exams of elective courses offered within programs p on day d and time slot s.

$\overrightarrow{\mathbf{4}\boldsymbol{\gamma}} \in \mathbb{R}^{DxSxPxL}$: Auxiliary continuous variable, number of conflicting exams of elective courses offered within programs p for year l on day d and time slot s.

$\overrightarrow{\mathbf{5}\boldsymbol{\gamma}} \in \mathbb{R}^{IxPxLxD}$: Auxiliary continuous variable, number of exams exceeding one on day d for the regular students in year l registered in department i and program p.

$\overrightarrow{\mathbf{6}\boldsymbol{\gamma}} \in \mathbb{R}^{DxS}$: Auxiliary continuous variable, number of exams exceeding one on day d for the students registered in department i and program p.

Hard constraints

Each courses' exam must be scheduled to a day and timeslot:

$$\sum_{d,s} \tau_{d,s,c} = 1 \quad , \quad \forall c \tag{1.1}$$

Exams for courses of the same subject must be simultaneous:

$$\tau_{d,s,c} = \tau_{d,s,c'} \quad , \quad \begin{matrix} \forall d \\ \forall s \\ \forall c \\ \forall c' \quad | Ccod_{c'} = Ccod_c \end{matrix} \tag{1.2}$$

For each regular student group no more than 2 exams for consecutive days:

$$\sum_{s,c \,|\, \substack{Cdep_c=i \\ Cprg_c=p \\ Clvl_c=l}} \tau_{d,s,c} + \sum_{s,c \,|\, \substack{Cdep_c=i \\ Cprg_c=p \\ Clvl_c=l}} \tau_{d+1,s,c} \leq 2 \quad , \quad \begin{matrix} \forall i \\ \forall p \\ \forall l \\ \forall d \quad | d, d+1 \in D \end{matrix} \tag{1.3}$$

For each program no more than 1 exam in consecutive timeslots:

$$\sum_{c \mid \substack{Cdep_c=i \\ Cprg_c=p \\ Clvl_c=l \\ Ccod_c \neq Ccod_{c'}}} \tau_{d,s,c'} + \tau_{d,s+1,c} \leq 1 \quad , \quad \begin{matrix} \forall i \\ \forall p \\ \forall l \\ \forall d \\ \forall s \mid s, s+1 \in S \end{matrix} \qquad (1.4)$$

For each program no more than 1 exam in consecutive timeslots:

$$\sum_{c \mid \substack{Cdep_c=i \\ Cprg_c=p \\ Ccod_c \neq Ccod_{c'}}} \tau_{d,s,c'} + \tau_{d,s+1,c} \leq 1 \quad , \quad \begin{matrix} \forall i \\ \forall p \\ \forall d \\ \forall s \mid s, s+1 \in S \\ \forall c' \mid \begin{matrix} Cdep_c = i \\ Cprg_c = p \end{matrix} \end{matrix} \qquad (1.5)$$

Soft constraints

Minimize exam conflicts:

$$\sum_{c \mid Ccod_c \neq Ccod_{c'}} \tau_{d,s,c'} + \tau_{d,s,c} \leq 1 + {}^{0}\gamma_{d,s} \quad , \quad \begin{matrix} \forall d \\ \forall s \\ \forall c' \end{matrix} \qquad (1.6)$$

Minimize exam conflicts for each program:

$$\sum_{c \mid \substack{Cdep_c=i \\ Cprg_c=p \\ Ccod_c \neq Ccod_{c'}}} \tau_{d,s,c'} + \tau_{d,s,c} \leq 1 + {}^{1}\gamma_{d,s,p} \quad , \quad \begin{matrix} \forall i \\ \forall p \\ \forall d \\ \forall s \\ \forall c' \mid \begin{matrix} Cdep_{c'} = i \\ Cprg_{c'} = p \end{matrix} \end{matrix} \qquad (1.7)$$

Minimize exam conflicts for each program and each year

$$\tau_{d,s,c'} + \sum_{c \,|\, \substack{Cdep_c=i \\ Cprg_c=p \\ Clvl_c=l \\ Ccod_c \neq Ccod_{c'}}} \tau_{d,s,c} \leq 1 + {}^{2}\gamma_{d,s,p,l} \quad , \quad \begin{matrix} \forall i \\ \forall p \\ \forall d \\ \forall s \\ \forall c' \;\big|\; \begin{matrix} Cdep_{c'} = i \\ Cprg_{c'} = p \\ Clvl_{c'} = l \end{matrix} \end{matrix} \tag{1.8}$$

Minimizing clashing electives throughout FEAS:

$$\tau_{d,s,c'} + \sum_{c \,|\, \substack{Cprg_c=p \\ Ctyp_c=1 \\ Ccod_c \neq Ccod_{c'}}} \tau_{d,s,c} \leq 1 + {}^{3}\gamma_{d,s,p} \quad , \quad \begin{matrix} \forall p \\ \forall d \\ \forall s \\ \forall c' \;\big|\; \begin{matrix} Cprg_{c'} = p \\ Ctyp_{c'} = 1 \end{matrix} \end{matrix} \tag{1.9}$$

Minimizing clashing electives throughout FEAS (year based):

$$\tau_{d,s,c'} + \sum_{c \,|\, \substack{Cprg_c=p \\ Clvl_c=l \\ Ctyp_c=1 \\ Ccod_c \neq Ccod_{c'}}} \tau_{d,s,c} \leq 1 + {}^{4}\gamma_{d,s,p,l} \quad , \quad \begin{matrix} \forall p \\ \forall l \\ \forall d \\ \forall s \\ \forall c' \;\big|\; \begin{matrix} Cprg_{c'} = p \\ Clvl_{c'} = l \\ Ctyp_{c'} = 1 \end{matrix} \end{matrix} \tag{1.10}$$

For each regular student group no more than 1 exam a day:

$$\sum_{s,c \,|\, \substack{Cdep_c=i \\ Cprg_c=p \\ Clvl_c=l}} \tau_{d,s,c} \leq 1 + {}^{5}\gamma_{i,p,l,d} \quad , \quad \begin{matrix} \forall i \\ \forall p \\ \forall l \\ \forall d \end{matrix} \tag{1.11}$$

For each program no more than 1 exam a day:

$$\sum_{s,c \,|\, \substack{Cdep_c=i \\ Cprg_c=p}} \tau_{d,s,c} \leq 1 + {}^{6}\gamma_{i,p,d} \quad , \quad \begin{matrix} \forall i \\ \forall p \\ \forall d \end{matrix} \tag{1.12}$$

Objectives

In order to meet the seven goals, we first minimize the auxiliary variables employed in constraints 1.6 to 1.12 within an additive function. And then, we focus on minimizing the number of exams assigned to the undesired timeslots as a second priority objective. Due to the minimized number of students having exams during rush hours or evening hours, the number of proctors required and course instructors supervising examinations are also minimized:

Priority 1 Objective:

$$Min\left(\sum_{d,s} {}^{0}\gamma + \sum_{d,s,p} {}^{1}\gamma + \sum_{d,s,p,l} {}^{2}\gamma + \sum_{d,s,p} {}^{3}\gamma + \sum_{d,s,p,l} {}^{4}\gamma + \sum_{i,p,l,d} {}^{5}\gamma + \sum_{i,p,l,d,s} {}^{6}\gamma\right) \quad (1.13)$$

Priority 2 Objective:

$$Min\left(\sum_{d,c}\left(\begin{matrix}\tau_{d,0,c}\cdot 9.Cstu_c + \tau_{d,9,c}\cdot Cstu_c + \\ \tau_{d,10,c}\cdot 3\cdot Cstu_c + \tau_{d,11,c}\cdot 9\cdot Cstu_c\end{matrix}\right)\right) \quad (1.14)$$

2.1.2. Model 2: Assigning rooms

During the examination period, the summer school did not take pause. Consequently, the rooms designated for examinations were even more limited. Using predetermined timetables produced by optimizing model 1, in model 2 we assigned each examination to the rooms. The reason for separating the room assignment from the timetabling process is not being able to identify the complete collection of sets of student groups that did not enroll in common courses. Thus, we first announced a timetable without room information to both collect data for clashing courses and, prevent further confusion due to room changes.

Additional sets and parameters

$T =: \{(d,s,c) | d \in D, s \in S, c \in C, \tau_{d,s,c} = 1\}$: Set of day-timeslot-course combinations from the basic timetable (Model 1 results)

K : Set of courses that require multiple consecutive timeslots

$R =: \{r | r = 1, \cdots, 16\}$: Set of the 16 rooms designated for midterm examinations by the FEAS administration.

$Rcpe_r$: Seating capacity of room r for examination

$Rflo_r$: The floor room r is on

U : Booking rate for rooms, default value is 0,95

Variables

$\vec{x} \epsilon \{0,1\}^{TxR}$: Binary integer variable for assigning rooms for each exam (course) on the predetermined timetable

$\vec{\alpha} \epsilon \mathbb{R}^C$: Auxiliary continuous variable, a measure of spaciousness in rooms assigned for course c.

Hard constraints

Room can be occupied for at most 1 exam at a time:

$$\sum_{c|(d,s,c)\in T} x_{d,s,c,r} \leq 1 \quad , \quad \forall d \; \forall s \; \forall r \qquad (2.1)$$

At least 1 room must be dedicated for each exam on the predetermined time:

$$\sum_{r,(d,s)|(d,s,c)\in DSC} x_{d,s,c,r} \geq 1 \quad , \quad \forall c \qquad (2.2)$$

The total seating capacity of the dedicated rooms must be greater than or equal to the number of students enrolled:

$$\sum_{r,(d,s)|(d,s,c)\in T} x_{d,s,c,r} \cdot U \cdot Rcpe_r \geq Cstu_c \quad , \quad \forall c \qquad (2.3)$$

Rooms can be occupied for at most one course on consecutive timeslots:

$$\sum_{c|(d,s,c)\in T} x_{d,s,c,r} + \sum_{c'|(d,s+1,c')\in T} x_{d,s+1,c',r} \leq 1 \quad , \quad \forall r \; \forall d \; \forall s \; | s, s+1 \in S \qquad (2.4)$$

If a room is occupied for a long exam, the room cannot be occupied for any courses for the next 2 timeslots:

$$\sum_{c\left|\begin{smallmatrix}(d,s,c)\in T\\ c\in K\end{smallmatrix}\right.} x_{d,s,c,r} + \sum_{c'|(d,s+2,c')\in T} x_{d,s+2,c',r} \leq 1 \quad , \quad \begin{matrix}\forall r\\ \forall d\\ \forall s \quad |s, s+2 \in S\end{matrix} \qquad (2.5)$$

Soft constraint

α is a measure of the spaciousness of dedicated rooms

$$Cstu_c \cdot \alpha_c \leq \sum_{r,(d,s)|(d,s,c)\in DSC} x_{d,s,c,r} \cdot Rcpe_r \quad , \quad \forall c \qquad (2.6)$$

Objectives

In FEAS, we assigned rooms on the lower floors to minimize movement, operations, and maintenance costs. This way we minimized total distance covered by students and proctors as well as minimizing elevator usage, air conditioning and, housekeeping activities. Then, in the second stage, we maximized spaciousness in rooms so that, students could concentrate better and proctors could manage the exams more easily. Also, minimizing crowdedness eliminates problems faced due to broken or missing classroom materials:

