19TH SCF INTERNATIONAL CONFERENCE ON INSTITUTIONAL, ECONOMIC, AND TECHNOLOGICAL DETERMINANTS OF ENERGY TRANSITION AMIDST GLOBAL CRISES

PROCEEDINGS BOOK

Proceedings of 19th SCF International Conference on "Institutional, Economic, and Technological Determinants of Energy Transition amidst Global Crises"

Istanbul

December 15-16, 2023

Editor:
Yilmaz Bayar
Bandirma Onyedi University Faculty of Economics and Administrative Science, 2023

All papers go through double-blind peer-review process.
All papers are printed as received, on authors' responsibility.

ISBN: 978-625-94286-1-1 (e-book)

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Chapter II – ABSTRACTS

Sustainable Economic Development for Insurance Companies

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Abstract

This research aims to provide an understanding of sustainable economic development in case of the insurance companies, emphasizing the links between economic, environmental, and social factors in a context in which the imperative for sustainable economic development has never been more pressing.

We will analyze the relationship between environmental sustainability and economic development, with a focus on how business and policymakers can integrate eco-friendly practices to drive growth while mitigating ecological impacts. Meantime, insurance companies, during identification their clients' needs, ask them about SDG. Also, the clients are informed that insurance companies are investing the financial resources in different funds that respect SDG principles.

Beside this there will be discussions about the importance of innovation in sustainable development, exploring how technological advancements and innovative business practices can contribute to economic growth while aligning with environmental and social sustainability goals.

The conclusions will highlight the fact that the insurance companies that decided to follow the actual trends related to SDG, will have more clients and this will lead to the GWP increase.

Keywords: Insurance companies, sustainable development

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Artificial Intelligence and the Future of Accounting

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Abstract

The impressive course of the evolution of artificial intelligence (AI) has marked an impetuous advance in 2023. Stunning prospects are emerging for a future based on AI virtual assistants, even if the prognosis of these virtual assistants directly depends on the resources and efforts we invest in training them to be our digital partners.

In parallel with this evolution, a new virtual identity is emerging, a digital alter ego fueled by our interactions with this assistant. Against this background of technological evolution, hopes and fears intersect in the business environment. Digital transformation, ever-accelerating automation, and robotization are preparing us for the challenges and opportunities that artificial intelligence brings in 2024.

Being at the forefront of these transformations has never been more important for companies that want to be successful. That is precisely why we need to understand the mega-trends in the business environment and extract the essential aspects that will shape the world of business in 2024.

Keywords: Digitization, the profession accounting, artificial intelligence, audit, internal control

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Crop Insurance Dynamics in the Context of Climate Change: Challenges, Adaptations, and Future Prospects

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Abstract

This study investigates the intricate interplay between crop insurance and the pervasive impacts of climate change on agriculture. Facing unpredictable weather patterns and increased climate-related risks, the traditional paradigms of crop insurance demand critical evaluation and adaptation.

Firstly, we analysed the ways in which climate change disrupts agricultural systems, influencing crop yields, regional weather patterns, and overall ecosystem resilience. The effectiveness of existing crop insurance frameworks in mitigating the diverse risks posed by climate change had been evaluated and findings reveal the limitations of conventional approaches and emphasize the need for adaptive measures that align with the evolving nature of climate-related challenges.

Furthermore, this research explores the socioeconomic implications of climate-induced disruptions on farmers and rural communities, emphasizing the role of crop insurance as a critical safety net. It investigates the potential disparities in access to and benefits derived from crop insurance, particularly among vulnerable and marginalized agricultural communities facing disproportionate climate-related burdens.

In addressing the identified challenges, this study proposes a series of adaptive strategies and innovative interventions for enhancing the resilience of crop insurance systems. These include leveraging advancements in satellite technology and remote sensing for improved risk assessment, incorporating climate forecasting models into insurance frameworks, and exploring novel financial instruments to strengthen the financial sustainability of crop insurance programs.

The research also investigates the climate change related policy and regulatory frameworks and results outlines there are necessary steps in policy adjustments that incentivize sustainable agricultural practices, promote climate-smart technologies, and foster a more inclusive and equitable distribution of insurance benefits.

This study provides a nuanced understanding of the challenges and opportunities inherent in the intersection of crop insurance and climate change.

Keywords: Crop insurance, climate change

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The Role of Marketing in the Formation of a Consumerist Society - Educating Consumers about the Transformation of Values and lifestyles for a Sustainable Future

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Abstract

A significant change in the business's focus from developing production and goods in accordance with customer demands and wants to placing the customer at the center of the problem gave rise to modern marketing as we know it today. The initiative to raise awareness of the problem of "unsustainable" development on the planet, which came from the institutional level, brought about changes in the behavior of market segments where concern for issues of environmental protection and sustainable development began to change their behavior. Thus, sustainable business has another new motive, which comes from the market, in the form of demand for more sustainable solutions. Many companies look at "sustainable customers" solely through their profitability, but this should not be the case with sustainable marketing in any case. It is necessary to understand and know how consumers think and decide, and to fit this into the overall intentions of more responsible business. The key to the problem of consumption today is the anthropometric value system that is at the core of the Western dominant social paradigm, and they claim that all micro-changes in consumption patterns are doomed if the assumption that the environment and society are resources for meeting human needs is not radically changed. The reason for the relatively benevolent understanding of contemporary problems in society and the environment on the part of consumers lies in the fact that they perceive them as something that is far in the future, which is why there is no immediate need to worry about it. Because of this, they often do not incorporate future outcomes and consequences into the decision-making process in the present. In the development of its programs, sustainable marketing must look for ways in which it can offer solutions to consumers that are sustainable, but due to the mentioned problem, this is not necessarily communicated as the main differentiating advantage because this does not guarantee cognition by consumers, which also means a change in lifestyle and system consumer values.

Keywords: Sustainable development, change in the value system of consumers, change in lifestyle

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Chapter II – FULL PAPERS

The Effect of Faith Popcorn's Trend of Cashing out on Consumer Behaviour Relating to Congregational Places and Restaurants

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Abstract

It is remarkable how a single event could perturb the equilibrium of our lives in today's world of progress and prosperity. Faith Popcorn predicted a 'Cashing out 'trend where consumers would prioritize experiences, for instance, the COVID-19 pandemic of 2020, which abruptly left countless individuals jobless. This sudden upheaval created economic and psychological pressures for those affected and compelled some to reevaluate their priorities.This crisis presented a unique opportunity for a specific group of individuals to hit the pause button on their lives. It allowed them to shift their focus from the relentless pursuit of wealth and career success to a more deliberate examination of what truly matters. It was a period of convalescence, an escape from the world's distractions, and an exploration of life's essence. During this time, people began to reevaluate their professional aspirations, becoming more open to accepting lower wages, often 20% to 40% less, in exchange for more time with their families or opportunities for volunteer work. This trend reflects a desire for a simpler, more meaningful lifestyle, a departure from the rat race. It underscores the importance of family gatherings around the dining table, over tea and coffee, making restaurants and cafes the most sought-after meeting places.This paper delves into the implications of the "cashing out" trend on consumer behaviour, emphasizing the growing realization that the quality of time spent with family holds more significant Value than the pursuit of material wealth. This study provides facts for further research in academic and business circles. Whether embracing a simpler rural life, working remotely, or enjoying a family meal at a local eatery or a high-end restaurant, the focus is on achieving a balanced and fulfilling life. It is a literature review related to this trend and its effects.

Keywords: Cashing out, faith popcorn, marketing trends, social gathering, restaurants, consumer behavior

1. Introduction

Are people weary of the rat race, fast pace, and stress of modern life that once defined success as the relentless pursuit of wealth and status? For years, this pursuit dominated the definition of success until the global tragedy of the COVID-19 pandemic, which disrupted normalcy and ushered in a revolutionary era in consumer culture. This era has been characterized by the 'Cashing Out trend,' where consumers prioritize experiences and quality time with meaningful connections over material possessions. This shift presents a unique opportunity for restaurants to capitalize on by tapping into the upgraded values of their patrons. Rather than solely focusing on luxurious feelings and serving, they prioritize building memorable, enjoyable experiences with loved ones. Initially a domestic activity, food consumption has shifted outside the house,

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becoming a family activity focused on pleasure and fun. The food marketplace is highly competitive. The National Restaurant Association estimates that almost 60% of restaurants fail in their first year of operation, and 80% fail within five years of opening. This failure rate is considered high compared to other industries. Food is an essential need for life, something people typically consume daily. According to Maslow's hierarchy theory, when a person's essentials are satisfied, they strive for an upgraded lifestyle.Consequently, consumers seek Value when visiting a restaurant, aiming not only to satisfy their needs but also to feel a certain level of deserved treatment. Competition intensifies between domestic and global restaurants, offering customers various choices. The increase in competition has expanded consumers' restaurant options. Consumers are often motivated to impress others by paying higher prices for prestige products. This behaviour is not limited to the leisure class but applies to all social and income classes, from the wealthiest to the poorest (Arsil et al., 2014; Wang et al., 2004). The pandemic served as a powerful catalyst for transformation, reminding everyone that life is short and meant to be lived. It nudged people towards conscious decisions such as prioritizing quality time over better pay checks and connection over conspicuous consumption. This yearning for meaningful experiences is not confined to the pandemic but resonates in the hearts of countless individuals who have faced tragedies and illness or desire a more fulfilling life. Given the growing phenomenon of eating out, understanding the criteria customers use in selecting a restaurant becomes strategic in comprehending food consumption trends. A trend describes a profound social and cultural movement, cutting across multiple realms of the consumer's life and various societies and marketplaces. It expresses primal human needs psychologically. 'Cashing Out' reflects working men and women questioning personal and career satisfaction and goals, opting for simpler living with deeper connections to those who matter to them. Faith Popcorn gained renown for identifying sweeping societal trends decades in advance, influencing countless businesses and individuals. Her work focuses on understanding the changing human experience and preparing others for the future. This paper discusses the "cashing out" trend, its impact on restaurant choices, and a breakdown of consumer behaviour and motivations.

2. Literature Review

The delight sequence is viewed as a causal chain in which surprising consumption with rewards would lead to high arousal levels, which creates a state of delight if combined with positive affect (Oliver et al., 1997). Delight is afterwards shown as a direct determinant of customers' wanting to revisit, which differs from the assumed research stated that satisfaction is the critical determinant of customer loyalty (e.g., Oliver, 1997; Bolton, 1998). Research investigating and analysing emotions describes surprise as short-lived and one of the eight primary emotions, along with acceptance and joy, fear, sadness, disgust, anger, and anticipation (Plutchik, 1980). Arousal, defined as a state of high activation, according to research, is the main reason for arousal in restaurants which leads to a positive effect on customers, defined as a pleasurable level of consumption-related fulfilment and satisfaction that leads to revisiting restaurants. Moreover, it is essential to build customer loyalty since it is recommended that service providers should always exceed customers' expectations to have them in a state of delight (Finn, 2005). The emotional reaction toward pleasurable consumption customer experiences would lead to enduring customer loyalty (Finn, 2005; Oliver et al., 1997).

2.1. Shifting Priorities

2.1.1. Quality Time

They They value experiences and memories over material possessions, seeking restaurants offering more than a meal (Bowden and Dagger 2011). Seeking a restaurant that offers a kind of experience, an adventure could be something simple as a little show or a cosy table with a lovely garden or any few to something complicated as they give the chef experience to customers, where they feel valued, and they can build their own experience.

2.1.2. Meaningful Connections

They prioritize spending quality time with loved ones, where connecting with loved ones in a restaurant is much easier without getting into different conversations. They have every tool and the right atmosphere to engage in heartwarming conversations, making happy memories no matter the saturation (Counihan 2004).

2.1.3. Well-being

They They are increasingly conscious of their health and well-being, seeking restaurants that offer healthy options and a relaxed atmosphere. Customers are increasingly tuning into their well-being (Mintel, 2023). It is no longer just about grabbing a quick bite but about fuelling their bodies with choices that resonate with their health goals and characters. This shift is evident in the rising popularity of healthy food options. Customers scan labels, seek fresh ingredients, and prioritize dishes that supply their bodies and minds. Whether choosing a protein bowl over a burger or swapping sugary drinks for sparkling water, these mindful choices reflect a newfound understanding that good food is an investment in well-being, a delicious path to a healthier, happier self. Thus, restaurants need to work on adding such options to their menu.

2.1.4. Personalization

They appreciate experiences and personalized service to feel special, avoiding restaurants that feel more general or impersonal. Personalization is the secret sauce for a loyal customer. For restaurants, personalization goes beyond hunger; it builds a relationship. It is about understanding individual needs and preferences and crafting experiences that resonate on a deeper level to satisfy them.

2.2 Decision-Making Factors

2.2.1 Experience

Consumers consider the overall dining experience beyond just the food itself. It includes ambience, service quality, and unique offerings like live music or interactive elements (Bos et al. 2013). For restaurants targeting parents, it is highly recommended to consider adding playgrounds for kids.

2.2.2 Value

Consumers Consumers prioritize Value over price, seeking experiences that justify the cost. Even if it means smaller portions or higher prices, they lean towards exceptional quality and experiences. A favourable value is found in the equilibrium between quality and price. Garvin

(1987) proposed eight dimensions of quality: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality.

2.2.3 Social Proof

Consumers heavily rely on recommendations and online reviews, valuing authenticity and genuine experiences over marketing hype (Roy 2018). Platforms like Google Maps and Instagram are pivotal tools for every restaurant. Instagram is estimated to reach 2.5 billion active users by the end of 2023, constituting nearly 47.84% of smartphones globally. This growth has made Instagram one of the most impactful social media platforms, significantly influencing businesses worldwide. Some businesses prioritize Instagram accounts over websites due to their e-commerce features. Instagram has evolved its content creation tools and engagement methods, becoming a pivotal platform for the food and beverage industry. It provides excellent content creation tools, interaction, engagement, and valuable insight data. Restaurant and food pages are among the most popular social media and Instagram content. According to a study by Zizzi, the age group from 18 to 35 interacts with food and restaurant content for 120 hours yearly on Instagram. Additionally, 30% are unwilling to visit a restaurant that lacks an engaging Instagram presence (Millennials).

2.2.4 Personal Connection

Consumers are drawn to restaurants that align with their values and personality, seeking a sense of belonging and community (Holt 1997). They prefer establishments that foster social interaction and a feeling of being part of a group, encouraging a sense of cultural, historical, and social involvement akin to being part of a family.

3. Materials and Methods

This paper assesses consumers' interest in visiting certain restaurants that have adopted the "Cashing Out" trend. It aims to explain how these restaurants applied this trend, their outcomes, and whether it proved beneficial.

4. Data and Method

The survey was given to patrons of 4- to 5-star restaurants offering a variety of Arabic food in Saudi Arabia, UAE, and Qatar, which included 100 restaurants in total. These surveys were directly given to patrons by the researchers. This type of restaurant was selected because relationship-building and customer loyalty are essential to financial success. All these restaurants were considered comparable as they targeted middle to upper-class customers, offered similar fine-dining Arabic food menu options, and charged equivalent prices for their menu items.

5. Empirical Analysis

The survey results are as follows: The awareness of the "Cashing out" trend is shown in Figure 1, which shows that 75% of restaurant owners know what it is or have heard about the "Cashing out" trend, which means that after COVID-19, owners had the motivation to develop their restaurants as restaurants and as businesses as xHsieh et al. (2023) suggested.

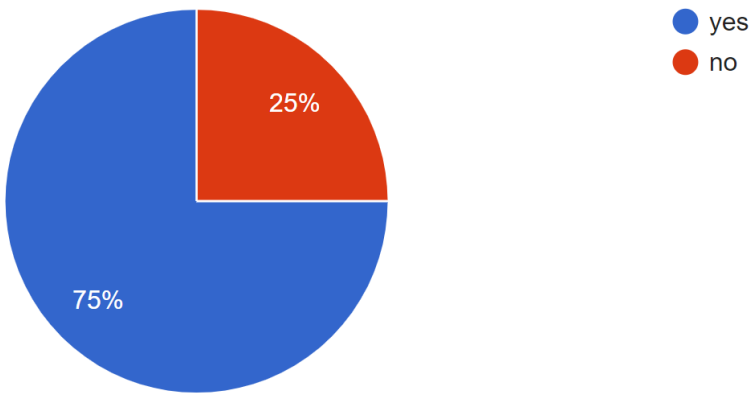

Figure 1: The awareness of the "Cashing out" trend

Then we questioned the profitability of the COVID-19 period since it was a time of tragedy; shockingly, 16% found it very profitable, 41.7% found it profitable, and 41.7% disagreed, as shown in Figure 2.

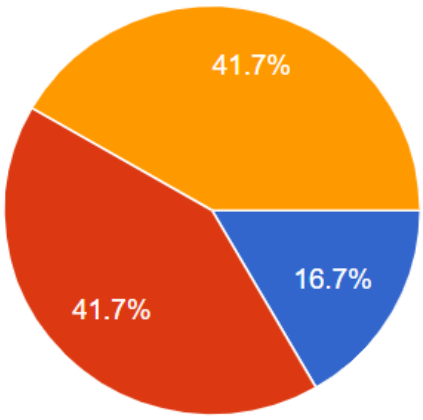

Figure 2: The profitability of the COVID-19 period

Afterwards, since focusing on experience-driven dining and trying to give customers an experience to live and remember, not just food, 33.3% of patrons have noticed on average customer spending specifically increased, 57.7% noticed a slight increase, and 9% remained constant.

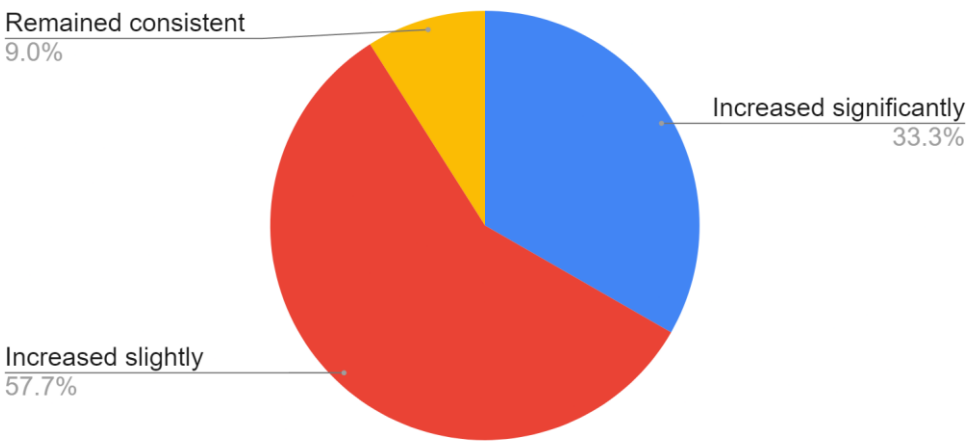

Figure 3

According to the survey, restaurant owners do believe from their experience that the most effective strategy of building customer loyalty under the "Cashing out" trend has been as follows: 8.3% found it was the value-added attractive offers and incentives. 25% unique and memorable dining experience, 25% believed it was personalized service and recommendations from a well-trained waiter to avoid the feeling of being "just another customer ", and 41.7% believe it is a combination of all which would be the most effective to build customer loyalty.

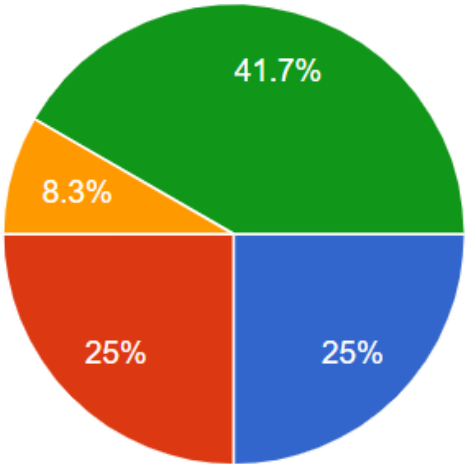

Figure 4

Also, in Figure 5, the leading financial benefit of catering to the "Cashing out" trend for these restaurants varied from 33.3% that it helped them build their loyalty while 41.7% stated that it did help them attract new customers to their restaurants via social media shared experience of old pleased customers and word of mouth, 16.6% believe it did lead to increasing frequency of visits due to how comfortable and fulfilling customers were. 8.3% did receive higher order values

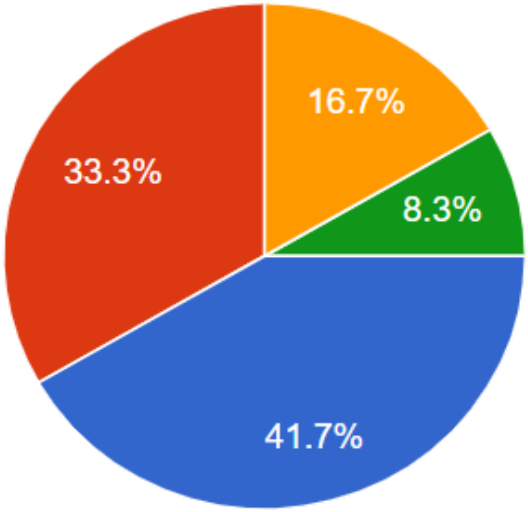

Figure 5

6. Conclusion

This study relies heavily on existing data and might lack the depth and control achievable through primary data collection. Focusing solely on the understanding of restaurant owners of their customers' behaviours initially limits the scope of the research. Future Research: Expand the study to investigate more with customers of the same restaurants using similar data collection and analysis methods. Conduct primary research through surveys or interviews with a broader sample of restaurants and customers.

In this paper, we reviewed the marketing trend of Face Popcorn trends "cashing out" in the consumer behaviour of restaurant customers, which is a similar daily or weekly destination for many individuals. Several strategic trends were discussed that could significantly impact restaurant marketing as we move into the 21st century. Only through the cashing out-trend does this type of marketing approach provide a huge benefit that enables restaurant owners and food service operators, in general, to prepare to create complex and dynamic relationships with their regular customers and gain the loyalty of new customers. Restaurants are a service field where no one buys a product but instead buys the benefits of the service, such as convenience, great taste, and an unmissable experience. We have proven through our paper that "cashing out "trend usage can benefit restaurant owners.

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Education Expenditures and Renewable Energy Consumption: A Causality Analysis for the New EU Members

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Abstract

Renewable energy production and consumption is a significant factor to combat environmental problems. This study investigates the causality between education expenditures and renewable energy consumption in the new EU member states over the 2000-2020 term via causality test. The findings of the panel causality test indicate a bilateral causal relationship between education expenditures and renewable energy consumption. In other words, there exists a feedback interplay between education and renewable energy consumption.

Keywords: Education expenditures, energy consumption, panel causality analysis

1. Introduction

Climate change has become a vital problem, especially for countries that are more vulnerable to environmental disasters. Energy consumption leads to the increases in greenhouse gases, especially carbon emissions, which are one of the main drivers of environmental degradation. Therefore, identification of cultural and economic factors that influence environmental sustainability is critical to tackling ecologically challenging challenges. The development and spread of environmental awareness is crucial for the environment protection. Therefore, taking initiatives to increase the level of education can be an important tool to combat environmental pollution (Khurshid et al., 2023).

Education has a key role in reducing carbon emissions. Improvements in the education can make a contribution to the environment by encouraging innovation and environmental awareness. The education expenditures through research and development can lead technological progress. As a result of education investments, green and energy-efficient technologies can be produced. These innovations, including energy-efficient equipments, clean energy sources and environmentally friendly facilities, can reduce carbon emissions in various economic sectors. Therefore, education expenditures can foster environmental sustainability (Wang et al., 2023). The aim of the study is to analyze the interplay between education expenditures and renewable energy consumption in the new EU member considering these theoretical considerations.

2. Literature Review

The effect of education on environment and renewable energy consumptio have been empirically analyzed by the researchers in the recent years. In this context, Zaman et al. (2021a) investigated the relationship among education expenditures, female employers, renewable energy consumption and CO_2 emissions in China for the 1991-2015 term through panel ARDL and FMOLS approaches and reached the conclusion that education expenditures negatively affedcted CO_2 emissions. Furthermore, they found that growing education expenditures also raised the female employers and the share of renewable energy use in total energy consumption. Huang et al. (2021) also analyzed the interaction among education expenditures, non-renewable energy consumption, and CO2 emission intensity in China for the 1971-2014 duration through

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ARDL method and revealed that 1% increase in education expenditures decreased the CO_2 intensity by 0.86%.

Zaman et al. (2021b) explored the interplay among education expenditures, remittances , energy use, income, poverty, and economic growth in Bangladesh, China, Egypt, India, Indonesia, Mexico, Nigeria, Pakistan, and Philippines for the 1990-2014 term through panel ARDL and disclosed that education expenditures positively influenced economic growth in the long-term.

Sarwar et al. (2021) explored the effect of education, health, economic growth, labor and capital expenditures on CO_2 emissions in 179 countries over the 1980-2016 period through panel DOLS and FMOLS methods and discovered a negative effect of education on CO_2 emissions. Furthermore, increases in the education quality reduced greenhouse gas emissions in these economies in the long term through the awareness and skills created by human capital.

Iqbal et al. (2022) examined the relationship between education expenditures, foreign direct investments, economic growth, exports, renewable energy, non-renewable energy use and CO_2 emissions in the BRICS countries over the 2000-2018 term through panel ARDL approach and disclosed a negative effect of education expenditures on CO_2 emissions. On the other hand, Tebourbi et al. (2022) explored the effect of education, urbanization, renewable energy consumption and foreign direct investments on CO_2 emissions in ASEAN countries for the 1986-2017 term through pooled mean group estimator and found a negative short and long-run effect of education expenditures on CO_2 emissions.

Mehmood (2022) investigated the effect of education expenditures, renewable energy and female employers on CO_2 emissions in Pakistan, India, Bangladesh, and Sri Lanka for the 1990-2020 period by cross-sectional autoregressive distributed lag approach and disclosed a negative effec of education expenditures on CO_2 emissions. Khurshid et al. (2023) also researched the interplay among education expenditures, urbanization, energy consumption, knowledge dissemination, and environment sustainability in Pakistan over the 1980-2021 term through NARDL method and discovered a positive effect of education expenditures on environmental sustainability.

Wang et al. (2023) analyzed the effect of education expenditures, renewable energy innovation, economic growth on CO_2 emissions in China during the 1988-2021 duration through Johansen cointegration approach and discovered a positive relationship between education expenditures and renewable energy innovation. Furthermore, both education expenditures and renewable energy innovation negatively influenced the CO_2 emissions. Last, Voumik and Ridwan (2023) examined the effect of education, foreign direct investments, population growth, and industrialization on the environment in Argentina over the 1972-2021 term through STIRPAT method and revealed that education expenditures increased the environmental sustainability in the short run.

3. Data and Method

This study examines the causal relation between education expenditures and renewable energy use in the new EU member states for the 2000-2021 term. Education expenditures (EDU) are proxied by government expenditure on education as a percent of GDP and renewable energy use (RNW) is represented by renewable energy consumption as a percent of total energy use. Both series are annual and obtained from World Bank (2023a and 2023b). The study covers the period of 2000-2020, because government expenditure on education data is available for all countries as of 2000, and data of renewable energy consumption ends in 2020. The sample of the study includes 11 new EU members (Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, and Slovenia)

The econometric analyses are performed through Stata 15.0 and Eviews 12.0 statistical programs. The causal relationship between education expenditures and renewable energy consumption is examined via JKS (Juodis, Karavias, Sarafidis) (2021) causality test.

The summary statistics of government expenditure on education as a percent of GDP and renewable energy consumption as a percent of total energy use are displayed in Table 1. The mean of tax government expenditure on education and renewable energy consumption are respectively 4.575% of GDP and 19.021% of total final energy use. But, renewable energy consumption remarkably change among the new EU members.

Table 1: Summary statistics of the series

Summary statistics	EDU	RNW
Mean	4.575	19.021
Std. Dev.	0.769	9.443
Maximum	6.997	43.75
Minimum	2.319	3.73
Observations	231	231

4. Econometric Analysis

In the econometric analysis, cross-sectional dependency between education expenditures and renewable energy consumption is investigated by means of LM, $LM_{adj.}$, and LM CD tests, and the tests' results are displayed in Table 2. The null hypothesis of cross-sectional independency is rejected regarding the probability values of cross-section dependence tests and the entity of cross-sectional dependency is discovered between two series.

Table 2: Cross-sectional dependence tests' results

Test	Test statistic	Prob.
LM (Breusch and Pagan, 1980)	398.3	0.0000
LM adj* (Pesaran et al., 2008)	82.35	0.0000
LM CD* (Pesaran, 2004)	18.31	0.0000

The homogeneity is explored through delta tilde tests of Pesaran and Yamagata (2008) and their results are displayed in Table 3. The homogeneity is declined regarding the probability values of the tests and entity of heterogeneity is disclosed.