Priority 1 Objective:

$$Min\left(\sum x_{d,s,c,r} \cdot (4 + Rflo_r)\right) \qquad (2.7)$$

Priority 2 Objective:

$$Min\left(\sum -\alpha_c\right) \qquad (2.8)$$

2.1.3. Model 3: Allocating students

An additional set

Set of day-timeslot-course-room combinations from the complete timetable (Model 2 results):

$$E =: \left\{(d,s,c,r)\middle| d \in D, s \in S, c \in C, r \in R, x_{d,s,c,r} = 1\right\}$$

Variables

$\overrightarrow{x'} \in \mathbb{Z}_+^{\,E}$: Integer variable, number of students enrolled in course c assigned to room r on the predetermined day and timeslot

$\vec{y} \in \mathbb{Z}_+^{\,D\text{x}S\text{x}R\text{x}I}$: Integer variable, minimum number of proctors that work for department i required on day d and timeslot s for room r

$\overrightarrow{{}^0\boldsymbol{\beta}} \in \mathbb{R}^{DxSxR}$: Auxiliary continuous variable, room usage rate over the 60% level

$\overrightarrow{{}^1\boldsymbol{\beta}} \in \mathbb{R}^{I}$: Auxiliary continuous variable, minimum number of personnel required for proctoring duties of department i

Hard constraints

Assign no more student than the seating capacity:

$$\sum_{c|(d,s,c,r)\in E} x'_{d,s,c,r} \leq Rcpe_r \cdot U \quad , \quad \forall d \; \forall s \; \forall r \qquad (3.1)$$

No student enrolled in can be left unseated:

$$\sum_{(d,s,r)|(d,s,c,r)\in E} x'_{d,s,c,r} = Cstu_c \quad , \quad \forall c \qquad (3.2)$$

For every 40 students seated add 1 more proctor:

$$\sum_{c \,\left|\, \substack{(d,s,c,r)\in E \\ Cdep_c = i}\right.} x'_{d,s,c,r} \div 40 \leq y_{d,s,r,i} \quad , \quad \forall i \; \forall d \; \forall s \; \forall r \qquad (3.3)$$

Assign at least 2 proctors for each room occupied for an exam:

$$\sum_i y_{ds,r,i} \geq 2 \quad , \quad \forall d \; \forall s \; \forall r \;\Big|\; \sum_{c|(d,s,c,r)\in E} x_{d,s,c,r} \qquad (3.4)$$

Minimum number of required proctoring personnel for each department:

$$\sum_r y_{ds,r,i} \leq {}^1\beta_i \quad , \quad \forall i \; \forall d \; \forall s \qquad (3.5)$$

Soft constraint

More than 60% occupation rate is not desired:

$$\sum_{c|(d,s,c,r)\in E} x'_{d,s,c,r} \div Rcpe_r \leq 0.6 + {}^0\beta_{d,s,r} \quad , \quad \forall d \; \forall s \; \forall r \qquad (3.6)$$

Objectives

In model 3, room usages rates over the 60% levels, total number of proctoring personnel required and, total number of proctoring duties were minimized together in an additive manner:

$$Min\left(\sum {}^{0}\beta_{d,s,r} + \sum {}^{1}\beta_{i} + \sum y_{d,s,r,i}\right) \quad (3.7)$$

3. Results

3.1. Data preparation

ETP is a problem of high complexity. Thus, we introduced a family of subsets of courses that our formulations loop over. Consequently, we reduced the complexity that may have led to the availability of the exact solutions. In addition, before proceeding to each next model, we restructured the sets to shrink the volume. E.g.: T instead of D,S and, C that reduce the cardinality from 5160 to 86 (98.33% reduction).

3.2. Model outputs

We solved the models in the Gurobi Optimizer (2019) v9.0.0 on an i7-7700HQ device with 16 GB of memory.

3.2.1. Basic timetable

Course-date-time information is the basic timetable and a sample fragment of the basic timetable is shown in Table 3. According to the basic timetable; 877 students (a student may be counted more than once as she/he is enrolled in multiple courses) are scheduled on the undesired hours, Deviations from desired values can be summarized as follows: $\overrightarrow{\boldsymbol{\gamma_0}} \cdot \vec{\mathbf{1}} = 26$, $\overrightarrow{\boldsymbol{\gamma_1}} \cdot \vec{\mathbf{1}} = 3$, $\overrightarrow{\boldsymbol{\gamma_2}} \cdot \vec{\mathbf{1}} = 2$, $\overrightarrow{\boldsymbol{\gamma_3}} \cdot \vec{\mathbf{1}} = 3$, $\overrightarrow{\boldsymbol{\gamma_4}} \cdot \vec{\mathbf{1}} = 2$, $\overrightarrow{\boldsymbol{\gamma_5}} \cdot \vec{\mathbf{1}} = 6$, $\overrightarrow{\boldsymbol{\gamma_6}} \cdot \vec{\mathbf{1}} = 39$.

Table 3. A fragment of the basic examination timetable

	Mon.	Tue.	Wed.	Thu.	Fri.
08:30	**ISLE218** Sec2 - Yr2 **ISLE218** Sec1 - Yr2	**IKTI402** Sec1 - Yr4	**ISLE304** Sec1 - Yr3	**KAMU202** Sec2 - Yr2 **KAMU202** Sec1 - Yr2	**ISLE110** Sec2 - Yr1 **ISLE110** Sec1 - Yr1
09:30	**ISLE407** Sec1 - Yr4	**EKON309** Sec1 - Yr3	**IKTI102** Sec1 - Yr1	**CALI402** Sec1 - Yr4	**EKON401** Sec1 - Yr4 **ISLE203** Sec1 - Yr3
10:30	**KAMU209** Sec1 - Yr2	**BUAD403** Sec1 - Yr4 **ISLE403** Sec1 - Yr4	**KAMU407** Sec1 - Yr4	**KAMU105** Sec1 - Yr1 **ISLE312** Sec1 - Yr3 **KAMU105** Sec1 - Yr1	**ULUS411** Sec1 - Yr4

3.2.2. Complete timetable

Table 4 illustrates a piece from the complete examination timetable, where Course, instructor, department-program, and number of students assigned with the room usage rates.

Spaciousness metrics, α_cs, are distributed within the range $[1.053, 4.167]$ with a mean of 1.499 and a standard deviation of 0.603. The 16 rooms available for are on the second, third, and fourth floors. The mean value of the floors of the rooms used, $\overline{x_{d,s,c,r} \cdot Rflo_r}$, is 2.392 and the standard deviation is 0.706.

Table 4. A fragment of the complete examination timetable

	Mon. - 11:30	Mon. - 12:30	Mon. - 13:30	Mon. - 14:30	Mon. - 15:30
room: A202	**ISLE315** Dr. M. Baş BADM -Pr2 (44 / 68) [88 %]		**IKTI302** Dr. T. Dağlaroğlu ECON -Pr2: (47 / 47) [94 %]		**IKTI405** Dr. M. Mert ECON -Pr2 (23 / 23) [46 %]
room: A203		**ULUS309** Dr. F. Taşdemir IREL -Pr3: (24 / 24) [48 %]		**EKON101** Dr. F. Emirmahmutoğlu ETCS -Pr2 (30 / 89) [60 %]	

room: A204	**ISLE315** Dr. M. Baş BADM -Pr2 (24 / 68) [60 %]				
room: A305	**KAMU420** Dr. İ. Keleş PADM -Pr2 (58 / 58) [83 %]			**EKON101** Dr. F. Emirmahmutoğlu ETCS -Pr2 (59 / 89) [84 %]	

3.2.3. Guidelines for proctoring duties

Table 5. A fragment of the total proctoring duties plan (Friday)

	ECON	**BADM**	**PADM**	**ETCS**	**PFIN**	**IREL**	**LECO**	**HLTH**	**ITRD**
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Fri. - o8:3o	1	5				2			
Fri. - o9:3o	2		2		1	1			
Fri. - 10:3o			1			1			
Fri. - 11:3o		2							
Fri. - 12:3o	1					1			
Fri. - 13:3o		3		2			1		
Fri. - 14:3o		1	3						
Fri. - 15:3o					1		1		
Fri. - 16:3o	2	5	2	1	4				
Fri. - 17:3o			1					1	
Fri. - 18:3o	3			1					
Fri. - 19.3o						1		1	
$^{1}\beta_i$	4	5	4	4	4	3	2	2	1
$\sum_{d,s,r} y_{d,s,r,i}$	42	62	34	26	15	33	16	5	5
$\vec{y} \cdot \vec{1}$	238								

After a tri-phase optimization process, we obtained the total proctoring duties plan. That is, we recommended a minimum number of proctoring personnel required, number of proctors required on each date-timeslot-room combination and, minimized

total number of proposed proctoring duties but we did not produce a proctoring schedule and left that micro-planning activity to the departments of FEAS. Table5 present fragment information on the number of proctors required on each timeslot for each department.

[1]β_is are the recommended minimum number of proctoring personnel required for department i. Totally, 29 proctors were assigned 238 duties, and the department of business administration had the busiest schedule with 62 duties.

4. Discussion

In this study, we addressed a summer school application of the examination-timetabling problem. The nature of the problem bore relaxed regulations that are, courses of both fall and spring semesters were available and, students may enroll in any elective throughout FEAS. Furthermore, students from other universities (visiting students) were allowed to register for the summer school. Challenging these complexities, our goal was to produce a timetable that benefitted all parties affected (students, proctors, instructors, housekeeping personnel and, FEAS administration) that had conflicting interests. We aimed to manage these conflicts by categorizing the formulated goals of each party into priority levels and then tackling them employing lexicographic goal programming.

For the aforementioned groups that were to be affected by the examination timetable, we first informally collected a prior data set of feelings and memories of disturbance associated with previous examination periods and made a list of preferences accordingly. E.g., students preferred no more than two exams in consecutive days, administration dictated the rooms were not to be shared for multiple exams and, there were undesired hours (administration did not want to pay overtime, students and proctors would both like to avoid tardiness). Then, before proceeding to model 2 (during the trial-and-error re-timetabling process), based on the observation that many alternative timetables were easily produced, additional unmentioned or newly discovered preferences (assigning rooms on the lower floors so that, housekeeping activity for a smaller area were made, operating costs were decreased, total distance traveled by students and proctors were minimized) surfaced.

In the formulation of our model, we tried each goal as a hard constraint separately and classified those made our model infeasible as soft constraints. And then, according to a priority plan discussed with the administration, we introduced the preferences as hard constraints, soft constraints, and objective functions in the lexicographic optimization process. Thus, we integrated all of the preferences in our model to produce a desirable decision for all.

Minimizing γ_0s, we ruled out the possibility that the basic timetable required more rooms than the available 16. Also, we maintained orderly operations at the examination coordination office, where the exam papers were handed over to proctors and then collected back. $\gamma_1, \gamma_2, \gamma_3$, and γ_4s are metrics of possible examination conflict in both compulsory and elective courses. γ_5 and, γ_6s relate to the possibility of multiple exams on the same day and thus, smaller values allowed study time between examinations and influenced success.