Table 3. Homogeneity tests' results.

Test	Test statistic	Prob.
$\tilde{\Delta}$	10.405	0.000
$\tilde{\Delta}_{adj.}$	11.239	0.000

The stationarity of EDU and RNW is checked by Pesaran (2007) CIPS unit root test because of the cross-sectional dependency between two series and its results are displayed in Table 4. The test results identify that EDU and RNW are I(1).

Table 4: Unit root test's results

Variables	Constant	Constant +Trend
EDU	-0.502	-0.073
D(EDU)	-8.027***	-6.125***
RNW	1.168	1.926

Variables	Constant	Constant +Trend
d(RNW)	-4.425***	-6.125***

*** and ** are respectively significant at 1% and 5% level.

The causal relationship between education expenditures and renewable energy consumption is investigated through JKS (2021) causality test and the findings are displayed in Table 5. The findings reveal a bilateral causal relationship between education expenditures and renewable energy consumption.

Table 5: JKS (2021) causality test results

Null hypothesis	HPJ Wald test statistic	P Value
EDU ↛ RNW	12.4582	0.0020
RNW ↛ EDU	3.6988	0.0545

5. Conclusion

This paper investigates the interaction between education expenditures and renewable energy use in the new EU members for the 2000-2020 term via causality approach. The findings of the causality analysis uncover a feedback relationship between education expenditures and renewable energy use. In this regard, education is significant tool to combat environmental problems. Therefore, improvements in education can contribute to the environmental sustainability through encouraging the environmental awareness and developing the green and energy efficient technologies and renewable energy production.

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Comparison of the Current Status of Green Growth ODA by Region: Focusing on the Granting Regions of DAC and Korea

Sang Soo Chae[1] Choong Lyol Lee[2]

Abstract

This study examined regional trends in green growth ODA recipient countries for the period 2002 to 2021 using CRS statistical data provided by OECD DAC. Green growth ODA in DAC countries amounted to about $37.3 billion between 2002 and 2006, and the size increased significantly between 2007 and 2011, reaching about $79.3 billion. This increase in the size of ODA increased to $99.8 billion between 2017 and 2021, showing that the size of ODA related to green growth has been rapidly increasing since the mid-2000s. In Korea's case as well, the size of green growth ODA has been increasing recently. As of 2007-2011, approximately USD 760 million was invested, and as of 2017-2021, approximately USD 2.5 billion of green growth ODA was carried out, showing that the proportion has been rapidly increasing recently. In the Asian region, as of 2021, Korea's green growth ODA is USD 330 million, accounting for the largest proportion of the total, or 58.9%, which is higher than DAC's proportion of Greater Asia (USD 977.18 billion), which is 46.9%. . A characteristic of Korea's green growth ODA award status is that the proportion of Asian countries is higher than that of all DAC countries. In DAC, South and Central Asia has the highest proportion, while in the case of Korea, Far East Asia has the highest proportion. In Africa and Europe, DAC accounts for a relatively high proportion. On the other hand, considering that Korea's total green growth ODA amount is about 2.7% of the total DAC, it is necessary to specialize in some regions such as Far East Asia or consider distributive policies for other regions or individual countries in realizing green growth ODA policies.

Keywords: Green growth ODA, DAC, Korean ODA, regional ODA

1. Introduction

Recently, the world economy has been focusing on the possibility of a prolonged general recession. In addition, discussions on various paradigms and policies to sustain economic development continue. This discussion on economic development changes depending on various environmental factors, and as the policy paradigm changes, the method of economic development in individual countries or regions changes. The main keywords of this paradigm are issues such as economic growth, sustainable development, social security, and eco-friendliness, which are gaining attention and having a significant impact on policy decisions in major countries.

Among the major issues of economic development, there is a long-term plan for sustainable development, and various policies to realize it are being implemented in detail. The recent global economy has faced some limitations in existing policies for sustainable development, necessitating the application of a new paradigm. To this end, the world has focused on the two goals of environmental factors and economic growth, and discussions on eco-friendliness, green growth, green economy, development aid, shared growth, and social economy are becoming active as new convergence policies for this purpose.

According to these environmental factors, the green growth ODA covered in this study has important implications. We consider eco-friendliness and green growth as an improvement direction in response to recent limitations in global economic growth. Green growth focuses on taking one step further to overcome the limitations of economic growth by considering eco-friendly factors and reducing environmental costs accordingly. In addition, development aid helps overcome these limitations in economic growth. In general, donor countries are made up of relatively developed countries, and recipient countries are made up of relatively poor

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countries. Therefore, in addition to the redistribution effect of resources, economic effects that occur during the process can also be expected.

Therefore, this study examines and discusses the current status of green growth ODA, a major element of recent sustainable development. It considers the eco-friendly element of economic growth, which is called green, and considers the recent green growth element that considers additional factors by considering growth. In addition, we would like to examine the scale of ODA implementation considering these green growth factors in ODA implementation, focusing on DAC countries. And through comparison with Korea, which has recently accelerated ODA and eco-friendliness, we will discuss the trends and characteristics of green growth ODA around the world and in Korea and suggest direction.

To examine this, we looked at the status of green growth ODA by region in DAC countries using statistics from OECD's ODA (Official Development Assistance) and DAC's Creditor Reporting System (CRS). In addition, we look at the status of Korea's green growth ODA by region and discuss the scale of Korea's green growth ODA and suggest direction through a comparison between DAC and Korea.[3]

Green ODA concepts discussed in existing literature are as follows. First, using Sethi et al.'s (2017) ODA for each SDG, ODA corresponding to the six SDGs (6, 11, 12, 13, 14, 15) classified by the UN (2016) in the global environment sector was classified as 'sustainable'. It is defined as 'green ODA for possible development' (Kang & Kim, 2022). Second, using the environmental markers included in DAC data, ODA for which the environment is a principal objective or a significant objective is defined as 'environmental marker green ODA' (OECD, 2021b). Third, by using the Rio marker, ODA that has any of biodiversity, climate change reduction, climate change adaptation, or desertification as a principal objective or a significant objective is designated as 'Rio Marker Green ODA'. Define (OECD, 2018). Fourth, we use green ODA defined by Hicks et al. (2010) and define it as 'Hicks Green ODA.' Green ODA (Kang Yeon-hwa, 2009) focusing on environment and energy-related fields was defined as 'environment and energy green ODA', and finally, 'green growth ODA' was defined with reference to the green growth strategy announced by Korea. ' (Kang Seong-jin, 2022). In this study, the most recent green growth ODA for sustainable development is used as the standard for green growth ODA (Kang Seong-jin, 2022), but the trends of DAC and Korea's green growth ODA are analyzed for green growth ODA modified for statistical significance. I looked.

Although research on green ODA has continued, there is a lack of research on green growth ODA that directly affects sustainable development. In particular, as in this study, the status of green growth ODA has been analyzed and examined by region, focusing on Korea. There is no research. Therefore, it can be said that there are implications in specifying and examining the status of green growth ODA by region, which is expected to play an important role in the process of Korea's economic development. Through this, we hope to contribute to discussing the direction and related policies for Korea's ODA and green growth.

This study is structured as follows. Chapter 2 defines green ODA and green growth ODA. Chapter 3 examines the status of green growth ODA implementation in DAC countries by region, and Chapter 4 examines Korea's green growth ODA implementation results by region and presents implications. Chapter 5 draws conclusions.

[3]Statistics on DAC's total ODA have been available since the 1990s, but statistics on green growth ODA have been compiled since 2002. In particular, in the case of Korea's green growth ODA statistics, data have been available since 2006, so data is available from 2002 to 2021. The analysis was conducted for the period of time.

2. Definition of Green ODA and Green Growth ODA

The concept of green ODA has been defined in various ways in the past. However, clear standards have not been established. Therefore, we discuss the definition of green ODA based on existing references, and also discuss the definition of green growth ODA, which is discussed along with sustainable growth and development, which is the main analysis of this study.

First, the concept of green ODA must first be discussed with regard to the Sustainable Development Goals. The Sustainable Development Goals (SDGs) are a plan proposed by the United Nations Environment Program (UNEP) under the United Nations (UN) and began with discussions on the global Our Common Future.

The basic definition is 'development that meets the needs of present generations without compromising the ability of future generations to meet their own needs'. And the major items related to economic growth for this plan were organized and presented.

The specific details of the Sustainable Development Goals (SDGs) were presented at the 70th United Nations General Assembly, which proposes the basic direction of humanity in 17 major themes and consists of 169 detailed goals and 247 detailed indicators. It is a concept that is a step forward from the existing Millennium Development Goals (MDGs), and while the existing goals were simply poverty-oriented, it presents a more comprehensive and forward-looking direction for qualitative improvement of humanity.

Table 1: Sustainable development goals

Target	Area	Detail	Target	Area	Detail
1	Person	End poverty	10	person	Eliminating inequality
2	Person	Solving hunger	11	Earth environment	Sustainable Cities and Communities
3	Person	Health and well-being	12	Earth environment	Sustainable consumption and production
4	Person	Quality education	13	Earth environment	Climate change response
5	Person	Gender equality	14	Earth environment	marine ecosystem
6	Earth environment	Clean water and sanitation	15	Earth environment	terrestrial ecosystem
7	Prosperity	Sustainable clean energy	16	peace	Peace, Justice and Strong Institutions
8	Prosperity	Good jobs and economic growth	17	partnership	global partnership
9	Prosperity	Industry, innovation and infrastructure			

Source: Seongjin Kang (2022); UN (2016).

Table 1 contains the 17 detailed items of the Sustainable Development Goals (SDGs). Five items can be divided into 'people', 'global environment', 'economic prosperity', 'peace', and 'partnership'. Under these classification criteria, the importance of the 'global environment' section of the Sustainable Development Goals (SDGs) is becoming more important, and the contents classified based on this category can be viewed as 'green ODA' items.

Table 2: Green ODA main definitions

Classification	Justice	Source
Sustainable Development Green ODA	Global environment sector among ODA for each sustainable development goal	-
Environmental Marker Green ODA[4]	DAC's environmental markers	OECD(2019)
Riomarker Green ODA[5]	Rio Marker	OECD(2019)
Hicks Green ODA[6]	Strong sense environmental action (EBD) Broad sense environmental action (ESD)	Hicks et al. (2010)
Environment . Energy Green ODA[7]	Environmental conservation and energy related	Kang Yeon-hwa (2009)
Green growth ODA	Green growth policy-related projects	Jiwon Jeong. Seongjin Kang (2012)

Source: Seongjin Kang (2022)
Note: ODA, official development assistance; DAC, Development Assistance Committee; EBD, environmental broadly defined project; ESD, environmentally strictly defined projects.

3. Status and Proportion of Green Growth ODA Granting Countries in DAC Countries by Region

3.1. Current status of green growth ODA by recipient country

Table 3 shows the status of green growth ODA implementation by region in DAC countries. It can be seen that the total ODA amount is continuously increasing on a DAC country-wide basis. From 2002 to 2006, approximately $37.3 billion worth of ODA was carried out, and from 2007 to 2011, the size increased significantly, reaching approximately $79.3 billion worth of ODA. This increase in the size of ODA increased to $99.8 billion between 2017 and 2021, showing that the size of ODA related to green growth has been rapidly increasing since the mid-2000s.

Looking at the recent ODA scale by single year, we can see that the size of ODA for green growth has increased from about $19.7 billion in ODA in 2018 to more than $20.8 billion since 2021, and even recently (after 2018), green growth has been growing. It can be seen that interest from donor countries has continued to increase.[8]

Looking at the trend of green growth ODA by region, it can be seen that the growth rate in the Asian region is high, reaching approximately USD 21.1 billion from 2002 to 2006, and increasing to USD 42.3 billion from 2007 to 2011. This increases to $46.6 billion from 2017 to 2021, which is the largest increase considering the size. Looking at each region in Asia, we can

[4]Environmental markers are indicators that identify activities aimed at achieving improvement in the physical and biological environment of the recipient country, recipient region, and support target.
[5]RioMarker is an activity that satisfies one of the following three objectives of the Convention: They include conservation of bio-diversity, sustainable use of products (ecosystems, species or generic sources) or fair or equitable sharing of the benefits of the utilization of genetic resources. of genetic resources (OECD, 2019)
[6]ODA can be defined as strongly defined environmental activities (ESD, environmental strictly defined projects), environmental broadly defined projects (EBD), neutral projects (N), and broadly defined non-environmental activities. (DBD, dirty broadly defined projects), and strongly defined non-environmental activities (DSD, dirty strictly defined projects).
[7]'Environment . 'Energy Green ODA' is classified into environmental and energy-related sectors by Kang Kang-hwa (2009) (Jeong Ji-won and Kang Seong-jin, 2012). Kang Yeon-hwa defined green ODA as environmental conservation and some energy-related codes that the Korean government has traditionally pursued.
[8]As of 2020, it shows a slight decline to approximately $18.7 billion, but this is related to the outbreak of COVID-19.

see that the growth rate is high in South and Central Asia. It was around USD 5.8 billion in 2002-2006, but increased to USD 16.7 billion in 2017-2021, showing the highest increase in green growth ODA among Asian regions. Meanwhile, in the case of Far East Asia, it increased to about $21 billion from 2012 to 2016, but has recently shown a slight downward trend to $15.3 billion from 2017 to 2021.

In the case of Africa, there has also been a recent high increase, and it can be seen that the highest proportion of green growth ODA was carried out recently at $36 billion between 2017 and 2021. Meanwhile, among major African regions (sub-Saharan Africa), it can be seen that South Africa has carried out a relatively high level of green growth ODA, amounting to $12.9 billion.

In the case of Europe, it showed an increase from 2007 to 2011 to $46.4 billion, but from 2012 to 2016, it decreased to $33.9 billion, showing a slight decline.

Table 3: Green growth ODA status by DAC recipient country region

Region/period	2002 -2006	2007 -2011	2012 -2016	2017 -2021	2018	2019	2020	2021
Asia	21179.7	40564.8	42375.9	46652.7	9223.3	9588.6	8142.3	9771.8
Far East Asia	8627.1	17622.3	16188.8	15345.6	3020.9	3262.2	2629.9	3448.6
South and Central Asia	5885.1	16777.2	21095.8	25689.2	5211.0	5274.0	4380.5	5308.7
Middle East	6483.1	5082.9	3734.5	4348.5	806.2	824.7	854.1	779.1
Africa	10467.3	22693.0	34795.0	36043.7	7080.5	7286.5	6914.1	7473.8
North of Sahaa	2973.1	5217.4	5770.7	5964.0	1226.0	1166.9	1089.7	1200.5
South of Sahaa	7170.9	16013.8	26629.8	27314.0	5322.8	5747.0	5221.5	5629.3
East Africa	564.2	1165.6	1881.0	2447.3	479.8	492.9	466.4	587.5
South Africa	3295.0	8301.4	13813.5	12986.5	2747.1	2660.9	2320.9	2386.9
Central Africa	487.6	688.3	1987.0	974.1	144.1	178.9	245.0	216.1
West Africa	2305.4	4708.2	6749.7	8538.0	1447.0	1871.8	1846.1	1952.1
Europe	1632.9	4647.2	3399.3	3251.7	612.0	555.5	635.1	621.2
America	3835.8	10613.2	13394.3	12264.4	2548.4	2135.9	2827.1	2584.0
South America	1819.8	4210.5	4352.4	4775.9	736.8	844.9	1309.1	967.5
Central America	1890.2	4982.5	8157.7	6433.5	1675.0	1127.5	1170.7	1333.3
Oceania	231.8	832.3	1333.4	1621.3	295.5	342.2	279.8	381.3
Melanesia	78.4	388.6	696.3	759.7	143.5	178.7	143.3	138.8
Micronesia	34.8	75.9	91.7	150.9	27.1	34.7	33.0	22.3
Polynesia	48.3	110.3	276.1	174.2	43.9	45.7	26.5	26.8
Sum	37347.4	79350.4	95297.9	99833.7	19759.7	19908.7	18798.5	20832.1

Note: ODA, official development assistance; CRS, creditor reporting system

Looking at the proportion of DAC's total green growth ODA, it is as follows. As of 2002-2006, the Asian region accounted for 47.4%. However, as of 2017-2021, it can be seen that it has slightly decreased to 46.7%. In addition, based on the most recent single year, the size of green growth ODA to the Greater Asia region remains flat at 46.9% in 2021. Meanwhile, the South and Central Asia region in the Cebu Asia region shows a relatively high proportion of 54.3%, showing that support for green growth has been relatively high.

Table 4: Share of green growth ODA by DAC recipient country region

Region/period	2002 -2006	2007 -2011	2012 -2016	2017 -2021	2018	2019	2020	2021
Asia	56.7	51.1	44.4	46.7	46.6	48.1	43.3	46.9
Far East Asia	40.7	43.4	38.2	32.8	32.7	34.0	32.2	35.2
South and Central Asia	27.7	41.3	49.7	55.0	56.4	55.0	53.7	54.3
Middle East	30.6	12.5	8.8	9.3	8.7	8.6	10.4	7.9
Africa	28.0	28.5	36.5	36.1	35.8	36.5	36.7	35.8
North of Sahaa	28.4	22.9	16.5	16.5	17.3	16.0	15.7	16.0
South of Sahaa	68.5	70.5	76.5	75.7	75.1	78.8	75.5	75.3
East Africa	7.8	7.2	7.0	8.9	9.0	8.5	8.9	10.4
South Africa	45.9	51.8	51.8	47.5	51.6	46.3	44.4	42.4
Central Africa	6.7	4.2	7.4	3.5	2.7	3.1	4.6	3.8
West Africa	32.1	29.4	25.3	31.2	27.1	32.5	35.3	34.6
Europe	4.3	5.8	3.5	3.2	3.0	2.7	3.3	2.9
America	10.2	13.3	14.0	12.2	12.8	10.7	15.0	12.4
South America	47.4	39.6	32.4	38.9	28.9	39.5	46.3	37.4
Central America	49.2	46.9	60.9	52.4	65.7	52.7	41.4	51.5
Oceania	0.6	1.0	1.3	1.6	1.4	1.7	1.4	1.8
Melanesia	33.8	46.6	52.2	46.8	48.5	52.2	51.2	36.3
Micronesia	15.0	9.1	6.8	9.3	9.1	10.1	11.7	5.8
Polynesia	20.8	13.2	20.7	10.7	14.8	13.3	9.4	7.0
Sum	100	100	100	100	100	100	100	100

Note: ODA, official development assistance; CRS, creditor reporting system

In the case of Africa, it accounts for the second highest share of green growth ODA at approximately 36.5%. The proportion is gradually increasing, showing a trend of increasing to 28.0% from 2002-2006 and 36.1% from 2017-2021. On the other hand, if you look at the recent single-year standard, you can see that the proportion remains at the 35% level. Meanwhile, in the case of Oceania, it is above the 1% level, and it can be seen that a rather high proportion of green growth ODA was carried out at 1.8% in 2021.

Table 5 shows the ODA status by region in DAC countries. It can be seen that the total ODA amount is continuously increasing on a DAC country-wide basis. From 2002 to 2006, approximately $1.4 billion worth of ODA was provided, and from 2007 to 2011, the size increased significantly, reaching approximately $6.6 billion worth of ODA. This increase in ODA amounted to $12.4 billion between 2017 and 2021, showing that the size of ODA related to green growth has been rapidly increasing since the mid-2000s.

Looking at the recent ODA scale by single year, we can see that the size of ODA for green growth has increased from about $1.9 billion in ODA in 2018 to more than $3 billion since 2020, and donor countries related to green growth have increased since 2020. It can be seen that interest has increased further.

Looking at the trend of green growth ODA by region, it can be seen that the increase in the Asian region is the largest, reaching approximately USD 270 million from 2002 to 2006 and increasing to USD 910 million from 2007 to 2011. This rapidly increases to $2 billion from 2017 to 2021, which is the largest increase among all regions. Based on detailed Asian regions, it can be seen that the growth rate in Central Asia is high. It was around USD 0.2 billion in 2002-2006, but increased to USD 420 million in 2017-2021, showing the highest increase in green growth ODA among Asian regions. Meanwhile, in the case of Far East Asia, it increased to about $550 million from 2012 to 2016, but is showing a slight downward trend to $430 million from 2017 to 2021.

In the case of Europe, it increased to $350 million from 2007 to 2011, but decreased to $260 million from 2012 to 2016, and has recently shown an increase again to $490 million from 2017 to 2021. In the case of the Middle East, it can be seen that a small amount of green growth ODA was recently carried out at USD 160 million compared to other regions.

In the case of Africa, there has also been a recent high increase, and it can be seen that the largest amount of green growth ODA was carried out recently at $4.28 billion between 2017 and 2021. Meanwhile, among major African regions, it can be seen that West Africa has carried out a relatively high level of green growth ODA, amounting to $310 million.

Table 5: Green growth ODA status by DAC recipient country region (other regions)

Region /period	2002 -2006	2007 -2011	2012 -2016	2017 -2021	2018	2019	2020	2021
Asia	273.7	913.8	1476.8	2050.5	282.0	375.8	489.1	405.9
Central Asia	23.6	231.8	310.0	427.1	68.1	99.0	62.2	149.6
Far East Asia	122.9	258.0	551.9	433.7	82.8	70.7	80.7	115.0
South Asia	14.5	103.5	56.9	72.7	9.0	9.6	26.1	18.4
America	162.5	1736.6	1224.6	1691.4	196.4	253.9	564.9	432.3
South America	57.6	221.7	684.6	683.2	55.5	140.1	154.0	179.5
Central= America	194.8	548.3	749.0	646.4	88.8	195.4	163.0	107.1
Europe	130.3	355.7	265.2	498.8	116.2	72.5	34.4	171.8
Middle East	18.9	111.8	134.3	163.3	25.8	25.9	28.5	28.5
Africa	364.7	1845.0	3008.0	4282.9	874.1	539.0	985.2	1124.4
East Africa	0.0	0.0	0.0	156.1	0.0	11.2	69.4	75.6
South Africa	0.0	0.0	0.0	73.2	0.0	0.7	42.3	30.1
Central Africa	0.0	0.0	0.0	267.6	0.0	10.3	93.7	163.6
West Africa	0.0	0.0	0.0	312.5	0.0	37.5	123.0	152.0
Oceania	78.2	349.9	299.2	675.5	122.8	91.1	93.8	255.5
Sum	1441.9	6676.1	8760.2	12434.7	1921.4	1932.5	3010.3	3409.1

Note: ODA, official development assistance; CRS, creditor reporting system

Looking at the proportion of DAC's total green growth ODA, it is as follows. As of 2002-2006, the Asian region accounted for 18.9%. However, as of 2017-2021, it can be seen that it has slightly decreased to 16.4%. In addition, based on the most recent single year, the size of green growth ODA to the Greater Asia region appears to be decreasing, reaching 11.9% in 2021. Meanwhile, among the detailed Asian regions, Central Asia shows a relatively high proportion of 4.3%, showing that a lot of support related to green growth has been provided.

In the case of Africa, DAC accounts for the largest proportion of green growth ODA. The proportion is gradually increasing, and it can be seen that it is increasing to 25.2% from 2002 to 2006 and 34.4% from 2017 to 2021. On the other hand, looking at the recent single-year basis, we can see that the proportion has decreased from 45.4% to 32.9% as of 2021. [9]Meanwhile, in the case of Oceania, it remains at the 5% level, and it can be seen that a rather high proportion of green growth ODA was carried out at 7.4% in 2021.

[9]When looking at the past three years, the impact of COVID-19 must be considered.

Table 6: Proportion of green growth ODA by DAC region (other regions)

Region/period	2002 -2006	2007 -2011	2012 -2016	2017 -2021	2018	2019	2020	2021
Asia	18.9	13.6	16.8	16.4	14.6	19.4	16.2	11.9
Central Asia	1.6	3.4	3.5	3.4	3.5	5.1	2.0	4.3
Far East Asia	8.5	3.8	6.2	3.4	4.3	3.6	2.6	3.3
South Asia	1.0	1.5	0.6	0.5	0.4	0.4	0.8	0.5
America	11.2	26.0	13.9	13.6	10.2	13.1	18.7	12.6
South America	3.9	3.3	7.8	5.4	2.8	7.2	5.1	5.2
Central America	13.5	8.2	8.5	5.1	4.6	10.1	5.4	3.1
Europe	9.0	5.3	3.0	4.0	6.0	3.7	1.1	5.0
Middle East	1.3	1.6	1.5	1.3	1.3	1.3	0.9	0.8
Africa	25.2	27.6	34.3	34.4	45.4	27.8	32.7	32.9
East Africa	0.0	0.0	0.0	1.2	0.0	0.5	2.3	2.2
South Africa	0.0	0.0	0.0	0.5	0.0	0.0	1.4	0.8
Central Africa	0.0	0.0	0.0	2.1	0.0	0.5	3.1	4.7
West Africa	0.0	0.0	0.0	2.5	0.0	1.9	4.0	4.4
Oceania	5.4	5.2	3.4	5.4	6.3	4.7	3.1	7.4
Sum	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: ODA, official development assistance; CRS, creditor reporting system

4. Status and Proportion of Korea's Green Growth ODA Recipient Countries by Region

The green growth ODA carried out in Korea by region is as follows. In Korea, the size of green growth ODA has recently been increasing. As of 2007-2011, approximately USD 760 million was invested, and as of 2017-2021, approximately USD 2.5 billion of green growth ODA was carried out, showing that the proportion has been rapidly increasing recently.

In the Asian region, as of 2021, Korea's green growth ODA is USD 330 million, accounting for the largest proportion of the total, or 58.9%, which is higher than DAC's proportion of Greater Asia (USD 977.18 billion), which is 46.9%. In addition, Korea's green growth ODA accounts for about 2.7% of the total DAC.

If you look at Korea's green growth ODA to the Greater Asia region, it is the largest in scale, and you can see that it is showing a very high increase (41.1%), especially during the period 2017-2021. Since 2017, many ODA projects related to Korea's green growth in Asia have been carried out, and it can be seen that Korea's interest in the green growth sector is increasing. In particular, unlike DAC, Korea is carrying out the largest amount of green growth ODA in the

Far East Asia region. As of 2021, approximately $1.9 billion has been provided, a higher proportion than Africa's $1.58 billion.

Table 7: Status of Korea's green growth ODA by recipient country region

Region/period	2002 -2006	2007 -2011	2012 -2016	2017 -2021	2018	2019	2020	2021
Asia	51.65	532.7	1072.44	1513.96	317.25	373.1	262.69	337.42
Far East Asia	16.99	276.54	586.08	846.62	213.76	179.97	124.14	190.76
South and Central Asia	27.67	208.85	399.44	574.39	81.84	166.44	129.45	132.7
Middle East	6.98	39.42	80.63	56.95	14.28	21.03	1.28	5.74
Africa	14.09	110.63	550.4	655.17	152.51	154.53	57.11	158.21
North of Saha	1.46	13.64	25.09	214.53	78.19	59.54	2.99	71.27
South of Saha	12.62	96.65	521.89	436.39	74.07	94.99	51.31	85.96
East Africa	10.12	36.8	39.1	68.89	1.87	32.15	6.7	23.65
South Africa	2.3	41.91	366.58	249.23	50.28	44.38	36.81	49.47
Central Africa	0	1.08	0.86	1.21	0.26	0.21	0.24	0.18
West Africa	0.2	12.84	113.81	116.99	21.65	18.24	7.55	12.64
Europe	17.09	55.9	0.16	1.25	0.05	0.02	0	1.13
America	6.41	64.84	179.38	409.81	79.2	118.94	51.15	68.97
South America	5.93	39.54	67	247.86	43.27	77.43	27.56	45.66
Central America	0.48	25.27	112.36	155.32	34.48	39.86	23.12	22.22
Oceania	0.03	4.87	6.03	18.52	2.01	2.93	5.74	6.88
Melanesia	0.02	3.11	4.27	7.87	0.99	1.2	3.1	2.11
Micronesia	0	1.02	0.87	4.31	0.85	0.91	0.81	1.45
Polynesia	0	0.4	0.76	4	0.04	0.62	1.23	1.99
Sum	89.27	768.94	1808.41	2598.71	551.02	649.52	376.69	572.61

Note: ODA, official development assistance; CRS, creditor reporting system

In the Americas, approximately $400 million was carried out between 2017 and 2021. In detail, the South American region carried out a relatively high level of green growth ODA of $240 million from 2017 to 2021. In other regions, green growth-related ODA projects were carried out in Oceania, and green growth ODA worth $0.18 billion was carried out from 2017 to 2021. Among detailed regions, Melanesia was relatively high.

Looking at the proportion of Korea's green growth ODA, it is as follows. It can be seen that most of the ODA support for Korea's green growth is provided to the Asian region. It was maintained at 69.2% from 2007 to 2011, but from 2017 to 2021, it was 58.2%, showing a slight decline. Recently, it appears that the highest ODA was carried out in single-tier projects at 69.7% in 2020.