The multiplicative inverse of the α_cs, can be interpreted as a crowdedness metric, $1/\alpha_c$ s. The crowdedness data is ranged between 24% and 95% with a mean of 73.8% and a standard deviation of 19.1%. That is, on average we managed to keep 26% of the capacity idle so, monitoring students became easier and classrooms were airier especially during long exams. On the other hand, 5880 students took their exams on the second floor where 1405 and 1418 took theirs on the fourth and the third floors respectively. Therefore, student, proctor, and instructor movements were minimized together with elevator usage. In addition, we did not assign any exams to three rooms to further save janitors' housekeeping activities, air-conditioning and lighting costs.

The research assistants (RA) in FEAS are assigned proctoring duties; therefore, 29 of the RAs were not let on leave and were exempted from the final examinations proctoring duties (if applicable). So, the disturbance of the research activity was kept minimal.

In contrast to conventional regulation-based and student-group-oriented formulation, we employed a trial-and-error approach and separated the date-timeslot assignment (basic timetabling) phase from room assignment in order to collect reports on clashing courses. We are the first to consider classroom crowdedness (usage rate over 60%) which eliminated broken or missing classroom material problems, eased

proctoring duties and, spacious and improved concentration that hopefully contributed to overall student success.

This paper offers a novel perspective via separating the ETP formulation and reprocessing datasets before each step, which is contrary to the traditional holistic optimization process but reduced complexity of the problem at hand and allowed a greater possibility to reach exact solutions. Research on ETP generally focuses on student welfare we broadened the focus to all parties. In addition, the minimization of classroom crowdedness is a unique detail.

5. Limitations

ETP is a modification of the course timetabling problem that is proven to be of high complexity (NP-Complete) (Even et al. 1975). Thus, we broke the formulation down into three models. Separating basic timetabling from room allocation may have led to sub-optimality. The reason for this main limitation is the lack of complete knowledge of student clusters enrolled in common courses. This misinformation is caused by the inclusion of the visiting students that are not integrated into the FEAS Student Database. Moreover, we believe distributing students to designated rooms and deciding the number of proctors required accordingly is separable from the ETP and did not cause further gap from the ideal results. Lastly, separating basic timetabling from room assignment made it possible to discover hidden preferences that may compensate for a possible optimal solution that does not cover the whole preference criteria.

A second limitation of this research is, we set runtime limitations to the optimization solver. Consequently, it is possible that we produced a suboptimal examination timetable. Yet, agility (ability to react to reports on clashing courses) was paramount to FEAS administration. Given agility is not a mathematically formulated constraint in our models, it is infrangible.

6. Summary and conclusion

In the present article, we offered a novel approach to tackle the ETP for cases where student groups are not available. Our formulations also included a policy for assigning proctoring duties. The formulation of the ETP in this study is three-fold: date-time assignment, room assignment, and student allocation. Through the formulation, we implemented data processing steps to create smaller subsets to loop over and thus, reduced complexity.

Future research may extend this work by employing different multiple objective decision-making (MODM) approaches, proving student allocation is separable from the ETP, and investigating additional approaches to reduce complexity.

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The CoViD-19 pandemic and the end of corporate risk management as we know it

Markus WILL

Zittau/Görlitz University of Applied Sciences, Germany

Abstract

Aim: The article is intended to contribute to a discussion on risks related to the CoViD-19 pandemic, which was started in the last issues of this journal.

Findings: The article discusses the thesis that conventional risk management is reaching its limits in its application in companies, particularly with regard to low-probability but high-impact events its applications seems nor appropriate. In complex and tightly coupled systems like global supply chains, catastrophic events must be considered "normal". The risk of a global pandemic is well known, and at the end of 2019 the first signs of an impending outbreak were also evident. Nevertheless, the global pandemic and the gradual lockdown was surprising in that no precautionary measures were taken. Therefore, this paper argues for a change of perspective from traditional risk management to business continuity management (BCM) and for increasing the resilience of supply chains.

Keywords: CoViD-19, risk management, black swans, business continuity, supply chain resilience

1. Introduction

The importance of the publications of two American organizational sociologists cannot be overestimated for today's risk and crisis management. It was Charles Perrow and Karl Weick who, like few other academics, described the normality of disasters (Perrow 2011, 2004, 1992) and possible options for action (Weick 2016; Weick et al. 1999; Weick, Sutcliffe 2011). It is thanks to their insights that valuable suggestions for better management of crises and the leadership of organizations in the VUCA

Contact details: Markus Willl, Zittau/Görlitz University of Applied Sciences, Germany. E-mail: m.will@hszg.de
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environment[1] can still be found today. In the face of the multiple sustainability crises, technological disruptions and the recent and ongoing CoViD-19 pandemic, it seems that conventional managerial approaches need to be adapted. Generally speaking, dealing with deviations from normal conditions is the main task of top management (Hoskisson et al. 2016; Jansen 2009; March, Shapira 1987), which requires flexible and adaptive action from decision-makers. Holding on to management instruments that have so far been promising or effective is probably the only thing that should not be normal (Jansen 2009). Karl E. Weick, therefore, advises: "Drop your tools"[2] (Jansen 2009; Weick 1996). Dealing with uncertainty is the big issue of our time – in everyday life as well as in politics, in personal infection protection as well as in crisis management for the coming months. CoViD-19 has made us drastically aware "Extremistan" (Taleb 2008) and its fragility in an interconnected worlds with non-linear interactions.

CoViD-19 and the lockdown pose enormous challenges for individuals, organizations and entire societies. Currently – i.e. in September 2020 – the financial and non-financial effects cannot yet be fully described. However, it is becoming increasingly clear that the crisis management of the pandemic has succeeded to varying degrees in different parts of the world (Cheng et al. 2020; Dehning et al. 2020; Wieler et al. 2020). However, it is undisputed that CoViD-19 hit the political and economic system as well as decision-makers by surprise, although a pandemic can be considered as a normal, expected and predicted event (Platje et al. 2020; van Dam, Webbink 2020). This diagnosis led van Dam and Webbink (2020) in a reflection paper in this journal to conclude, that "the most influential decision-makers collectively and systematically deny and wilfully ignore predicted future disasters" (van Dam, Webbink 2020: 9).

The advice to "drop the tools" and the diagnosis of "wilful ignorance" refer as the starting points for this article, which aims to describe the limit of conventional enterprise non-financial risk management systems and to contribute the discussions

[1] VUCA stands for volatility, uncertainty, complexity, and ambiguity (see for instance: Chawla, Lenka 2018).

[2] And I mean here: not only with regard to analysis, but also the execution of management itself.

which started in CEREM with articles from Joost Platje and fellows and Ynte van Dam and Joke F. Webbink (Platje et al. 2020; van Dam, Webbink 2020).

The logic of the argumentation is as follows: In complex and closely coupled systems, such as global supply networks, disruptions are to be considered as normal, as described by the normal accident theory (section 2). Conventional risk management and its applications often refer to a probability-based approach and should allow thresholds for intervention to be set based on cost-benefit analyses. This approach to risk management is referred to as "conventional risk management" in this paper, and its limitations are described (section 3). Section 4 deals with the description of the pandemic as a "black elephant", i.e. a foreseen but ignored risk, and as a wicked problem. This leads to further insights into the limitations of conventional risk management. Finally, this paper advocate for changing the perspective from causes and their probability towards a more preventive approach. Business continuity considers critical processes for deriving measures for rapid recovery and restart.

2. Normal disasters

The more complex the effects between system components and the closer the coupling of system elements, the more "normal" or inevitable disasters become (Perrow 2011, 2004, 1992). The term "normal" is by no means a statement of frequency. Instead, it should indicate that particular organizational structures cause inherent system characteristics which favour accidents and make them "normal". For the description of inherent system properties, Perrow employs the two distinct categories interaction and coupling (Perrow 2011, 1992).

Interactions describe the relations between different components in a DEPOSE system (i.e. design, equipment, procedures, operators, supplies and materials, environment). A linear interaction exists if a component only interacts with a preceding or following component, as in the case of a lamp series connects or a simple assembly line. Component (a) influences component (b) and this, in turn, influences component (c) etc. Linear systems are mostly trivial, these simple interactions occur immediately and during regular operations. In case of deviations and unplanned

operation conditions, failures can be easily detected by operators. Taking the example of the assembly line, this means that if a component or unit fails, the effects "down the line" are predictable, adverse impacts can be foreseen, and countermeasures can be planned *ex-ante* and initiated (Perrow 1992: 107 f.). Before the failed technical component, incoming parts are pent up. Behind it, incompletely assembled parts are carried on (Perrow 1992: 108). It is irrelevant how many steps or components the assembly line consists, be it three components or 1000 or 1,000,000. On the other hand, there are more *complex interactions* in which the system components can all interact with each other. There are also external factors that influence the interaction of the system components positively or negatively. Complex interactions can be "by-design", or they occur unexpectedly in case of failures. Complex systems are often not immediately transparent for the operating personnel. Components can have common-mode functions, i.e. see have several functions and operate two or more other components. If a malfunction of common-mode functions occurs, a variety of consequential or dependent errors occur. As the number of mutually influencing components increases, the complexity of the overall system increases and the number of possible reactive interactions no longer increases proportionally but by square or exponentially. Ramifications, feedback loops and disruptions characterize complex interactions. If each element can influence another, the effects are no longer predictable. Such highly complex systems are often controlled by cybernetic processes (including feedback loop process control).

However, due to cognitive limitations, they are difficult for humans to understand (Dörner 1997). In most cases, attempts are made to reduce complexity and keep the system linear, i.e. to mitigate or prevent unintentional complex interactions between the elements through safety precautions or buffers. Paradoxically, the preventive extension of the DEPOSE system with redundant components, one of the dominant security strategies in critical infrastructures, unfortunately, leads to an increase in complexity and thus to a reduction in security and a false sense of security (Sagan 2004).

Highly complex systems are not necessarily error-prone or fragile systems. According to Perrow, another aspect, independent from the complexity of interaction, is the coupling of elements. The concept of coupling refers to the cohesion of

fragmented parts of a social system (e.g. an organization) and the number of mutual variables (Glassman 1973; Vester 2012; Weick 1976). Elements of an organization can therefore be coupled with tight and dense linkages or not. *Closely coupled systems* imply that there is no buffer zone or elasticity between two interconnected parts (or subsystems). Disturbances thus have an abrupt effect on the overall system, whose resilience is low. The processes are difficult to change, and there is no possibility of delays in the operation. Only one method and one set of resources can achieve the objectives. *Loose coupling*, on the other hand, allows individual parts (or subsystems) to act according to their own logic and interests. With closely coupled systems, this possibility is limited. Loosely coupled systems have no direct connections but are also not entirely independent. There is room for manoeuvre, processes can be changed, and alternative methods of achieving objectives are conceivable. Due to margins, buffers and redundancies or the possibility of substituting specific resources, delays in the operational process can be tolerated. Loosely coupled systems are therefore less prone to failure and more stable (Weick 2016).