The African region accounted for a high proportion of 30% from 2012 to 2016, but it slightly decreased to 25.2% from 2017 to 2021. By region, South Africa accounts for the majority, with West Africa accounting for the next highest proportion.

Next, it can be seen that the Americas carried out a relatively high level of green growth ODA at 15.7% from 2017 to 2021. In addition, it accounted for a high proportion of 18.3% in 2019 and is showing a slight decline to 12% in 2021. Oceania has the lowest proportion. However, the detailed region is the same as DAC, and the Melanesia region appears to account for the majority.

Table 8: Korea's share of green growth ODA by recipient country region

Region/period	2002 -2006	2007 -2011	2012 -2016	2017 -2021	2018	2019	2020	2021
Asia	57.8	69.2	59.3	58.2	57.5	57.4	69.7	58.9
Far East Asia	32.8	51.9	54.6	55.9	67.3	48.2	47.2	56.5
South and Central Asia	53.5	39.2	37.2	37.9	25.7	44.6	49.2	39.3
Middle East	13.5	7.4	7.5	3.7	4.5	5.6	0.4	1.7
Africa	15.7	14.3	30.4	25.2	27.6	23.7	15.1	27.6
North of Saha	10.3	12.3	4.5	32.7	51.2	38.5	5.2	45.0
South of Saha	89.5	87.3	94.8	66.6	48.5	61.4	89.8	54.3
East Africa	80.1	38.0	7.4	15.7	2.5	33.8	13.0	27.5
South Africa	18.2	43.3	70.2	57.1	67.8	46.7	71.7	57.5
Central Africa	0.0	1.1	0.1	0.2	0.3	0.2	0.4	0.2
West Africa	1.5	13.2	21.8	26.8	29.2	19.2	14.7	14.7
Europe	19.1	7.2	0.0	0.0	0.0	0.0	0.0	0.1
America	7.1	8.4	9.9	15.7	14.3	18.3	13.5	12.0
South America	92.5	60.9	37.3	60.4	54.6	65.1	53.8	66.2
Central America	7.4	38.9	62.6	37.9	43.5	33.5	45.2	32.2
Oceania	0.0	0.6	0.3	0.7	0.3	0.4	1.5	1.2
Melanesia	66.6	63.8	70.8	42.4	49.2	40.9	54.0	30.6
Micronesia	0.0	20.9	14.4	23.2	42.2	31.0	14.1	21.0
Polynesia	0.0	8.2	12.6	21.5	1.9	21.1	21.4	28.9
Sum	100	100	100	100	100	100	100	100

Note: ODA, official development assistance; CRS, creditor reporting system

Korea's green growth ODA by region is shown in the table below. In Korea, the scale of green growth ODA has recently been increasing. As of 2007-2011, USD 0.1 billion was invested, and as of 2017-2021, USD 0.8 billion of green growth ODA was carried out, showing that the proportion has been rapidly increasing recently. As of 2021, Korea's share of green growth ODA towards Asia accounts for approximately 80.5% of the total, which is very high compared to DAC's share towards Asia of 11.9%. In addition, Korea's green growth ODA accounts for about 0.5% of the total DAC.

If you look at Korea's green growth ODA to the Greater Asia region, it is the largest in scale, and you can see that it is showing a very high growth rate, especially during the period 2017-2021. Since 2017, many ODA projects related to Korea's green growth in Asia have been carried out, and it can be seen that Korea's interest in the green growth sector is increasing.

In other regions, the proportion of green growth ODA to the Americas is high at $0.12 billion, with South America accounting for a relatively high amount. ODA projects related to green growth have been carried out in other regions such as Africa and Oceania, but appear to be on

a somewhat decreasing trend.

Table 9: Green growth ODA status by region in Korea (other regions)

Region/period	2002-2006	2007-2011	2012-2016	2017-2021	2018	2019	2020	2021
Asia	0.0	7.6	11.9	67.9	13.4	11.4	14.4	15.7
Central Asia	0.0	1.3	0.2	0.0	0.0	0.0	0.0	0.0
Far East Asia	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0
South Asia	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0
America	0.0	0.2	0.0	12.6	2.9	3.3	0.9	1.6
South America	0.0	0.0	0.3	0.8	0.0	0.3	0.3	0.0
Central America	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle East	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Africa	0.0	0.4	4.1	1.4	0.2	0.0	0.0	1.0
East Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oceania	0.0	0.0	3.0	1.8	0.0	0.0	0.6	1.2
Sum	0.0	10.0	19.5	85.2	16.6	15.4	16.1	19.5

Note: ODA, official development assistance; CRS, creditor reporting system

The proportion of Korea's green growth ODA is as follows. It can be seen that most of Korea's ODA support for green growth is being provided to Asian countries, and it remains at 75.8% from 2007 to 2011 and remains at 79.7% from 2017 to 2021, showing some increase. You can.

The Americas and Africa regions account for the next highest proportion. It can be seen that in the Americas, interest in green growth ODA has increased relatively from 2017 to 2021. On the other hand, the African region accounted for a high proportion from 2012 to 2016, but decreased again to a very low proportion from 2017 to 2021, so this change needs to be noted.

Table 10: Proportion of green growth ODA by region in Korea (other regions)

Region/period	2002-2006	2007-2011	2012-2016	2017-2021	2018	2019	2020	2021
Asia	0.0	75.8	60.7	79.7	81.1	74.0	88.9	80.6
Central Asia	0.0	12.6	1.2	0.0	0.0	0.0	0.0	0.0
Far East Asia	0.0	0.0	0.0	0.1	0.0	1.1	0.0	0.0
South Asia	0.0	0.0	0.0	0.1	0.0	1.1	0.0	0.0
America	0.0	1.8	0.0	14.8	17.3	21.4	5.7	8.2
South America	0.0	0.0	1.5	0.9	0.0	2.2	1.6	0.0
Central America	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle East	0.0	5.9	0.2	0.0	0.0	0.0	0.0	0.0
Africa	0.0	3.5	20.8	1.6	1.4	0.0	0.0	4.9
East Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oceania	0.0	0.0	15.3	2.1	0.0	0.0	3.7	6.1
Sum	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: ODA, official development assistance; CRS, creditor reporting system

5. Conclusion

This study used development statistical data provided by OECD DAC to examine regional trends in green growth ODA recipient countries, which have recently become an issue, over the period 2002 to 2021.

Green growth ODA in DAC countries amounted to about $37.3 billion between 2002 and 2006, and the size increased significantly between 2007 and 2011, reaching about $79.3 billion. This increase in the size of ODA increased to $99.8 billion between 2017 and 2021, showing that the size of ODA related to green growth has been rapidly increasing since the mid-2000s. Looking at the trend of green growth ODA by region, it can be seen that the growth rate in the Asian region is high, reaching approximately USD 21.1 billion from 2002 to 2006, and increasing to USD 42.3 billion from 2007 to 2011. This increases to $46.6 billion from 2017 to 2021, which is the largest increase considering the size. Looking at each region in Asia, we can see that the growth rate is high in South and Central Asia.

In Korea's case as well, the size of green growth ODA has been increasing recently. As of 2007-2011, approximately USD 760 million was invested, and as of 2017-2021, approximately USD 2.5 billion of green growth ODA was carried out, showing that the proportion has been rapidly increasing recently. In the Asian region, as of 2021, Korea's green growth ODA is USD 330 million, accounting for the largest proportion of the total, or 58.9%, which is higher than DAC's proportion of Greater Asia (USD 977.18 billion), which is 46.9%. . In addition, Korea's green growth ODA accounts for about 2.7% of the total DAC.

If you look at Korea's green growth ODA to the Greater Asia region, it is the largest in scale, and you can see that it is showing a very high increase (41.1%), especially during the period 2017-2021. Since 2017, many ODA projects related to Korea's green growth in Asia have been carried out, and it can be seen that Korea's interest in the green growth sector is increasing.

The economic and environmental scale of green growth ODA increased from about $600 million in 2000 to 2009 to about $12.3 billion in 2010 to 2019 from the existing sustainable development green ODA presented by Kang Seong-jin (2022). A very meaningful feature of Korea's foreign aid policy is that sustainable development ODA and sustainable development green ODA have increased compared to other countries. Another characteristic is that Korea provided relatively more support to SDGs that meet the purpose of economic activities, such as SDG9, in sustainable development ODA. In addition, other green ODA support also shows an increasing trend, showing that along with the overall ODA increase, Korea's foreign aid policy is also giving a lot of consideration to green ODA.

A characteristic of Korea's green growth ODA award status is that the proportion of Asian countries is higher than that of all DAC countries. In addition, DAC has the highest proportion in South and Central Asia, while in the case of Korea, Far East Asia has the highest proportion. In the case of Africa and Europe, DAC accounts for a relatively high proportion, showing that Korea is more concentrated in Asia and the Far East than all DAC donor countries. On the other hand, considering that Korea's total green growth ODA amount is about 2.7% of the total DAC, it is necessary to specialize in some regions such as Far East Asia or consider distributive policies for other regions or individual countries in realizing green growth ODA policies. There is a need.

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Evaluation of a "Flipped Classroom" Pilot Experience Using an LMS at ENCGC

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Abstract

This study aims to examine the results of a pilot flipped classroom experience (CI) conducted for an Operational Marketing course dedicated to 3rd year students at the National School of Commerce and Management in Casablanca, using a specially designed LMS. for Marketing courses. The course pe-riod was spread over the fall session of the 5th semester. We taught 2 groups of students with a total of 210 students, and we used CI's pedagogical approach by a learning management system (LMS) designed by ourselves. Post-session inter-views were conducted with the students of the 2 CI groups to gather information on their perception of the learning environment. In addition, a comparison of quantitative grade results between the groups of the 2021-2022 academic year and those of this 2022-2023 academic year was used to compare the academic results between the two teaching methodologies. On the one hand, the opinions of the students on the flipped classroom were mixed and the favorable opinions rather concern the use of LMS for this teaching method while supporting the major role of the student for the success of the CI. On the other hand, the comparative analysis of the marks showed a clear increase for the 2 groups of almost 3% compared to the previous year when the pedagogy used was that of the traditional class.

Keywords: Flipped classroom, LMS, assessment, teaching First Section

1. Introduction

Educational stakeholders are in a perpetual quest for a better teaching approach and confirmed teaching quality. With the technological enthusiasm and digital explosion, pedagogical innovation is at the forefront, and the flipped classroom method is ideally combined with hybrid teaching methods [1]. The flipped classroom is a pedagogical model in which the sequence of in-class lessons and homework is reversed chronologically. Course materials and/or videos presenting the course content can be viewed by students before the in-class session, while class time is dedicated to exercises, projects, or discussions [2].

The use of technology and distance learning platforms (LMS) is a key element in ena-bling courses to be prerecorded and made available to students outside the classroom. The philosophy behind the flipped classroom teaching methodology is that it allows instructors to teach both content and the learning process. According to Eric Mazur, a physics professor at Harvard University, learning is a two-step process. First, you need some transfer of information; second, you need to make sense of that information by connecting it to your own experiences and organizing the information in your brain [3]. The flipped classroom is designed to create a classroom experience that inspires life-long learning and aligns with Mazur's two-step process reference. The practice of the flipped classroom has garnered much attention; however, its success depends on proper teacher training and student initiation. Our research question is as follows: To what extent is the flipped classroom beneficial to the learning experience and student performance?

To answer this question, we will first conduct a literature review to provide an overview of the practice in theory. Secondly, we will examine real-world results data from a flipped classroom-based experience where we taught a Marketing course in initial training for two cohorts, one using the flipped classroom methodology and the other using traditional lecture-based teaching. The results will be discussed by comparing the average grades as a key indicator of teaching performance.

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2. Literature Review

Lectures at home, homework in class" is the slogan by which the practice of the flipped classroom has been popularized. The practice of this pedagogical innovation was initi-ated in 2008 by Jonathan Bergmann and Aaron Sams, two chemistry teachers at Wood-land Park High School in Pike Peak, Colorado, who struggled to find time to reteach lessons to absent students. They used their own money to purchase software that al-lowed them to record lessons and made them available online. The results were unex-pected; they found that even students who hadn't missed classes could enhance their learning through the capsules and videos viewed at home[1] (F. Eichler & Peeples, 2016).

Eric Mazur, one of the pioneers of the approach, states that, "If you were to enter one of my classrooms, you would think I'm teaching a kindergarten class, not a physics class," because students were so active and engaged in group work.

Teachers who use the flipped classroom model universally agree that simply watching recorded videos outside of class hours is not enough to ensure the model's success. It is rather how teachers integrate these educational videos into a comprehensive approach that makes the difference.

Academic literature is extremely limited regarding actual quantitative studies on the effectiveness of the flipped classroom. The following table summarizes the results of flipped classroom experiments in Morocco and around the world.

Table 1: Flipped classroom evaluation from literature

Studies	**Authors & Year**	**Results**
Mount Saint Vincent University	Thompson,2014 Mombourquette	-Students reported that they felt they were more success-ful in the flipped classroom. -There was no difference in grades when comparing the flipped classroom with the two traditional lecture-style courses.
High School à Clin-ton Township, Mich-igan	Alvarez, 2012	"The flipped approach holds the golden key for students, as educators can control and remove barriers to learning, allowing teachers to deliver their best presentations and share resources."
American University	Jeremy Strayer, 2009	The evaluation of the flipped classroom was conducted based on the criteria of the College and University Class-room Environment Inventory (CUCEI) to assess percep-tions of the learning environment. The aspect of innova-tion and cohesion received higher ratings from students who had experienced the flipped classroom.
The UNC Eshelman School of Pharmacy USA	Ferreri et O'Connor (2013)	More time is allocated to gather patient information and apply that information to patient self-care scenarios.
Ibn Toufail Univer-sity-Morocco	R.Mattougui (2022)	The comparison of pre-tests and post-tests allowed us to observe that students have successfully developed argu-mentative writing skills through the implementation of a hybrid approach that promotes flipped learning for the teaching of the French language.

Studies	Authors & Year	Results
BTSA France	Canizares & Gardiès, 2019	The analysis of learner activities related to information has revealed a limited level of constructed knowledge during this phase of distance learning. However, it is important to note that learners appreciate the opportunity to choose and control their learning time through the selection of a "viewing time," a "pace of learning," and even a "repetition time" when it comes to watching video capsules [4].
The Faculty of Sci-ences of El Jadida	Lakrami et al., 2018)	There was a significant improvement in grades in the sum-mative assessment results. 80% of the students confirmed that they were motivated to explore this new form of online self-directed learning for the first time[5] .

There was a significant improvement in grades in the summative assessment results. 80% of the students confirmed that they were motivated to explore this new form of online self-directed learning for the first time.

3. Research Methodology

This research outlines the process of our flipped classroom experience with 3rd-year students at the National School of Commerce and Management in Casablanca. We con-ducted the experiment with a group of 98 students (Group A) and another group of 108 students (Group B) through our own educational portal, www.marketingpsj.com, which we specifically designed for our students voluntarily and with our own resources (Figure 1).

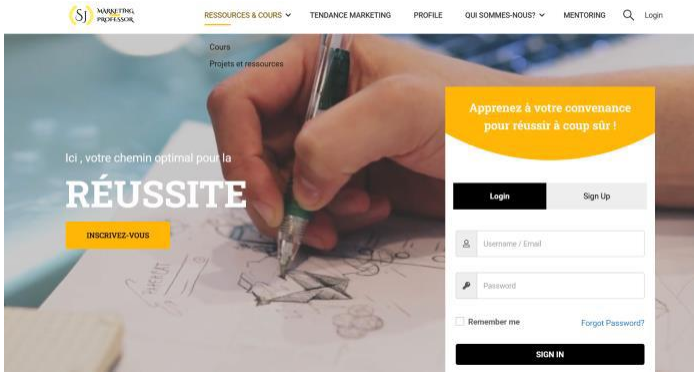

Figure 1: Our distance learning platform (LMS) caption (www.marketingpsj.com)

The use of asynchronous courses is not intended to replace in-person classes but rather to serve as a supplement to support the flipped classroom method [6] F. Eichler. The platform utilization rate was at 100%, as illustrated in Figure 2.

Figure 2 : Online course utilization from our website

The website was the tool deployed for a scripted asynchronous course designed to allow students to engage in formative assessment after each chapter of the course in the form of automatically corrected Multiple Choice Questions (MCQs) [7]. The MCQ tests are completed by students at home, enabling them to revisit gaps and misunderstandings in their learning. Our research meth-odology is based on a qualitative study [8]. According to Atkinson, the qualitative approach is preferred over quantitative methods for a better understanding of a phenomenon, gathering opin-ions, and understanding perceptions for a new experience. Thus, interviews allow for obtaining more in-depth and detailed information than other methods. Moreover, Stenius et al. (2017) stated that case study interviews can provide insight into research issues and offer a better method for obtaining quality data. In this study, open-ended questions were used to inquire about students' experiences in a flipped classroom. Open-ended questions were used because they encourage respondents to answer freely in their own words, leading to unexpected responses [9] , and often provide richer data than closed-ended questions[8]. The results of this qualitative study are con-sidered and interpreted alongside students' final grades. The 10 participants in the study were selected using a convenience sample based on two criteria: availability and cooperation [9]. A guide with 5 open-ended questions was prepared, and respondents' textual responses were rec-orded. The textual corpus of responses was then consolidated in a tabular format to identify emerging patterns in the research. Organizing data into sections with a matrix-like structure is recognized as a practical method for facilitating the matching of qualitative data patterns [8] .

4. Results and Discussion

As mentioned above, the ten study participants were selected using a convenience sample. We asked students questions regarding their self-assessment of the flipped classroom experience, their commitment to viewing the course material at home, whether the marketingpsj.com platform was beneficial for this purpose, and whether they would prefer the same pedagogical approach for other modules. The analysis of responses revealed two types of respondents, optimists, and pessimists. Table 1 shows the distribution by student type, with a coding of 0 to 9 used to represent the student type.

Table 2: Coding of responses

Student profile	**Number &Code**	**Recurring words and phrases**
The Optimistic	4 ; 0 ; 1 ; 8 ; 9 ;3 ;6	Pleasurable experience; I enjoyed the experience; More active learning; Better interaction; The flipped classroom experience is highly beneficial; Time-saving; Better com-prehension and focus on essentials; Easy access to course materials; I was able to regularly review my courses, they are easily accessible; An improvement in the learning experience; Remarkable engagement compared to other courses; Students can work at their own pace and revisit difficult concepts as many times as they wish; It helped me allocate more time to my studies outside of classes; Course preparation organization.
The Pessimistic	2 ; 5 ;7	I prefer not to have this method for complex subjects; I'm not the type of student who reviews my courses be-fore coming to class; however, in class, I am very attentive and can remember a lot.

Some students, characterized as optimistic (4; 0; 1; 8; 9), find this method effective and beneficial for their learning, while others (2; 5; 7) prefer in-person explanations. The general opinion of the students on the flipped classroom was mixed. Optimistic students spoke positively about the learning experience or rather the learning environment, which promotes

more interaction with the teacher, the ability to ask more questions than usual, and group work. However, Student 1 emphasized that the flipped classroom can only be beneficial if students commit to reviewing their course material before coming to class (*"...The flipped classroom experience is highly beneficial if students fulfil their part of the work"*). This viewpoint was echoed by pessimistic Student 5, who stated (*"...Personally, the flipped classroom method was not effective for me. What motivates me to learn the material are the discussions and interactions I have with my colleagues during class; it's these exchanges that create a conducive learning atmosphere, something that is absent when I study the course alone at home"*).

Half of the students expressed interest in adopting the same pedagogical approach for other modules taught, with students (4; 0; 1; 8; 9) saying:

"Yes, of course, courses this way are much more enjoyable."

"Yes, I would like to adopt this mode of learning for other subjects because it saves us time, we understand better, and we get to the essentials."

"As for me, I would like to see the adaptation of this pedagogical approach in several courses, given its positive impact on all levels related to the acquisition and understanding of information and knowledge. ..."

On the other hand, others are more attached to traditional teaching and believe it depends on the nature of the subjects:

"No, because in some subjects, it's more effective to have the explanation from our teacher to better assimilate the concepts."

"It really depends on the nature of the course. If we talk, for example, about accounting or applied mathematics, I would need the guidance of the teacher throughout the course to ensure its understanding, given the complexity of the subject. But if we talk about organizational theory, the flipped classroom method is effective because the concepts of the subject are theoretical."

However, all those interviewed agree that the implementation of an LMS was beneficial for their learning for three main reasons:

• The course scripting allowed for better understanding.

• The accessibility of the platform at any time allowed for self-paced learning ("...The journey from my place of residence to ENCGC is long, '1 hour and 15 minutes by tram,' so I take advantage of that time to read my course on my smartphone").

• The quizzes after each chapter allowed for revisiting misunderstandings and learning errors.

Figure 3: Student Comments on the Platform (www.marketingpsj.com)

A comparative study was conducted based on the analysis of the averages from two different academic years, which can be beneficial for comparing the effectiveness of flipped classroom teaching versus traditional teaching in terms of student performance [3]. By comparing the students' averages for the two academic years, it is possible to determine whether there has been an improvement, a deterioration in student performance with the implementation of the flipped classroom, or no change in grades. Table 2 presents the results for the two academic years: 2021-2022 in traditional classroom mode and 2022-2023 in flipped classroom mode using the market-ingpsj.com LMS platform.

Table 3: The comparison of average grades

Groups	Average Grades Traditional Classroom 2021-2022	Average Grades Flipped Classroom	Variation Improvement in Group Average
A	10,42	11,34	+2.08%
B	11,64	12.07	+3.7%
(A and B)	11.03	11.70	**+2.89%**

In conclusion, the aim of this study was to compare academic results between two teaching methodologies: flipped classroom and traditional lecture-style teaching, as well as to analyze students' perceptions of the flipped classroom environment. Two cohorts of the same course, Marketing Management, were included in the study. One cohort consisted of students from the 2021-2022 academic year in traditional classroom mode (Groups A and B), and the other cohort was from the 2022-2023 academic year, with the fall semester being taught in a flipped classroom mode (Groups A and B). Both groups received the same course outline, content, and pedagogical objectives.

The average grades were compared, and ten students were interviewed about their experiences in the flipped classroom using an LMS. Identical questions were posed to all students, but they were open-ended to allow students to freely comment on their personal experiences. The main findings of this study were the existence of two student profiles: the optimist and the pessimist. The optimist had a positive experience with the flipped classroom, perceived its benefits, and would like to have the same pedagogical approach for other subjects. The pessimist, on the other hand, preferred the traditional method and did not recommend the flipped classroom for other subjects. Nevertheless, all students reported that the use of the marketingpsj.com platform was beneficial for understanding the course and exam preparation.

This study was informative and confirmed that the flipped classroom, to date, has produced positive results with better teaching performance as evidenced by the analysis of grades, which align with the findings in the literature review. As the instructor behind this pilot experience of the flipped classroom at ENCGC, we emphasize that:

1. Firstly, students' understanding of the purpose of the flipped classroom must be effectively communicated, and students should have the opportunity to express their concerns regarding their responsibilities in this new learning style.

2. Secondly, student buy-in must be obtained so that they engage in the learning process.

3. Thirdly, instructors must be supported in creating online pedagogical resources (such as video production and course scripting). They should be adequately trained in the effective implementation of the flipped classroom.

If the conditions are correctly defined, the flipped classroom should have the potential to be an extremely effective learning mode. We intend to conduct further flipped classroom experiments once we have established formal procedures for communicating the process to students. We note two limitations of this study: first, we collected student responses ourselves, even though

the survey was administered or discussed with students only after the end of the semester and the publication of final grades. Second, the number of interviews is limited. To address this, we plan to conduct focus groups and a longitudinal study to delve further into the study's scope.

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Improving Energy Consumption of a Building Using Geothermal Energy

Negin Maftouni[1] A. Mazlooman Taleshi[2]

Abstract

Nowadays, with the growth of the population, the amount of energy demand has increased drastically. A large share of energy is produced by fossil fuels, which themselves cause the release of greenhouse gases and carbon into the environment. Today, the destructive consequences of using these types of fuels, which by releasing their pollutants, cause global warming, various environmental pollutions, and damage to animals and humans, are more obvious than ever. This issue has caused many concerns for human societies. Therefore, in the last few decades, efforts to reduce the use of these types of fuels and to find a clean and suitable alternative have accelerated. Renewable energy sources are one of the suitable alternatives because they do not have the pollution of fossil fuels and can be used without restrictions in exploitation. Due to the low price and availability of fossil fuels, Iran is one of the countries with high carbon emissions. Buildings in Iran, with a 40% share in fuel consumption, have a significant contribution to carbon emissions, and therefore, there is a need to pay more attention to energy consumption approaches in this area. One of these approaches is the design of zero energy buildings. In the design of these buildings, active and passive design methods are used, which include studying the building specifications and using renewable energy sources. In this research, it has been tried to use these methods and geothermal energy source as a renewable energy source to design a near-zero energy building in the climate of the city Khoi, Iran, in Design Builder software, so that it has optimal consumption. In the results of this design, by using insulation and suitable materials 34.71%, by choosing suitable openings 35.08% and finally by choosing suitable geothermal system along with all these factors, 72.03% energy reduction compared to the base building was obtained.

Keywords: Zero energy building, geothermal energy, design builder

1. Introduction

Most of the energy used by humans is non-renewable energy, which, in addition to its advantages, has many disadvantages, such as pollution, carbon emissions, and limited sources of this type of energy. While these disadvantages can be easily removed by using renewable energy sources and benefit from clean, unlimited and sustainable energy. Considering that a huge part of the energy produced in countries is consumed in the residential sector and buildings, two solutions are usually offered for sustainable energy consumption, one of which is to reduce the demand for energy and the other is to use energy efficiently.

According to the research conducted, since the industrial revolution until now, the excessive use of fossil fuels has caused the temperature of the earth to increase by 0.5 degrees Celsius and also decrease the concentration of the ozone layer by 20% in different parts of the earth. (IPCC Report Analysis, (n.d).)

Likewise, instability in the price of fossil fuels and the strong need to reduce carbon dioxide emissions, which have caused global warming and climate change in recent decades, are other influential factors for switching to renewable energy in recent years.

According to the reports, residential buildings in Iran play a role of 25% in the emission of greenhouse gases in the country. (Eshraghi et al., 2014)

The building sector also consumes the most energy by allocating more than 40% of the total energy produced in the country. (ISO - ISO 50001, 2011.)

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According to the reports provided by the Research Center of the Islamic Council and the Department of Energy Studies, Iran ranks 11th among other countries in terms of energy consumption. (Islamic Parliament Research Center, 2017)

All the mentioned reasons indicate the need to take action to optimize the energy consumption of buildings, both in existing structures and in structures under construction and design.

One of the rich sources for harvesting energy that is renewable and clean is geothermal energy, which has a very high potential to meet the needs of the energy sector.

Due to its geographical location and being located in a part of the earth where significant sources of geothermal energy are located, Iran has a very high potential for exploiting this energy.

By turning more towards the use of this energy in recent decades, many studies and researches have been done in the field of using this energy for cooling, heating or electricity production, but in less research comparing the methods of using and exploiting It and the selection of an optimal method for residential units, which according to the obtained statistics, are among the most energy-consuming sectors, have been discussed.

There are not so many researches focusing on comparing different methods of exploiting and consuming this sort of energy in residential buildings which are among the highest energy consumers.

In 2015, Long and his colleague investigated the thermophysical effects of wall material characteristics on thermal performance and energy of the building, and the results showed that for an external wall, the thermal conductivity of the material should be low and its volumetric heat capacity should be high, and for internal walls, it is necessary the thermal conductivity is not higher than 0.5 (w/mk). (Long & Ye, 2015)

In 2018, Parveen and his colleagues replaced the common systems in the country with a geothermal heat pump system for buildings under construction in Shiraz city in 2018. As a result of this research, it was found that 25,997,236 cubic meters of natural gas are saved annually, and by exporting this saved amount of gas, it is possible to achieve a dollar profit equal to 7.8 million dollars, and also prevent from the release of environmental pollutants to the environment the amount of 208 5.000 tons (Parvin et al., 2018)

In 2019, Shabanian et al measured the effect of polystyrene insulation in reducing the energy consumption of residential buildings in Iran's cold climate. As a result of this research, it was found that the use of this insulation in the outer wall of the building can reduce the heating load of the building by 27% based on the conditions. (Shabanian et al., 2021)

In 2020, Amani and his colleagues investigated the feasibility of constructing a zero-energy building in the cold and semi-arid climate of Iran. The results of the simulations showed the possibility of building the structure in this climate according to the design factors, and by observing these factors, the energy consumption of the building was reduced by 30%. (Amani and Moghadas, 1400)

Also in 2020, Pilehchi and his colleagues optimized the factors affecting the thermal performance of double-glazed windows in Tehran. The findings showed that the use of reflective glasses with xenon and an air gap of 8 mm provided the maximum savings in that research amounting to 14.99%. (Pilechi et al. 2020)

In this research, by using insulation with XPS Extruded Polystyre ne-CO2 Blowing material and AAC blocks, the energy consumption of the building has increased 71.34% and it was found by choosing suitable openings (Dbl Clr 3mm/13mm Arg window glass) energy

consumption of the building has improved by 35.08%. Finally, with the selection of the geothermal system, along with all these factors, 72.03% energy reduction was achieved compared to the base building. Also, the amount of carbon emissions and the investment return period for the building in the optimal state were calculated as values of 4854.762 (kg) and 1.01 years respectively, and this building has an A energy label according to the national standard number 14253.