In linear systems, close coupling is an optimal way to organize (Perrow 1992: 132). The more tightly coupled a system is, the faster and more efficient work can be done, as is to be achieved, for example, with lean management, which is popular with corporate consultants, and through just-in-time production processes (Saurin et al. 2013; Soliman et al. 2018). However, this increases the dependency on the supplier or a network of suppliers. If the right part is not delivered at the right time, the production process must be stopped. There is no room for manoeuvre; everything has to run according to plan. However, in organizations characterized by complex interactions and close interdependencies, which are likely to include globalized supply chains (Choi, Wu 2009; Dyer, Nobeoka 2000; Skilton, Robinson 2009), resilience decreases and disruptions, interruptions or disasters become more inevitable or can be considered normal. For (risk) management, this means that disturbances are virtually inevitable. Hence the determination of probabilities, which is a standard procedure in conventional risk management seems unnecessary.

3. Conventional risk management and its limitations

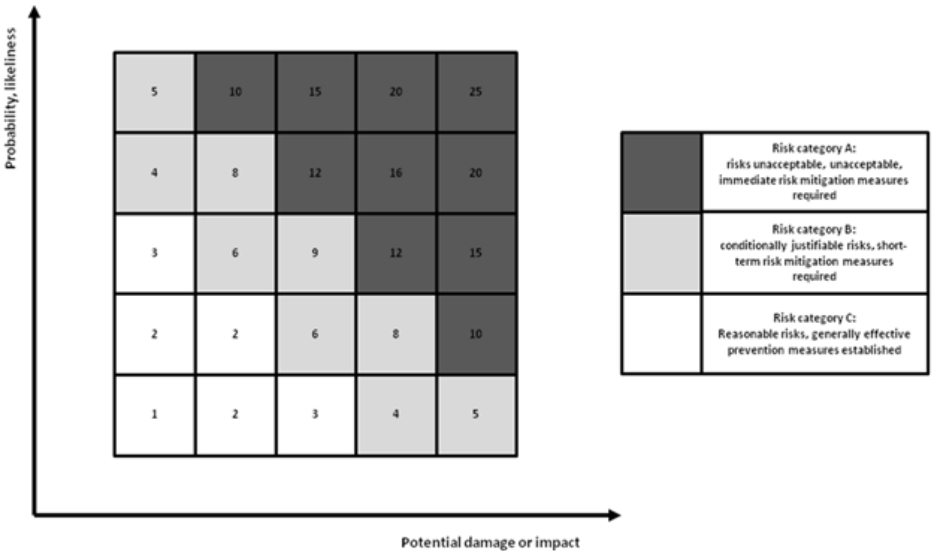
Risk management is a framework to the more or less systemic analysis and assessment of the positive or negative impacts of particular events and activities on organizations. The aim of risk management is, according to the international management system standard ISO 31000, to acquire a proper understanding of issues involved (Zio 2018) and to take coordinated and informed decisions to control risks and to avoid adverse outcomes. Systemic understanding is expected to allow for rational management of (potentially) hazardous industrial operations. Quantitative risk assessment is, for more than 50 years now, based on the concept of (Bayesian) probability (Kaplan, Garrick 1981; Kelly, Smith 2009; Zio 2018), the frequency of occurrence and adverse impacts, i.e. the number of fatalities (Starr et al. 1976). These underlying principles, which have first been applied with regard to large technological systems, their siting and public tolerance and acceptance (Farmer 1967) are still remaining (Aven 2020; Jonkman et al. 2003). Generally speaking, risk management deals with the possibility that an event occurs which poses (typically negative, i.e. undesirable, adverse or harmful)[3] consequences. Impacts are often described with reference to particular values, the impairment of objectives or by monetarization. In its most simplified form, risk management relies on the risk equation described as

$$R = Frequency \times Impact$$

and the risk matrix (see Figure 1) as its graphical representation (Kaplan, Garrick 1981). The risk equation and matrix represent expected damage and estimated likeliness of occurrence of an event.

[3] This is at least the everyday life understanding, where risks are related to negative outcomes where as beneficial effects are typically considered a chances or opportunities.

Figure 1. Example of risk matrix



The expected damage is classified into categories by using simple ordinal scales, for example, from 'no damage' or 'minor damage' to 'very high damage'. The probability or likeliness of occurrence is estimated based on a suggested frequency in the same manner. It ranges, for instance, between 'very unlikely' to 'most likely' or 'pretty sure'. In order to derive risk mitigation measures, prioritization is necessary that characterizes the need for action. In the case of operating risks, the assigned values for damage and probability are multiplied and classified into risk priority classes by the help of thresholds. Those thresholds follow the ALARP-Principle, which stands for the minimization of risk to an acceptable or tolerable level, which is considered "as low as reasonable practicable" (Jones-Lee, Aven 2011). The ALARP principle, which was first specified as a regulatory requirement in UK's Occupational Health and Safety laws (Jones-Lee, Aven 2011; Melchers 2001), takes into account that effort and money must be spent in risk reduction, but also that spending are limited. The guiding principle is an economic one, based in cost-benefit-analysis (Ale et al. 2015). ALARP does not aim to achieve zero risks at all cost. The relation between cost and the benefit of risk mitigation may not be disproportionate from an individuals or organizations perspective. Needless to say that this perspective is

unethical and not appropriate for societal decisions. Thresholds that separate the area of tolerable risk from the intolerable risk must be explicitly defined for each organization and context, for example:

- Risk class A: risks unacceptable, unacceptable, immediate risk mitigation measures required.
- Risk class B: conditionally justifiable risks, short-term risk mitigation measures required.
- Risk class C: Reasonable risks, generally effective prevention measures established.

Admitted, the risk formula is a straightforward and pragmatic way and why it enjoys great popularity in practice. It forces the user to apply an abstract and descriptive two-dimensional evaluation grid (i.e. index of probability and extent of damage). The result is an orientation variable that can be used in any context to rank particular actions according to their degree of risk (Renn 2007; Wilson, Crouch 2001). However, the concept was criticized mainly from social scientists for various reasons, i.e. for its application in the context of risk technologies and due to its generalization of time and place (Beck 1988, 1992a, 1992b). Due to the context-specificity and subjectivity of the procedure, requirements for objectivity cannot be met, which is why the risk formula is not suitable for use in science or politics (Douglas, Widavsky 1983; Jasanoff 1999; Perrow 2011).

This critique, however, can be countered by the fact that (1) in principle, every risk assessment is subjectively influenced and can never claim objectivity. Accordingly, there is always a need for political regulation. (2) It must be recognized that it is precisely the abstraction from the individual case to a generalized case that enables the comparison of situations and alternatives and that risks and potential dangers can be presented relative to each other. Accordingly, preference should be given to those options for action that cause the least damage, regardless of the distribution of affectedness (Renn 2007). Nevertheless, the it is advisable to reflect on the approach in order to avoid arbitrarily use and (cognitive) biases. Strictly speaking, the risk formula can only be reliably applied under certain conditions (Banse, Bechmann 2013; Ganz, Deuerler 2011):

a) The damage event occurred very frequently and could be observed well; the retrospective view is representative and trustworthy. Only in this case, a sufficiently exact data basis can be compiled to be able to conclude from a random sample on the whole, in order to determine or extrapolate expected values for the probability.
b) For damaging events, triggering factors can be identified, and robust cause-effect chains and, at best, dose-effect relationships can be determined.
c) Subjective assessments must be justifiable, coherent and free of contradictions and thus not "arbitrary".
d) Blindness to black swans cannot be excluded; even reliable systems bear risks (i.e. if complex and closely coupled).

Two of the aspects, (a and d), mentioned above will be explained in more detail at this point. Firstly, for the estimation of the frequency and the probability of occurrence, reliable data and information are needed. This sort of information relates either to the historical events or is just a subjective guess on future likelihood. The latter is highly speculative and subjective. However, also the view into the past is deceptive, as has long been known in the philosophical criticism of naïve inductivism (Chalmers 2013; Hume 1993; Russell 2004, 2001). Induction relates to the derivation of general knowledge based on observations, i.e. the analysis of past events. Inductive confidence grows with the number of observed events, and so does the feeling of security, but in the most remarkable security, it is also most dangerous. For illustration, the story of the *"inductivist turkey"* is often presented: A farmer feeds a turkey every day. Before concluding based on only a few observations, the turkey collects data for a longer period taking into account different circumstances. Following the concept of induction, the turkey concludes this will continue, so the turkey develops a feeling of security and reliability that it will be well treated and fed every day. The turkey inductively concludes from the past to the future. Suddenly the turkey's throat is cut on Thanksgiving Day (Chalmers 2013, relying on Russell

2001)[4]. The end of the story is simple: it does not matter how many events or cases are observed in the past as nothing can guarantee that the next case will follow this particular trajectory.

Another problem of inductive reasoning, especially concerning risk management, is the *black swan fallacy*. The metaphor of the black swan was coined, besides others, by Karl Popper and his concept of falsification (Popper 2002). In another context N.N. Taleb has used the term, namely regarding extremely unlikely (improbable) events with large-scale and disruptive impacts (Taleb 2008). These Black Swan events are nearly impossible to predict. Nobody thought of Black Swans (such as Fall of the Berlin Wall, the Fukushima nuclear accident, the internet revolution, etc.), and they occur surprisingly and unexpectedly ("unknown unknowns"). Indeed, humans fail to recognize black swan events or tend to ignore them – also in industrial risk management (Murphy, Conner 2012). This is due to a wide range of fallacies, such as (Pfluger 2009; Taleb 2008):

- Fade out: We pretend that there are no black swans. "Outliers" occur so rarely, is it worthwhile to take precautions and develop a corresponding perception?
- Confirmation fallacy: We concentrate on selected segments of what happened and, more generally, we focus on what we do not see.
- Tunnelling: We concentrate on defined sources of uncertainty ("known unknowns"), on a list of documented black swans (and neglect others that we do not easily think of).
- Narrative fallacy: Stories are told, the characteristic patterns follow and give us a distorted image (Platonism, "map not territory", "what we see is not what is there").

[4] „Domestic animals expect food when they see the person who usually feeds them. We know that all these rather crude expectations of uniformity are liable to be misleading. The man who has fed the chicken every day throughout its life at last wrings its neck instead, showing that more refined views as to the uniformity of nature would have been useful to the chicken." (Russell 1912/2004, according to: https://archive.org/details/problemsofphilo00russuoft/page/98/mode/2up?q=Domestic+animals+expect+food [09.09.2020].

In addition, there is another issue leading to biased risk perception, which is the paradox circumstance that we are afraid of the wrong risks. Let's call this the "white shark" effect, it means that (some) people tend to assess certain risks as very high and play down others, even though statistically those risks are very low (e.g. fear of electro smog, polluted indoor air or pesticide residues in food). These issues may pose risks, but if compared to the statistically recorded causes of death, it is evident that people are more likely to die from poor nutrition, high blood pressure, smoking or overweight (Renn 2014). A reason for the individual overestimation is that risks are social constructs (Renn 2014, 2007), which are biased by (social) media, fake-news but also personal characteristics and risk preferences that affect the perception and therefore the acceptance of risks.

This said, it becomes understandable why, despite the pragmatic preference for the risk matrix as an easy-to-use tool, the limits of the approach must be considered at least, if the tool of a risk matrix is not better dumped and replaced by more meaningful approaches. Looking at current pandemic, which can be used as an example of wicked problems, the futility of the approach can be made even more apparent.