2. Materials and Methods

The building under investigation is a two-story residential building located in Khoy city of West Azarbaijan province. The floor area of the building is 110 square meters and the area of each unit is 85 square meters. Figure 1 shows the front niew of the building.

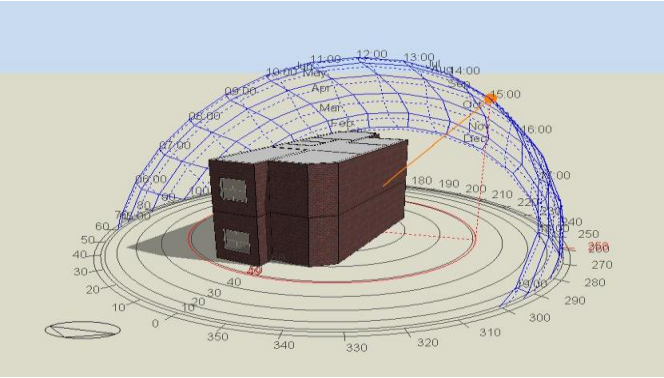

Figure 1: Front view of the building.

At first, after transferring the building map to the software, according to the input data, the cooling and heating load of the building is calculated in the basic state for a period of one year, and then, according to the design parameters such as materials, openings, et. ... the optimal parameter is replaced. In the next step, the structure's air conditioning system will be investigated in the basic state and replaced with a geothermal heat pump system. By replacing this system, the scenarios of using this energy will be examined so that the model that is more optimal in terms of energy consumption and economic efficiency is selected as the air conditioning system for this building.

In addition to choosing this system, all the materials and variables that can be investigated to optimize the energy of the building and make it close to zero energy are also replaced with the basic model and finally an optimal model for this building is presented. Figures 2 and 3 show the HVAC schematics for the base building and the case of bulding with geothermal heat pump and auxiliary boiler, respectively.

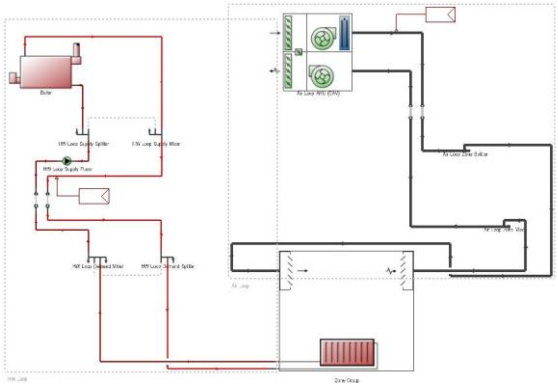

Figure 2: The base building air conditioning system.

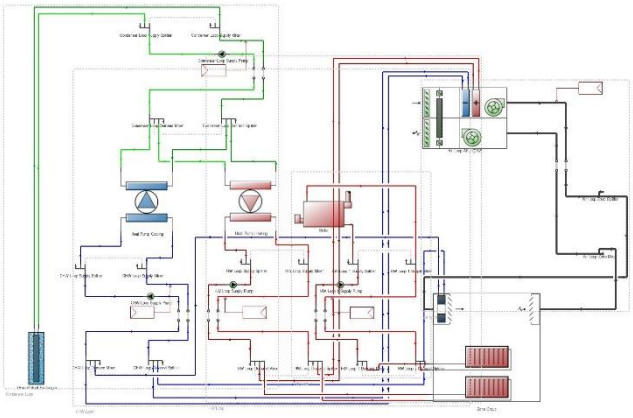

Figure 3: Building HVAC system with geothermal heat pump and auxiliary boiler.

3. Results and Discussion

According to the simulations, it was found that the building with surface geothermal heat pump system along with an auxiliary boiler with the amount of annual energy consumption of 12262.522 (kWh) and 72.03% reduction in energy consumption compared to the base case that the amount of annual energy consumption That is 101/43849 (kWh), it is the optimal condition of the building and it can be considered as a model of a near to zero energy building, while maintaining the level of thermal comfort of the residents. Of course, the building model using a vertical geothermal heat pump system with an auxiliary boiler also has almost the same energy consumption of 12272.066 (kWh), which has a 72.01% reduction in annual energy consumption compared to the basic state, and is considered an optimal model, but because of the slight difference, as well as drilling at a lower depth, which also has lower costs, the building model with the surface geothermal heat pump system along with an auxiliary boiler is considered as a designed zero energy building model.

According to the output data from the simulation results, the amount of carbon production and emission in the basic state is equal to 18070.92 (kg) per year, which is reduced to 4854.762 (kg) for the optimal state building, which indicates a decrease of 13 73.0% in carbon emission in the optimal model.

Also, the value of the return of investment will be equal to 1.01 years, which is a short time and makes this plan justifiable for investment. Figure 4 reports the energy consumption for various stages.

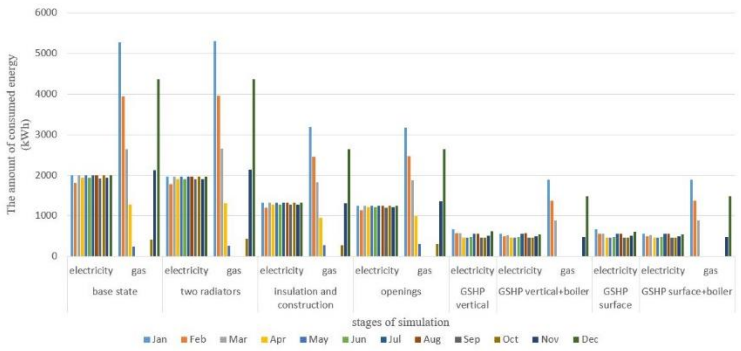

Figure 4: The amount of energy consumption in each stage of designing a near zero energy building

4. Conclusion

The building investigated in this thesis is a two-story building with residential use and 110 square meters of infrastructure located in Khoy city of West Azarbaijan province, which was investigated during several stages of its energy. The results showed that the energy consumption of this building in the basic state was 101.43849 (kWh), which reached the value of 28628.07 (kWh) in the first stage of passive design and using insulation and materials with suitable thermal conductivity coefficient. which is reduced by 34.71% compared to its value in the basic state. By changing the type of windows and using shades, the amount of energy of the building decreased to 28461.81 (kWh), which is 35.08% less than the base state. In the active design phase and by replacing the building's air conditioning system and using a vertical geothermal heat pump, the building's energy was reduced by 98.59%, but due to the low comfort temperature range in winter, to increase this temperature and at the same time save Energy consumption, an auxiliary boiler was used along with the system, and in this case, the energy consumption of the building reached 12272.066 (kWh), which is 72.01% less energy consumption compared to the basic model. In the surface method, the amount of energy consumed was 6407.774 (kWh) from the use of geothermal energy, which was also reduced by 85.39% compared to the base case, but in this case, a suitable temperature comfort level was not provided, so in order to solve the problem for this model, an auxiliary boiler was used, and the results indicated a reduction of 72.03% of energy with a calculated energy value of 12262.522 (kWh), which at the same time provides thermal comfort to the residents, and finally this system as An optimal system in terms of energy performance was considered for a building close to zero energy. In this regard, the amount of carbon emissions and the investment return period for the optimal building were calculated as 4854.762 (kg) and 1.01 years, respectively, and this building has an A energy label according to the national standard number 14253.

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Economic Freedom and Tax Revenues: A Causality Analysis for G-7 Countries

Mahmut Unsal Sasmaz[1] Yilmaz Bayar[2]

Abstract

Tax revenues are a critical income source for the public expenditures. Therefore, the factors underlying tax revenues are important for tax collection. This study examines the causal relation between economic freedom and tax revenues in G-7 countries between 2000 and 2021 by way of causality analysis. The results of panel causality test reveal a mutual interplay tax revenues and economic freedom.

Keywords: Economic freedom, tax revenues, panel causality analysis, G-7 countries

1. Introduction

Economic freedom means that each person controls his or her own labor and property. In the countries with high economic freedom, individuals have the freedom to work, produce, consume and invest as they wish and governments allow labor, capital, and goods to move freely and avoid coercion or restriction of freedom beyond what is necessary to protect and maintain freedom itself. Economic freedom has many social and economic implications for the societies. In this context, economic freedom can impact the economic growth via economic liberalization. Economic freedom can affect economic activities, employment, competitiveness, economic welfare and tax revenues through growth channel (Alabede, 2018, Kutbay, 2020).

Furthermore, economic freedom may generally lead innovation, entrepreneurial progress and increases in productivity. More tax revenues can be obtained because individuals with relatively higher economic freedom are liable to more engage in taxed economic activities such as labor, investment, and trade. In addition, one of the sub-indices of the economic freedom index is trade freedom. In this context, individuals can deal with trade more without government intervention in case of trade freedom. Also, individuals have the freedom to exchange goods and services and are not exposed to non-tariff barriers in their commercial transactions. Thus, foreign capital inflows and technology transfer may gain momentum as the openness of a country increases. In conclusion, export-based economic growth together with the improvements in productivity may increase the tax revenues (Naappe, 2021).

This study examines the mutual interplay between tax revenues and economic freedom in the G-7 countries for the 2000-2021 term by means of causality test. The next section of the paper outlines presents the associated empirical literature summary and data and method are explained immediately afterwards. The empirical analyses are performed in Section 4 and the paper is concluded with the Section 5.

2. Literature Review

This paper investigates the interplay between economic freedom and tax revenues. Most of the empirical studies have usually discovered a positive impact of economic freedom on tax revenues, relatively few studies such as Sameti and Shahchera (2006), Naape (2021), and Tekin

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et al. (2018) have found a negative or insignificant relationship between economic freedom abd tax revenues.

Egger and Winner (2004) investigated the relationship between economic freedom and tax revenues in 46 developing and developed countries for the 1980-1997 via panel data analysis and unveiled a positive interactioj between economic freedom and tax revenues. On the other hand, Dioda (2012) analyzed the drivers of the tax revenues in 32 Latin American states over the 1990-2009 term and uncovered the economic freedom as a positive determinant of tax revenues.

Castro and Camarillo (2014) also examined the impact of structural, economic, social, and institutional factors on tax revenues in 34 OECD members for the 2001-2011 term and revealed that economic freedom had a positive effect on tax revenues. Zarra-Nezhad et al. (2016) explored the determinants of tax revenues in a panel of 83 countries through dynamic regression and specified that economic freedom positively affected the tax revenues. Alabede (2018) also examined the interplay between tax revenues and exonomic freedom ib 42 Sub-Saharan African states over the 2005-2012 duration and uncovered a positive influence of economic freedom on tax revenue.

Bahtiyar and Odabaş (2020) also analyzed the interaction between tax revenues and economic freedom in 32 OECD members for the 1996-2016 duration via cointegration analysis and found a positive long-term relationship between tax revenues and economic growth. Diler (2020) analyed the effect of economic freedom and inflation on corporation tax in Turkiye for the 1988-2017 period through time series analysis and uncovered a significant causality from corporation tax to the economic freedom.

On the other hand, Sameti and Shahchera (2006) explored the interplay among economic freedom, economic growth, and tax revenues in MENA countries over the 1980-2002 term through panel data analysis, but found an isgnificant interaction between economic freedom and tax revenues. Naape (2021) examined the effect of economic freedom on tax ravenues in 14 SADC countries over the 2000-2017 term through dynamic regression and revealed a negative influence of economic freedom on tax revenue. Last, Tekin et al. (2018) analyzed the impact of economic freedom on tax evasion in 63 countries and discovered a negative relationship between economic freedom and tax evasion.

3. Data and Method

This study examines the causal interplay between tax revenues and economic freedom in the G-7 economies for the 2000-2020 term. The tax revenues (TAXREV) is proxied by total tax revenues (% of GDP) and obtained from OECD (2023). On the other hand, economic freedom (EF) is proxied by economic freedom index of Fraser Institute (2023). The study covers the period of 2000-2021, because annual series of economc freedom and tax revenues are available as of 2000, and economic freedom lasts in 2021.

The econometric analyses are performed through Stata 15.0 and Eviews 12.0 statistical programs. The causal relationship between economic freedom and tax revenues is analyzed by JKS (Juodis, Karavias, Sarafidis) (2021) causality test.

The summary statistics of tax revenues and economic freedom are displayed in Table 1. The mean of tax revenues and economic freedom index are respectively 34.349% of GDP and 8.018. But tax revenues series remarkably change among G-7 economies for the 2000-2021 term.

Table 1: Summary statistics of the series

Summary statistics	TAXREV	EF
Mean	34.349	8.018
Std. Dev.	6.437	0.338
Maximum	46.068	8.84
Minimum	22.911	7.25
Observations	154	154

4. Econometric Analysis

In the econometric analysis, cross-sectional dependency between tax revenues and economic freedom is analyzed with tests of LM, $LM_{adj.}$, and LM CD, and the test results are reported in Table 2. The null hypothesis of cross-sectional independency is abnegated given the probability values of three tests and the subsistence of cross-sectional dependency is disclosed between tax revenues and economic freedom.

Table 2: Cross-sectional dependence tests' results

Test	Test statistic	Prob.
LM (Breusch and Pagan, 1980)	112.1	0.0000
LM adj* (Pesaran et al., 2008)	35.76	0.0000
LM CD* (Pesaran, 2004)	8.169	0.0000

The homogeneity is examined with delta tilde tests of Pesaran and Yamagata (2008) and their results are reported in Table 3. The homogeneity is abnegated given the probability values of two tests and subsistence of heterogeneity is disclosed.

Table 3. Homogeneity tests' results.

Test	Test statistic	Prob.
$\tilde{\Delta}$	2.719	0.007
$\tilde{\Delta}_{adj.}$	2.925	0.003

The stationarity of EF and TAXREV is analyzed by Pesaran (2007) CIPS unit root test because of the cross-sectional dependency between two series and its results are shown in Table 4. The test results identify that EF and TAXREV are I(1).