4. CoViD 19 pandemic: a wicked black elephant

In the Chinese city of Wuhan (Hubei Province), a new and unknown form of pneumonia was detected end of 2019. The disease was reported to the WHO office on 31 December 2019. The Central Government of China imposed the "Wuhan Lockdown" on 23 January 2020 after the novel coronavirus to other major cities in China and other regions and countries, including Hong Kong, Macau, Taiwan, Thailand, Japan, South Korea, and the United States[5]. WHO officially described the Wuhan lockdown as "unprecedented in public health history" and declared a "Public

[5] https://en.wikipedia.org/wiki/COVID-19_pandemic_lockdown_in_Hubei#:~:text=On%2023%20January%202020%2C%20the,pinyin%3A%20W%C7%94h%C3%A0n%20f%C4%93ng%20ch%C3%A9ng [10.09.2020].

Health Emergency of International Concern" on 30 January 2020[6]. The name COVID-19 was given to the novel coronavirus disease on 11 February 2020 and exactly one month later, the WHO declared a global pandemic officially, as the disease was detected on all continents (Balog-Way, McComas 2020; McAleer 2020). In the further course of time, almost all countries with detected COVID-19 cases have enforced some form of pandemic lockdown, which covered the entire country or only individual regions or cities[7]. The term lockdown[8][9] was commonly used with regard to mass-quarantines or stay-at-home orders as well as closures of certain types of businesses, or bans on lager events and gatherings[10,11]. The lockdown was justified with the high transmissibility and the possibility of overburdening the health care systems. It was some sort of preventive lockdown because virologists and infectious disease modellers predicted large scale impacts and death tolls unless early action is taken and maintained (representative of the many studies (Adam 2020; Davies et al. 2020; Dehning et al. 2020) – an approach which was strongly criticized at an early stage (Ioannidis 2020). The pandemic and lockdown measures have indeed impacted global economies and supply chains. Predictions and scenarios are – by nature – uncertain, but the outbreak already had and will have significant impacts on the global economy (Atkeson 2020; Guerrieri et al. 2020; Ludvigson et al. 2020; McKibbin, Fernando 2020; Nicola et al. 2020). According to predictions by the IMF, the global GDP will decrease by 4.9% in 2020, with an average annual change of -8% in the US and -10% in the Eurozone, and -3% in emerging markets and developing economies (IMF, 2020). The NBER predicted a cumulative loss in industrial production of 20% and in service sector of nearly 39% for the US for 2020 to 2021 (Ludvigson et al. 2020). The IMF also projects that recovery will be gradual, taking into account that the pandemic is a global and multi-period event. However, global GDP growth is

[6] However, the Spanish Flu and Black Death are examples where governing bodies also took radical measures in different places, though not globally at the same time.
[7] https://en.wikipedia.org/wiki/COVID-19_pandemic_lockdowns [10.09.2020].
[8] https://www.businessinsider.com/countries-on-lockdown-coronavirus-italy-2020-3?r=DE&IR=T [10.09.2020].
[9] https://en.wikipedia.org/wiki/Lockdown [10.09.2020].
[10] https://www.politico.eu/article/europes-coronavirus-lockdown-measures-compared/
[11] https://www.businessinsider.com/countries-on-lockdown-coronavirus-italy-2020-3?r=DE&IR=T [10.09.2020].

projected at 5.4 % for 2021, which is about 6.5% lower than in pre-COVID-19 projections (IMF 2020). On the company level, the impacts are mostly related to supply and demand drops. More specifically, effects of the global pandemic cause supply chain interruptions and declines in demand leading to a reduced workload which causes effects on employment, which in some countries have been compensated by state-aids and through short-time work.

Taking the automotive industry as an example, which is one of the essential branches of the German economy, the pandemic was plunging the industry in both a demand and supply shock. In China, the world's largest market, for example, factories were closed until February 2020 and sales decreased dramatically by 80 %, and are after the first recovery still 50% below compared to the previous year[12]. However, it must also be said that the (German) automotive industry is also facing a number of other problems, and the current poor performance cannot be attributed solely to the pandemic. Overall, the industry is also under pressure due to mistakes in the past ("diesel gate") and developments in the area of climate protection and the expansion of alternative mobility concepts (electric mobility, hydrogen fuel cells) in connection with digitization and automation and an increasing share of shared-economy business models that have not been taken into account for too long. The fact, that there are (currently) multiple superimposing transformations and decision making takes place under conditions of complete uncertainty without a fundament of accurate data ("Knight'sche Unsicherheit", Knight 2017/1921) makes it even more worrisome. Most challenges humankind is confronted with on various levels are considered as "(super-)wicked problems" (Levin et al. 2012; Rittel, Webber 1973). To put it very short, a wicked problem is a messy problem (Ackoff 1997), where no silver-bullet solution exists, standard-operation procedures are not appropriate and new approaches have quickly to be collaboratively developed, under the condition of uncertainty, to tackle a problem, which however cannot be finally solved. When applied to the pandemic, wickedness shows itself in different ways (Zizka 2020). As SARS-CoV-2 and the related disease is not fully understood, a vaccine is not available yet in a global scale and the future infection scenarios remain uncertain, there is no definite problem

[12] https://www.deutschlandfunk.de/coronavirus-und-die-autoindustrie-nagelprobe-fuer-eine.2897.de.html?dram:article_id=473726 [10.09.2020].

formulation. The is no obvious stopping rule: as infections recently increase in a second wave, no one can be sure, when the pandemic will be over. There is no 'right' or 'wrong' and hence the number of approaches towards solutions is infinite. Each approach, however, is a "one-shot-operation" and there is no room for trial-and-error. This creates an awkward situation for decision-makers, as each decision can make the situation even worse.

It seems, therefore, that the CoViD-19 pandemic is a significant new member in the family of "wicked problems" and social messes (such as habitat destruction and dramatic loss of biodiversity, poverty or climate change), which appear open and non-linear systems. As nobody knows when the pandemic will end and what direction it will take, in the absence of the "right thing to do" and the fact, that trial-and-error comes at an unacceptably high cost, what is left is an incremental muddling through (Braybrooke et al. 1963; Lindblom 1959; Wildavsky 1973). This brings us back to the limitations of conventional risk management, as described above. The CoViD-19 pandemic is an event that could have been expected, but which came across the globe by surprise or unexpectedly, as otherwise countermeasures (e.g. stockpiling of face masks, sanitizers and disinfection agents, respirators) would have taken place. It seems that CoViD-19 is not precisely a black swan event, but a black elephant. The metaphor of the "elephant in the room" is widely used to describe an obvious problem, which is not addressed but instead ignored[13]. Insurance experts expect a pandemic every 20 years[14] and potential threats of "the monsters at door" have been described at various places as existential risks (e.g. Casti 2012; Ord 2020; Taleb 2008). It is likely that pandemics are present in many standard risk inventories and response plans are developed for it, but they eke out fate in the filing cabinet or are actually repressed or ignored. The same seems to be true when it comes to the detection of early warnings: China reported the novel corona-virus outbreak end of 2019, and there are indications that the dangers were known earlier (Platje et al. 2020). Therefore, the

[13] A similar metaphor is the "green swan" which points to a high likely risk, which timing and occurrence is unknown and which properties and impacts are too complex to be fully understood (Bolton et al. 2020; Müller, Hornig 2020; Silva 2020).

[14] https://www.handelsblatt.com/finanzen/banken-versicherungen/gunther-kraut-pandemie-experte-der-munich-re-alle-20-bis-30-jahre-kann-so-etwas-wie-corona-passieren/25770456.html?ticket=ST-527058-0edblFrcIrnadfmpii1K-ap4 [10.09.2020].

question arises, why the possibility was not seen earlier (Müller, Hornig 2020), why it was an unseen evidence (Platje et al. 2020: 152). Van Dam and Webbink (2020) argue in this journal, that it is a matter of conscious ignorance, of buying into collateral damage, which is systemically embedded in the neo-liberal capitalist economic system (van Dam, Webbink 2020). The precautionary principle, which suggests that even a few indications should suffice to initiate preventive measures, is undermined in the neo-liberal logic. Instead, the authors assume that the problems that have become apparent in the supply of certain medical products and the provision of beds in intensive care units in recent months are almost inevitably the result of an economic system that places short-term corporate profit and shareholder interests above the common good. Van Dam and Webbink point out another interesting point, namely that concerning wicked-problems: "everyone can define the problem and its cause in one's own way to derive one's favourite solution to the problem. Whatever measure is implemented to counter the crisis can be labelled anything from overreacting and creating panic to ignoring the seriousness and wilful [sic!] negligence" (van Dam, Webbink 2020: 13). They see this aspect reinforced by policies put under pressure by public opinion: "Even more perversely an avoidable crisis that is managed successfully also scores better in the media than a manageable crisis that is avoided successfully." (van Dam, Webbink 2020: 13).

Although risk management and early warning systems are used in corporations, they seem to fail to detect short-term impacts on supply chain management and other business operations. When being confronted with low-probability and high impact black swan events, or unexpected but predicted events ("black elephants"), conventional approaches to risk management are limited (Murphy et al. 2020; Murphy, Conner 2012; Werther 2013). Hence it is recommended in this paper, to change the perspective towards a more preventive approach, i.e. business continuity, which aims to increase the resilience of operations.

5. Changing the perspective: prevention, business continuity and supply chain viability or resilience

Given the limitations of risk management and the circumstance that the CoViD-19 pandemic is a wicked black elephant, an event that its expected and unexpected at the same time (Platje et al. 2020), which causes severe socio-economic impacts and far-reaching consequences and where is no prescriptive and promising in the face of uncertainty and complexity except of "muddling through", alternative approaches to corporate risk management are needed. One approach to overcome the limitations of conventional probability-based risk management could be to change the perspective towards the prevention of assets and maintaining the effectiveness and to allow for a restart of critical infrastructures. As we have seen during the pandemic and the global lockdown, companies and other types of an organization rely on the effective functioning of infrastructures and supply chains. The interruption of critical and vital processes and infrastructures may represent an existentially threatening risk (Sheffi 2007). Two approaches are worth to be considered:

1. Reducing vulnerability, i.e. business continuity planning
2. Supply Chain Resilience

Ad 1) Business Continuity Management

Business continuity planning and management seeks to preserve or restore the capability of companies to achieve its mission, its operations in terms of delivery of products and services and its customer base and market share (Hiles 2010; Will, Brauweiler 2020 and the relevant international standards such as ISO 22300: 2018, and ISO 22301: 2019).

Business Continuity Planning involves several steps, where the Business Impact Analysis (BIA) and the development of BC strategies and measurements as well as trainings and exercises. It is crucial to identify critical assets, infrastructures and process, which are essential to keep operational productivity, e.g. IT systems, electricity as well as supply with urgently needed raw materials and materials or preliminary products. During an BIA the focus is on the effects not on the causes and

their likelihood. The aim is to estimate the range of damage to specific and crucial assets concerning different effect categories (see Table 1)

Table 1. Examples for effect categories related to vital assets are

Loss of facility and infrastructures	Offices, factories, warehouses and other physical structures and tangible assets, that can become inaccessible or unusable (due to floods, fires, chemical contamination, loss of power, condemnation by inspectors etc.).
Loss if information	Equipment, machinery and office can always be replaced, while loss of intangible assets such as information and intellectual property, besides others, may irreversible. With the advent of cloud technology and automated backups, the solutions to protecting information are available to everyone
Disruption in operations	Labour strikes, supply chain breakdown, mass transit disruption, pandemics and other events
Technology disruption	caused by hardware malfunction, cyber attack, network failure and software issues
Organizational disruptions	that prevent organizations from fulfilling their obligations such as legal, regulatory, intellectual property, bankruptcy and financial malfeasance

Source: Hiles (2010).

When considering the impact of disruptions, BIA aims to estimate time frames concerning duration of interruption, the time period within the disruption becomes unacceptable and the desired recovery time. Metrics such as Maximum Tolerable Period of Disruption (MTPD), Minimum Business Continuity Objective (MBCO), and the Recovery Time Objective (RTO) are suggested by the relevant international standards ISO 22313 and ISO 22313 (see further descriptions in Hiles 2010; Will, Brauweiler 2020).

The metrics indicate the needs for recovery, which then shall serve as a basis for the allocation of funds in order to realize one or more direct responses to crisis or disruptions. Examples are (Will, Brauweiler 2020):

- *Capacity reserves* for production facilities, redundant processes, e.g. external backup data centres to avoid information blackouts, redundant and independent feeds of data, energy and material supply, collaboration with other companies or mutual aid agreements, double sourcing of critical materials and components,

different alternative transport modes, replacement of vending machines by man-power, securing the availability of manpower by personnel leasing, satellite offices and teleworking-options.

- *Substitution strategy* of core functions for instance in headquarters, including management, finance and accounting department, personnel department, public relations department and a system of deputies.
- *Stockpiling and inventory management* raw materials, semi-finished products and energy to compensate for the interruption of supply and demand.
- *Separation:* Inventories of finished products that should be physically separated from production.
- Rapid replacement and substitute procurement.
- Estimate inventories along value chains, including finished goods, blocked goods, spare parts and parts with lower quality ratings. After-sale stocks might be used to bridge shortcomings.

Table 2. Metrics for Business Continuity Planning

Maximum tolerable period of disruption (MTPD)	The MTPD of an certain activity takes into account the duration after which the organization irrevocably suffers damage if the critical processes for the delivery of goods or the provision of services fail
Minimum business continuity objective (MBCO):	MBCO refers to the minimum level of product or service quality that is acceptable to the organization to still achieve its business objectives during a disruption
Recovery Time Objective (RTO):	RTO relates to the capacity and the time within it is planned that an activity or dependency is to be resumed, i.e. the period during which a process can fail without significantly hampering business activity.
Recovery point objective (RPO):	RPO refers to the point to which information or other inputs used by an activity must be restored to enable the activity to operate on resumption.

Source: Hiles (2010).

Ad 2) Supply Chain Resilience

Business Continuity Planning focuses mainly on on-site assets and critical infrastructures from 1st-Tier suppliers. However, as shown by the pandemic, it might also be necessary to take actions for mitigating supply chain interruptions as well as

to build up resilience against future disruptions, in particular as it is uncertain but possible that a second global lockdown occurs (Alicke et al. 2020). In order to enhance supply chain resilience, further aspects can be considered (Alicke et al. 2020; Ivanov 2020; Ivanov, Dolgui 2020; Jansen 2009; Sheffi 2017, 2006):

1. *Supply Chain Transparency* builds on an inventory of critical components and their suppliers and aims at the identification of alternative sourcing options and the creation of "multitier supply chains". This step requires the involvement of tier-one suppliers to identify tier-two and beyond suppliers. Cooperation can take the form of information-sharing agreements which also allow for early-warning systems to monitor lead times and inventory levels. It might also include discussing Business Continuity Management with Tier-1-suppliers to establish recovery plans for particular suppliers and commodities. In case that Tier-1-suppliers decide to refuse cooperation or do not have visibilities on their own supplies, triangulation from different information sources and business-data providers and databases might be necessary.
2. *Redundancies:* Having redundancies, i.e. a plan B[15], is an obvious strategy to protect against interruptions and to maintain services to customers while operations are being established. Organizations need redundancies – in the capital, in suppliers, in production capacity – to overcome crises. To protect themselves against small fluctuations, organizations have set up emergency storage facilities or maintain redundant technical systems. However, it was precisely these buffers that were intended to avoid waste through cost-fixed consultants and the lean management principle with tightly meshed logistics chains It is also important not to reverse the advantages of lean management and, despite this, to ensure a certain degree of crisis resilience. The basic forms of redundancy lie in the dual design of critical infrastructures (i.e. emergency power supply, IT systems, backups) and also in additional stocks of parts, materials or raw materials (i.e. SOSO-strategy: "sell one, stock one", Sheffi 2006: 190). While the creation of artificial buffers for tightly coupled and complex systems is a sensible measure, keeping capacities

[15] Or even no plan… The capacity to develop plans and grab opportunities to quickly adapt to external disruptions seems to be a key (see Platje et al. 2019).

that are largely unused is very expensive and profit-oriented companies can hardly afford this. It is therefore necessary to proceed with a sense of proportion and to look for optimal ways to increase resilience

3. *Assessment of customer demand:* It is the core activity and at the same time the greatest challenge of supply chain management to forecast future customer demand with sufficient lead time. Complex statistical models and forecasting methods are often used for this purpose, but they always have uncertainty and are less suitable in the event of low-probability events. As has been well seen in the current case, crises may increase or decrease demand for particular products. Shortage-buying of consumables that are perceived to be short on supply may sends demand signals, which are unrealistic in the long term. Hence, besides advanced statistical forecasting, more dynamic forms of monitoring are recommended in order to react to inaccuracies (Alicke et al. 2020). This includes to use market information from business intelligence providers as well as reaching out directly to customers. Another aspect is to increase flexibility by replaceability of parts, postponement and a triage approach to initially serve only the most important customers (i.e. by strategic importance, margin, revenue).

In addition to the short- and mid-term measures described, it is also recommended to utilize scenario planning to estimate the potential implications of a prolonged or second-wave lockdown. On the basis on the information gathered during Business Continuity Planning, a cross-functional task force (with representatives from marketing and sales, operations, and strategy) can estimate other impacts in critical resources and business units in order to develop response strategies.

6. Conclusion

The whole history of humanity can be described as an attempt to tame existential uncertainties and threats, e.g. in the form of wild animals, forces of nature, diseases or war, and the desire to transform them into security. Entire sciences such as economics try to convert uncertain risks into probabilities and foreseeable developments – and then everything often turns out quite differently.

The paper aimed to discuss the limitations of conventional risk management critically. It has argued, that the estimation of probabilities for the occurrence of risks and consequences fails concerning black-swan events and also black elephant-type of events, which could be expected but still are ignored. Uncertainty can never be eliminated entirely, and solutions often bring unexpected side effects. Hence there is an "illusion of certainty", which is mainly triggered by conventional risk management approaches, but fail under circumstances as described. The paper has shown from the theoretical perspective of the Normal Accident Theory, that in complex tightly coupled systems, organizational structures are prone to disruptions: are virtually inevitable. Taking the recent CoViD-19 and the global lock down in early 2020 as an example, it is argued, that the pandemic is a black-elephant type of event. This means, that pandemics could be expected, their occurrence is not surprising, but often ignored. The findings of the paper suggest, that risk management could be shifted from the estimation of probabilities and cause-effects chains towards a more preventive approach. Business continuity management considers critical processes and focusses on preventive measures for rapid recovery and restart. The findings will be of interest mainly for decision-makers and risk managers, who often rely on naïve approaches to risk management. This new understanding should help to improve preparations for supply chain interruptions and other impacts of global pandemics. The argumentation of this study is limited, as further research on examples for successful recovery of supply chain interruptions of global supply chains is outstanding. It can also be argued that concerning black-swan-preventive measures, it might be rational to ignore this sort of events, as otherwise, a cognitive overload could occur. In principle, the costs of appropriate prevention measures are infinite, because with sufficient imagination, one can imagine ever more fantastic horror scenarios ("space mutant hamsters conquer the world"). This would be a fruitful area for further work, which might explore in which way rational ignorance can lead to the identification of credible worst cases.

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Exchange of new ideas: towards a more open, cooperative and sustainable world

Johannes (Joost) PLATJE, WSB University in Wrocław, Wrocław, Poland

Grahame FALLON, Brunel University, London, United Kingdom

Mehmet Baha KARAN, CEVI & Hacettepe University, Ankara, Turkey

Wim WESTERMAN, University of Groningen, The Netherlands

Yoram KROZER, Sustainable Innovations Academy, Amsterdam, The Netherlands

Markus WILL, University of Applied Science Zittau/Görlitz, Germany

Katarzyna KUREK, Johan VAN OPHEM, Wageningen University & Research, The Netherlands

Abstract:

Aim: Provide a summary of the expressed views, presentations and discussions during the ISINI14 (2020) online conference.

Design: Next to rather traditional but this time online presentations, the discussions not only took place by way of oral communication, but also via an online tool. The administrators of the conference prepared in a word-processing programme a framework, where the participants could enter issues, questions and comments in real time, and react to each others writings. These issues, questions and comments were also discussed orally. The results of the exchange of new ideas are presented below, and should provide an impulse for further discussion at ISINI online meetings in the future.

Correspondence address: Johannes (Joost) PLATJE, WSB University in Wrocław, ul. Fabryczna 29-31, 53-609 Wrocław, Poland. E-mail: johannes.platje@wsb.wroclaw.pl (Johannes (Joost) PLATJE), grahame.fallon@brunel.ac.uk (Grahame FALLON), mbkaran@hacettepe.edu.tr (Mehmet Baha KARAN), w.westerman@rug.nl (Wim WESTERMAN), krozer@xs4all.nl (Yoram KROZER), m.will@hszg.de (Markus WILL), katarzyna.kurek@wur.nl (Katarzyna KUREK), johan.vanophem@wur.nl (Johan VAN OPHEM).
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Findings: In order to achieve sustainable development, protect democratic values and empower citizens in different countries with a different institutional setting, a sound balance between open markets and sound regulation should be struck at various levels. Global and regional (EU) cooperationis needed for solving challenges to sustainable development – e.g. in relation to unexpected events such as the COVID-19 pandemic and climate (change) as a kind of public good.

Keywords: new ideas, empowerment, climate change, COVID-19, European Union, decision making process, risk management, sustainable development

JEL: D70, D81, F02, Q01, Q54

1. Introduction

The 14th conference of the International Society of Intercommunication of New Ideas (ISINI 2020, see www.isini.info) was held online. While online discussions do not have the charm of life discussions (where coffee breaks are an important element of free and creative discussion), it will be necessary to use this instrument in both the nearby and also the later future.

This is not only for reasons related to the uncertainty regarding to COVID-19 and future pandemics, but also due to the action needed in the framework of pro-active climate policy. While poorer countries and areas may face troubles with access to the Internet (infrastructure, hardware), online meetings may facilitate participation for people without funding and difficulties with obtaining a visa for, e.g., EU countries.

It is a challenge to create interesting discussions that are also providing the necessary fun and if something goes wrong in terms of use of technology, we can only learn from this. Errors and frictions can be expected when people have different experiences with the multiple tools used. This is a challenge the scientific community needs to deal with, in order to include, among others, scholars with different skills and funding for equipment.

While personal engagement is probably the most important factor for success, the organizers used a simple, additional „experimental" instrument for discussion – a word file in MS Sharepoint where all assigned participants can write in real time together in the file. Questions, comments and ideas can be put into the file at any moment, this as an alternative to e.g. using the chat function.

The aim of conference was to discuss about ideas, and „to create or recreate alternative paradigms that can help to formulate adequate policies to solve [current and future] problems“ (www.isini.info) This requires conducting discussion and posing questions. The description of the exchange of ideas is presented in this article.

The opening speech of the vice president of CEVI (Center for Energy and Value Issues – co-organizer) is presented in Section 2, after which the opening session on COVID-19 and other ingored threats is referred to in section 3. In Section 4 and 5, a summary of the presentations and discussions of the Andries Nentjes Memorial Session (see also “The Legacy of Andries Nentjes” in this issue of CEREM), as well as an outsider view on the EU decision making process can be found. Section 6 concludes.

2. CEVI views at the ISINI 2020 conference[1]

We regretfully watch that the world has entered a new era in recent years. Moreover, the pandemic and the ensuing economic recession made the situation worse. While income inequality in the world increased after the 2008 crisis, we observed the rise in populism and support for autocracy,as well as increasing anti-globalization in most countries. Authoritarian and populist leaders as well as administration styles of such countries such as China have become role models.

In this context, it seems unlikely that the world will soon return to the idea of mutually beneficial globalization that defined the early 21st century. Moreover, without the incentive to preserve the collective gains from global economic integration, the architecture of global economic governance established in the 20th century would rapidly disintegrate. On top of all these developments, like the fall of the Berlin Wall or the collapse of Lehman Brothers (triggering off the financial crisis of 2008), the coronavirus pandemic is a world-shaking event that we can only begin to imagine today.

[1] Opening speech by Prof. Dr. Mehmet Baha Karan, Vice President of CEVI (Center for Energy and Value Issues, https://www.centerforenergyandvalue.org/about.html).

As many thinkers and scientists have argued, just as this disease has shattered lives, upset markets, and reveals the (lack of) competence of governments, it will lead to permanent changes in political and economic power, which only will become visible later. As Prof. Yuval Harari (2020) points out, we have two important choices to make in this time of crisis. The first choice is between totalitarian surveillance and citizen empowerment, whereas the second is between nationalist isolation and global solidarity. People who fear that they will lose their health or jobs due to the crisis will probably seek strong and authoritarian governments. Developing technology increases the surveillance capacity of the state, curtailing the freedom of individuals. This in turn leads to weakening social and economic institutions, in particular touching the position of the weakest individuals..

However, as Prof. Acemoğlu and Prof. Robinson reveal in their recent book *The Narrow Corridor* (2019), liberty emerges only when a delicate and precarious balance is struck between the state and society. Both the epidemic itself and the resulting economic crisis are global problems. They can only be solved effectively by international cooperation. Harari advises to choose global solidarity in order to master the COVID-19 crisis as well as future crises that might assail humankind in the 21st country.

I think that all participants of this conference will prefer citizen empowerment to totalitarian surveillance and global solidarity to nationalist isolation. However, this is not an easy task in a world where people are greedy, self-interested, and have many short-term expectations. Regardless of the field in which they work, scientists and community leaders need to tirelessly demonstrate the importance of international cooperation, collaboration, and consensus. Multinational associations such as ISINI and CEVI should not forget that their existence and development is only possible when international solidarity is seen as superior to national and individual interests.

Not just as a summary of the CEVI contributions at the conference, I like to point at the importance of energy, economics and finance topics separately, jointly and even beyond in the current era. This should be done in a world that takes up civil liberties to, e.g., switching energy suppliers, as well as choosing financing policies. In this world, a mix of conventional and renewable energy is asked for.

Also, capital investments in general should be carefully planned to make money and a better world.

I believe that the ideas emerging in the course of this conference will strengthen the countries' institutions and global solidarity. Although our efforts are small steps on a worldwide scale, it should not be forgotten that tiny grains of sand come together with large structures.

3. On COVID 19, Climate Change and other examples of ignored threats (Opening Session)

"Poking in the Mist", was the title of the keynote speech in the opening session of the conference. As the metaphor suggests, strategic and risk management in organisations is often a 'muddling through' in the face of uncertainty, ignorance, volatility and complexity. It has always been that way, because almost the entire history of mankind can be read as the desire to transform insecurity into security and robust actions. This begins with the flight from the sabre-toothed tiger, and is also the case with the current crisis management of natural disasters and pandemics or the issue of climate change.

So the issue is how robust decisions can be made, justified and legitimised. When predicting extremely rare events (so-called "Black Swans"), we often suffer due to cognitive limitations, or are surprised by the events. This is despite the fact that certain events have either been predicted or at least appear to be expectable. Pandemics, for example, are considered in actuarial science to be an event that can occur every 20 years.[2] Nevertheless, such events, let us call them "black elephants", are ignored. In fact, there are probably no Black Swans, but rather ignored warning signals (Amyotte et al. 2014)

The discussions in the contribution then focused primarily on the question of the extent to which this ignorance, i.e., the deliberate fading out of catastrophes that

[2] https://www.handelsblatt.com/finanzen/banken-versicherungen/gunther-kraut-pandemie-experte-der-munich-re-alle-20-bis-30-jahre-kann-so-etwas-wie-corona-passieren/25770456.html?ticket=ST-527058-0edblFrcIrnadfmpii1K-ap4 [10.09.2020].

threaten the existence of a company or the society, is a rational act (see also Will 2020, this issue).

4. Environmental protection and climate change (Andries Nentjes Memorial Sessions)[3]

The first presentation[4] concerned quantitative assessments of the potential carbon leakage under the Paris Agreement. This potential is rather big, especially if the USA does not participate in abatement. Online discussions centered on the reliability of the data and on the institutional mechanisms of the Paris Agreement that may help to foster compliance with the emission targets of countries around the world. Important issues for future research are the inclusion of carbon leakage into the CO_2 accounting regarding imports and exports of a country, enabling assessment of the dynamic effects of climate policy.

The second contribution[5] concerned sustainable development from a long-term evolutionary perspective and the current need for a sustainability revolution. Discussing Glaubrecht's (2019) book on the end of evolution, it was mentioned that history of Homo Sapiens seems to be one of extinction of other species. As this is a difficult to grasp issue, which may easily lead to a nihilistic approach, it was emphasized that there is a need for a range of narratives that could inspire (different groups of) people to engage in sustainable behaviour.

In the online discussion, Schrauwen explained: "I think evolution is simply based on remorseless competition (although "friendly"cooperation is a way to win this competition, too). Diversity is the result of mutations and the fact that very many small niches for specialized species can be found in an ecosystem. I don´t believe that homo sapiens is doomed to get extinct and only robots will "survive",

[3] The two Andries Nentjes sessions were organized by Edwin Woerdman and Yoram Krozer, former PhD students of Andries Nentjes.

[4] Lewis Carl King (Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona, Spain). Partly based on work done together with Jeroen van den Bergh (School of Business and Economics & Institute for Environmental Studies, VU Amsterdam University, The Netherlands.

[5] Bas Schrauwen, article published in this volume.

like Harari sometimes seems to suggest. Glaubrecht does not say this either. His worst-case scenario is a massive collapse of the human population with some small group of survivors adapting to a then different planet. Humans have proven to be extremely flexible and adapted to many extreme climate changes in the course of their existence as a species. I personally think even a better future is still possible, if we realize a global sustainability revolution, accept that many disasters nevertheless will come and learn to adapt."

However, due to the focus on short-term costs and benefits by most people, organisations and governments, extinction of Homo Sapiens remains "a very probable outcome and from a purely biological and evolutionary perspective it simply is the way things go. We would get extinct along with all the other creatures we have been driving to extinction. It certainly is what is going to happen if we do not take action. … I honestly believe we still could choose a different path."

In the next presentation,[6] seven hypotheses were provided capturing the likely development of climate law in the EU. The central hypothesis is that EU climate law will be overtaken by the market, as a result of the quest by entrepreneurs for innovation profits from selling carbon-free technologies. Online discussions focused on the ultimate consequence of EU climate law becoming obsolete due to technical progress as well as on the question whether climate policy can still be effective in case of economic (and energy) growth.

The presentation on fisheries policies in Chile[7] discussed territorial use rights in fisheries (TURFs). It was shown that fishermen catch less than their quota to increase future quota. Online discussions centered on the difference between TURFs and tradable fisheries quota, which have been abolished in Chile, and how the quite successful TURF system can be nevertheless subject to gaming ('poaching'). The regulator uses a biological model to forecast natural growth (and thus determine the quota) depending on the stock. A problem remains that the quotas did not specify where the fish should be caught. This led to overfishing in particular areas.

[6] Edwin Woerdman (University of Groningen, The Netherlands).
[7] Bouwe Dijkstra (University of Nottingham, UK), in co-operation with Juan Rosas-Munoz (University of Bio-Bio, Chile).

The next presentation[8] provided an overview of opportunities for a just economic transition in the Polish Silesia region, which has to shift from coal mining to low-carbon activities and technologies, such as e-batteries and e-vehicle production. Online discussions stressed the political problem of coal lobbying in Poland, including the resistance to change by trade unions, and also questioned the possibilities to link the region with the automotive manufacturing sector in Germany. As miners are relatively well-paid, phasing out coal mining will probably require strong (financial) incentives to present opposition from the coal miners, being strong stakeholders in the Polish institutional setting.

In the discussion on the presentation on the limits of economic theories and models[9] it was argued that models are no simplification of reality, as is often argued in economic textbooks. Theories are grounded in worldviews, and as such a social construct, that expresses how we think the world looks like. Thus, a model may become a perceived picture of the world, a partial, simplistic tool used to create policy. Furthermore, as Edwin Woerdman posed it, a question is what are the determinants of the fashion for certain economic theories and models – e.g., after game theory became fashionable among economists, we moved to institutional economics and now we are in a behavioral economics hausse (= adding psychology to economics).

The final presentation[10] considered the writings of philosophers like Spinoza and Kant to discuss elements of optimism in a time of uncertainty. The presenter warned for the decay of democratic values in society. As such, she confirmed the arguments presented in Section 2 of this article. Online discussions focused on the dangers of having losers from globalization but also on Fukuyama's end of ideology, which theorizes that liberal democracy is the superior form of people's government. An interesting issue for research posed by Edwin Woerdman is that the end of ideology cannot be refuted (liberal democracy) from a rational point of view. It can be

[8] Beni Feidler and Shubhra Chaudrhy, presenting a joint study project together with Rozemarijn van Dijk and Pei-Hsin Cheng as students of the EUREC Master Sustainable Energy System Management (SESyM), supervised by Wytze van der Gaast (Hanze University of Applied Sciences, Groningen, the Netherlands).
[9] Hans Visser (VU Amsterdam University),
[10] Ingrid Visser-Roos (Inholland University of Applied Science, Diemen, the Netherlands),

overthrown in reality by religious and populist irrationality (ISIS, Trump, Putin, etc), so the future of democracy remains uncertain.

5. EU decision making processes: an outsider view[11]

For a long time, the so-called democratic deficit in EU decision making processes has been a political issue (Bonde 2011; Sotiris 2017; Sorace 2018). It became a strong element in the Brexit campaign – Take Back Control (Mavrozacharakis et al. 2017; Bell 2017; Alemanno 2020). As emphasized in Section 2 of this article, this is an example of the friction between global solidarity and local co-operation and empowerment, which is fundamental in the discussion on the subsidiarity principle (see Etzioni 2018).

In the discussion, the following issue for research was brought forward. Brexit can be a considered kind of stress-test for the EU. If managed properly, Brexit can only strengthen the EU. When the UK manages it well, then this is a sign that the EU in current form is fragile, or weak, and needs more serious changes than EU-optimists may like. In other words, Brexit might be perceived as an experiment, where failure of the UK leads to positive experience for the EU-27, or to a rearrangement of principles of functioning of the EU.

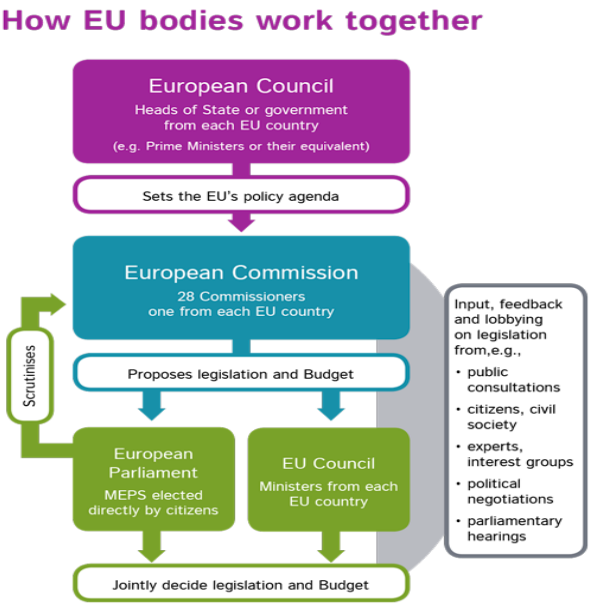
The panel was organized to take a closer look ar the process of decision making at the EU level (see Figure 1). The standard decision making procedure is based on co-decisioning between the major institutions, i.e., the European Commission, the European Parliament and the European Council. Usually, the legislative initiative is taken by the European Commission. Throughout the decision making process and before the final form of a regulation is approved, the advantages and disadvantages of a possible policy is assessed. The European Commission requests an impact assessment during the second reading, when the draft of the regulation is under

[11] This panel was organized and moderated by Katarzyna Kurek (Wageningen University & Research, The Netherlands), while Grahame Fallon (Brunel University, London, United Kingdom & WSB University in Gdańsk, Poland) was the discussant.

review in the European Parliament. The process of the EU decision making includes the engagement of the outsiders, i.e., external stakeholders.

During this panel, four representatives of different stakeholders presented their experience and knowledge in influencing the decision making process at the level of the EU institutions. The purpose of this panel was to bring together external actors like organizations, lobbyists or non-EU countries who regulary deliver their messages to the EU regulatory bodies. Such interactions are particularly needed as anti-EU fractions and the euro-skeptical movements gain strength. Moreover, involvement of stakeholders in the decision making process is a sign of bottom-up involvement in democratic practices. Their major message is actually that there is limited room to influence the decision making processes of the EU institutions, i.e., a democratic deficit exists. In this context, the invited panellists presented how different stakeholders actively engage in the EU decision making process.

Figue 1. How EU bodies work together



Source: https://www.tasc.ie/opengovtoolkit/public-decision-making/european-union/

The first presentation covered the particularly important topic, 'From seating arrangements to legislative procedures: influencing EU decision making processes as a lobbyist' from a highly experienced lobbyist perspective.[12] A series of key points and issues regarding the basic nuts and bolts of the lobbying process, the main decision makers with whom lobbyists interact, the strategies that lobbyists employ to maximise the impact of their work on EU decision making, and the way in which impact can be maximised given the constraints that lobbyists face in the EU context were outlined and explained. A number of top tips, tricks and considerations that lobbyists should heed and follow in order to maximise their impact on the EU decision making process were presented. It was argued that identification of communication channels and establishing long term relations is crucial to sucessful lobbying processes. In the discussion on the issues, the following was brought forward by one of the participants: "Is lobbying an element of a democratic society? My father used to say that lobbying strengthens specific interest groups, who enrich themselves at the expense of the common citizen. And as a consequence, it can strengthen the perceived democratic deficit."

Other issues requiring research are: (i) Lobbying at EU or member state level – which has the greater impact? (ii) What impact have recent EU crises, such as the Eurozone problems, Brexit, COVID-19, etc., been having on the EU lobbying process, and on the most effective strategies for maximising the resultant impact? (iii) How do effective EU lobbying strategies differ, when for example lobbyists are working on behalf of large and small business clients? (iv) Lobbyists usually have a negative perception in the EU ambience. How can be this changed, since they are EU decision making stakeholders too? (v) Are there known flagship case studies of significant lobbyists impact on an EU law? (vi) What are the most desired skills of a successful lobbyist? (vii) What has been the impact of COVID-19 on the decision-making processes in the EU institutions and for lobbyists?

The next presenter provided insight into how to optimise interactive innovation and the delivery of EU policies to speed up innovation in rural areas of Europe. The presentation, 'Better rural innovation: linking actors, instruments and policies

[12] Glenn Cezanne (Time and Place Consulting).

through letworks (LIAISON)'[13] began with an outline of the EU's Liaison project, before going on to explain the division of (EU plus EEA) Europe into four macro-regional clusters for interactive innovation study and promotional purposes. On the example of Horizon 2020 agriculture projects, the interactive innovation model was introduced. This is a mechanism developed by the European Commission, aiming at building a dialogue between the citizens and various EU stakeholders. The mechanism is mostly applied in the Western EU member states. The pilot projects are case studies which can support the development, use and application of the interactive innovation model in Central and Eastern European (CEE) countries. The rest of the presentation discussed the meaning of interactive innovation, how it is understood by different actors in the agricultural innovation process, the operation of interactive innovation in the agricultural sphere in the EU/EEA, its development in CEE countries, the evaluation of interactive innovation and key sources of knowledge that had been drawn throughout the project.

In the discussion, the following issues were raised for further elaboration: (i) How are CEE as well as West European agricultural interests reflected in the EU's rural innovation strategy? (ii) How far and in which ways does it provide support for both larger and smaller farmers who wish to implement and improve their innovative practices? (iii) Do the H2020 projects result in co-designing or impacting EU decision making processes? (iv) Is interactive innovation too difficult to handle for the agricultural sector? It is to a large extent a top-down productionist sector? (v) How about the involvement of citizens in interactive innovation? (vi) Are some sectors projects to be more innovative than others? (vii) Is interactive innovation a kind of sustainable innovation?

The third contribution 'Contribution to the EU decision making process - The perspective of a third country'[14] gave, on the example of Moldova, an informative and thought-provoking introduction to the question: how can the third countries influence the EU's decision making process, aided by partnership arrangements? It was emphasized that there exists the need for the EU to follow the principle of flexibility when creating partnerships with third countries, and that it should tailor

[13] Anna Augustyn (Groupe de Bruges).
[14] Aliona Balan (College of Europe).

make its approach to cooperation with each of these countries in order to maximise the resultant political, economic and security benefits. The non-member states countries are involved in decion making processes through dedicated political platforms and organizations. It has been underlined that impact on the EU policies by the third countries is stronger when they cooperate to deliver a joint message. Single actions find less attention at the EU regulatory level. The advocacy function can also be addressed by external programmes such as H2020, FP7, The EU Health Programme and COSME.

In the discussion, a series of related, follow up questions were identified: (i) Which of the Eastern partnership countries is presenting the biggest challenge to EU decision makers, and how is this challenge currently being dealt with? (ii) How effectively are the EU's relations with Russia, the EU's largest and most problematic neighbour, currently being managed? (iii) Taking Moldova as an example, has partnership proved to be a useful stepping-stone on the road towards possible future EU accession? (iv) In which areas of the EU laws are non-members countries mostly consulted? (v) What is Moldova's status in its EU negotiations? (vi) Which organizations in Moldova participate in the EU consultations? Are they any non-governmental civil consultants involved? (vii) Which of the channels of EU cooperation that are mentioned can be found to be the most successful so far?

The final presentation 'Opportunities and obstacles for SMEs regarding EU decision making process in the context of innovations'[15] dealt with the ability of EU (and, in particular Polish) SMEs to engage with the EU decision making process and the support that representatives such as ZPP (The Union of Entrepreneurs and Employers) can give them to help them to manage this interaction effectively. This organization which represents over 50,000 members is not assured a place in the EU regulation process. The role of ZPP is fostering the dialogue between the EU institutions and local organizations. Joint voices of entrepreneurs and employers have a larger probability of being heard by policy makers.

In the discussion, the following questions for deeper elaboration were raised: (i) How much progress has been made towards creating a truly friendly environment

[15] Agata Boutanos (ZPP – Związek Przedsiębiorców i Pracodawców (Union of Entrepreneurs and Employers)).

for SMEs when dealing with EU decision makers? (ii) How important has been the role of ZPP in helping to create such an environment? (iii) Are the advantages and difficulties created by the EU decision making process and EU regulation greater for innovative CEE and Polish SMEs than for their counterparts in Western Europe? (iv) The role of media / social media for SMEs. (v) How important is the proximity to the EU decision making institutions in the online era? Is a Brussels office a must for an organization like ZPP? (vi) Is the current online work environment an obstacle for the development of ZPP in Brussels? (vii) The need for a Small Business Act for Europe is high! How do organizations like ZPP support the awareness for the small businesses on the European level?

6. Concluding remarks

The world is facing huge challenges. Besides the current COVID-19 crisis, climate change, energy provision, increasing inequalities, are only a few example of crises that may hit the world. As a consequence, it may be necessary to change the approach in economic research. For example, in a discussion on the liquidity of the enterprise in normal and crisis times, it was asked whether we shouldn't start to talk about crises being the norm. This implies that liquidity, like other economic indicators of the company, should be crisis proof. From the point of view of consumers, like with governments, the current debt rates and lack of savings make them vulnerable to crises. While in a crises, following Keynes, saving can be an individual virtue and social vice (reducing aggregate demand, in turn leading to a deeper economic crisis), savings create a buffer for bad times, similar to the possession of property and physical capital. This requires a complete rethinking of the economic system, with lower economic activity, but also, following Taleb (2012), less painful downturns. Less inequality may bring more resilience, while health care should be considered a public good, which would imply a revolution in international co-operation. In this context, it should be remembered what Dag Hammarskjöld, the secretary general of the United Nations between 1953 and 1961 said (Hammarskjöld 1954). The United Nations (and in the current context, other

global organizations such as the World Health Organization) are not meant to bring us into heaven, but to keep us out of hell.

Regarding the creation of new ideas for a more and open, cooperative and sustainable world, when making policy decisions, it may be good to consider two quotes of Mustafa Kemal Ataturk, the founder of the Turkish Republic (https://www.goodreads.com/author/quotes/2793859.Mustafa_Kemal_Atat_rk).

"Our true mentor in life is science."
"If one day, my words are against science, choose science."

Science, when properly carried out, does not ignore threats of pandemics, climate change, financial crashes, and so on. It seems rather to be political leaders, managers, decision makers, people in general ignoring existing information and signals, preparing the way for Black Swans to surprise the ignorant victims.

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