Table 4: Unit root test's results

Variables	Constant	Constant +Trend
EF	-1.135	0.897
d(EF)	-4.250***	-3.585***
TAXREV	1.134	-0.395
D(TAXREV)	-6.449***	-5.699***

*** is significant at 1%.

The causal relationship between tax revenues and economic freedom is examined with JKS (2021) causality test and its results are shown in Table 5. The causality analysis uncovers a bidirectional causal interplay between economic freedom and tax revenues.

Table 5: JKS causality test results

Null hypothesis	HPJ Wald test statistics	P Values
EF ↛ TAXREV	9.1051	0.0105
TAXREV ↛ EF	4.3995	0.0359

5. Conclusion

This paper investigates the causal interplay between tax revenues and economic freedom in G-7 countries between 2000 and 2021 by way of causality analysis. The results of panel causality test reveal a mutual interplay tax revenues and economic freedom. The findings of the study indicate that measures to improve the economic freedom are important for tax revenues. In this context, rule of law, protection of property rights, ensuring the integrity of the state and increasing judicial efficiency are critical factors fostering economic freedom. In addition, ensuring a fair tax system, effective and efficient use of public expenditures, ensuring freedom of work and monetary freedom also contribute to the economic freedom. Thus, the free movement of labor, capital and goods is ensured and in turn foreign capital inflows also increase and economic growth, employment, economic welfare and tax revenues are positively affected from this process.

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Environment Taxes and Renewable Energy Use: A Causality Analysis for the New Member States

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Abstract

Environmental taxes and renewable energy are significant tools to combat environmental problems. This study investigates the causal interaction between environmental tax revenues and renewable energy consumption in the new EU member states for the period of 2010-2020 via causality test. The causal relationship between environment taxes and renewable energy use is examined with Emirmahmutoglu and Kose (2011) causality test and test findings are denoted in Table 5. The panel findings reveal a unilateral causal relationship from environmental tax revenues to the renewable energy consumption. The country level causality analysis also uncovers a significant unidirectional causality from environmental tax revenues to the renewable energy consumption in Czechia, Latvia, and Lithuania.

Keywords: Environmental taxes, renewable energy consumption, panel causality analysis

1. Introduction

The globalized world has faced significant challenges to ensure the environmenta lsustainability. Global population growth, The increase in world population, the rigidity of traditional production and consumption patterns, the complexity of economic activities, globalization and harmful emissions make it difficult to achieve environmental sustainability. In this context, it is important to alleviate environmental pressures and combat climate change through various institutional, legal, and market-based environmental policy tools (Bozatlı and Akça, 2023).

The environmental tools are one of the most effective tool to internalize the negative externalities that cause environmental pollution. As a matter of fact, environmental taxes may lead to the use of new technologies to combat environmental pollution. Thus, there may be a shift towards renewable energy, which is a less carbon-intensive and sustainable energy source (Ameer et al., 2023). Increasing the use of renewable energy can help not only ensure ecological sustainability but also financial sustainability. In this way, it can support the achievement of sustainable development and improvements in welfare level.

This study examines the two-way relationship between environmental tax revenues and renewable energy use in the new EU member states for the 2010-2020 duration via causality test. The next section summarizes the empirical literature and data and methodology are then explained. The econometric analyses are conducted in Section 4 and the paper is concluded with the Section 5.

2. Literature Review

Ghazouani et al. (2021) examined the connection between environmental taxes, technologies, regulations, renewable energy, and environment in 9 European countries including Belgium, the Czech Republic, France, Germany, Italy, the Netherlands, Poland, Spain and the UK for the 1994-2018 duration through panel data analysis and unveiled that environmental taxes and renewable energy improved the environment. On the other hand, Shahzad et al. (2021)

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investigated the effect of environmental taxes, technologies, environmental policy stringency index on renewable energy production in 29 developed economies for the 1994-2018 duration through cointegration and regression approaches and found a positive effect of environmental policy stringency index, technologies and urbanization on renewable energy.

Wolde-Rufael and Mulat-Weldemeskel (2022) analyzed the relationship among environmental taxes, renewable energy, and CO_2 emissions in 18 18 Latin America and Caribbean economies over the period of 1994-2018 through regression and revealed a negative effect of environmental taxes and renewable energy on CO_2 emissions and a positive effext of environmental taxes on renewable energy. Doğan et al. (2022) also explored the effect of environmental taxes on renewable energy consumption in G7 economies for the 1994-2014 period through panel data analysis and found that effect of environmental taxes on renewable energy consumption accelerated with taxation level. Yunzhao (2022) researched the interaction among eco-innovation, renewable energy, environmental taxes, and carbon emissions in E−7 economies during the 1995-2018 period and found that environmental taxes and renewable energy decreased the carbon emissions and disclosed a bilateral causal interplay between environmental taxes and renewable energy.

Bashir et al. (2022) investigated the interplay among environmental taxes, environmental technologies, environmental regulations, and renewable energy in 29 OECD countries over the 1996-2018 duration through cointegration and quantile regression and disclosed a negative impact of environmental taxes on renewable energy use. Dogan et al. (2023) analyzed the relationship among energy taxes, environmental taxes and renewable energy in EU countries for the period of 1995-2019 via panel data analysis and unveiled a negative impact of environmental taxes on renewable energy use.

Bozatlı and Akça (2023) examined the effect of environmental taxes, renewable energy consumption, environmental technologies on ecological footprint in the OECD members over the 1994-2018 duration and found a negative effect of environmental taxes and renewable energy use on ecological footprint. Aydin and Bozatli (2023) analyzed the impact of environmental taxes and economic indicators on renewable energy use in the top 10 renewable energy-consumed OECD countries over the 1994-2019 via ARDL and NARDL approaches and disclosed a positive long-run effect of environmental taxes on renewable energy use. Last, Ameer et al. (2023) examined the effect of environmental taxes and renewable energy electricity on renewable energy use in E-7 countries over the 1990-2020 period and found a positive effect of environmental taxes on renewable energy use.

3. Data and Method

This study examines the causal relationship between environmental taxes and renewable energy use in the new EU member states over the 2010-2020 period through causality analysis. The environmental taxes (ENVTAX) is proxied by environmental tax revenues (% of GDP) and obtained from Eurostat (2023). On the other hand, renewable energy use (RENEW) is represented by renewable energy consumption as a percent of total energy use and provided from the World Bank (2023). The study covers the period of 2010-2020, because annual series of environmental tax revenues exists as of 2010, and renewable energy consumption data lasts in 2020.

The econometric analyses are performed through Stata 15.0 and Eviews 12.0 statistical programs. The causal relationship between environmental tax revenues and renewable energy consumption is examined through Emirmahmutoglu and Kose (2011) causality test.

The summary statistics of renewable energy consumption and environmental tax revenues are denoted in Table 1. The mean of renewable energy consumption (% of total final energy

consumption) and environmental tax revenues (% of GDP) are respectively 22.124% of total final energy consumption and 2.465% of GDP. However, renewable energy use show a remarkable changes among the countries over the 2010-2020 duration.

Table 1: Summary statistics of the series

Summary statistics	RENEW	ENVTAX
Mean	22.124	2.645
Std. Dev.	8.862	0.555
Maximum	43.75	3.92
Minimum	9.49	1.64
Observations	121	121

4. Econometric Analysis

In the econometric analysis, cross-sectional dependency between environmental taxes and renewable energy use is checked with tests of LM, $LM_{adj.}$, and LM CD, and the test results are reported in Table 2. The null hypothesis of cross-sectional independency is declined given the probability values of these tests and the entity of cross-sectional dependency is unveiled between environmental tax revenues and renewable energy use.

Table 2: Cross-sectional dependence tests' results

Test	Test statistic	Prob.
LM (Breusch and Pagan, 1980)	115.8	0.0000
LM adj* (Pesaran et al., 2008)	9.34	0.0000
LM CD* (Pesaran, 2004)	7.468	0.0000

The homogeneity is examined with delta tilde tests of Pesaran and Yamagata (2008) and their results are reported in Table 3. The homogeneity is declined given the probability values of two tests and entity of heterogeneity is disclosed.

Table 3. Homogeneity tests' results.

Test	Test statistic	Prob.
$\tilde{\Delta}$	2.595	0.009
$\tilde{\Delta}_{adj.}$	3.043	0.002

The stationarity of RENEW and ENVTAX is explored with Pesaran (2007) CIPS unit root test because of the cross-sectional dependency between two series and its results are shown in Table 4. The test results identify that RENEW and ENVTAX are I(1).

Table 4: Unit root test's results

Variables	Constant	Constant +Trend
RENEW	-0.842	-1.186
d(RENEW)	-2.999***	-2.749***
ENVTAX	1.057	-0.825
D(ENVTAX)	-2.011**	-2.722

*** and ** are respectively significant at 1% and 5%.

The causal relationship between environment taxes and renewable energy use is examined with Emirmahmutoglu and Kose (2011) causality test and test findings are denoted in Table 5. The

panel findings reveal a unilateral causal relationship from environmental tax revenues to the renewable energy consumption. The country level causality analysis also uncovers a significant unidirectional causality from environmental tax revenues to the renewable energy consumption in Czechia, Latvia, and Lithuania.

Table 5: Emirmahmutoglu and Kose (2011) causality test results

Countries	**ENVTAX ↛ RENEW**		**RENEW↛ ENVTAX**	
	Test statistic	**P value**	**Test statistic**	**P value**
Bulgaria	1.099	0.295	1.442	0.230
Croatia	1.097	0.295	1.148	0.284
Czechia	**4.546**	**0.033**	0.151	0.698
Estonia	0.247	0.619	1.291	0.256
Hungary	0.093	0.760	0.007	0.932
Latvia	**4.834**	**0.028**	0.525	0.469
Lithuania	**10.030**	**0.002**	1.944	0.163
Poland	0.082	0.775	1.372	0.241
Romania	0.157	0.692	0.016	0.900
Slovak Republic	0.022	0.883	1.391	0.238
Slovenia	0.509	0.476	0.241	0.624
Panel	**36.307**	**0.028**	21.053	0.517

5. Conclusion

This study investigates the causal interaction between environmental tax revenues and renewable energy consumption in the new EU member states for the period of 2010-2020 via causality test. The panel findings of the causality test reveal a unilateral causal relationship from environmental tax revenues to the renewable energy consumption. The country level causality analysis also uncovers a significant unidirectional causality from environmental tax revenues to the renewable energy consumption in Czechia, Latvia, and Lithuania.

Environmental taxes are one of the vital environmental policy tools for the countries to encourage the widespread use of renewable energy in combat with environmental pollution. Therefore, regulations to foster the the effectiveness of the environmental taxes, renewable energy use, and environmental technologies would contribute to the environmental sustainability. The countries can generate income and contribute to the development of renewable technologies through environmental taxes.

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The Importance of Green Technology in The Context of Sustainability

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Abstract

Green technology, which aims to develop environmentally friendly products and services, is a technology that helps to prevent negative climate impacts in the future and to use resources efficiently. Focusing on sustainable innovation by taking into account short and long-term environmental impacts, green technology aims to reduce waste and pollution, increase efficiency, replace existing technologies with environmentally friendly new ones, ensure sustainability and new employment conditions. Green technology offers innovative solutions that improve and sustain the quality of life while reducing the harmful effects of human life on the environment. As the need for sustainable living increases, organisations focus on developing more rational and environmentally friendly solutions. The aim of this study is to emphasise the importance of green technology and to reveal its advantages over the related sectors.

Keywords: green technology, green products, recycling, renewable resources

1. Introduction

Technological developments in the historical process have brought about major changes in industry. Significant transformations have been experienced in the fields of steam power (mechanisation), electricity (mass production), electronic and information technologies (automation) and cyber-physical systems (digitalisation), which were the driving force of the First Industrial Revolution. While these transformations have brought many benefits to humanity, they have also brought many social, economic, technological and environmental threats.

Green technology, which is created to be environmentally friendly from the production line to its use, offers many different solutions that support sustainability, including clean energy production, recycling of waste, reduction of harmful emissions to the environment and energy saving (Fan et al., 2023). Green products and technologies are environmentally friendly by definition. Energy saving, recycling, health and safety conditions, renewable resources and more are used in the development of a green product or technology (Lal, 2018). The main reasons underlying the acceleration of renewable technology are the depletion rate of fossil fuels, problems in their supply and the environmental pollution caused by them. Compared to the past, the need for green technology is similar to today. Due to the depletion of natural resources and intensive use of non-renewable resources, many sectors are switching to green technology today (Peng et al., 2021).

Modern technology today is based on a wide range of hardware, complex systems and networks as well as human interaction. Green technology initiatives cover all stages from designing a product to reaching the end user in order to achieve a greener environment. In this context, it is important to develop green technologies and make them safer (Shahzad et al., 2022).

The production and use of technology causes air, water and noise pollution. In general, the adoption of green technology aims to reduce the amount of electricity used by electronic devices such as computers, to properly dispose of or recycle obsolete electronic equipment, to design energy efficient computers, servers, printers, projectors and digital devices and to use them in

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an environmentally friendly manner (Das et al., 2018). In line with these objectives, green technology is expected to reduce the impact of technology on the environment, improve the quality of the computing environment and contribute to the goals of making the world a more environmentally friendly place (Aithal and Aithal, 2016). Green technology will be transferred to future generations as a technology that can meet current needs without jeopardising the conditions necessary for future generations to meet their needs. Investing more in green solutions, reducing environmental risks and protecting natural resources are high on the world agenda (Du and Li, 2019a). Green technology, which is an environmentally friendly technology and therefore also known as environmental technology or clean technology, has gained momentum with sustainable development initiatives and goals and has recently become one of the fastest growing areas (Bisoyi and Das, 2015).

2. The Importance of Green Technology

Green technology is expected to increase the use of new energy production methods in the future and reduce the negative effects of global climate change caused by increasing carbon emissions. At the same time, green technology, which offers energy sources that do not consume critical fossil fuels, combats global warming by reducing greenhouse gas emissions such as nitrogen/carbon dioxide, combines technology with recyclable components and helps to have a pollution-free atmosphere (Abidin et al., 2020). The main objectives of green technology are to control global warming, reduce greenhouse gas emissions and develop innovative inventions that do not affect natural resources in a way that is less harmful to the health of humans/animals/planet (Peattie, 1999). In general, the necessity of green technology is related to the reduction of risks to the environment and the conservation of natural resources. At the same time, green technology enables the use of clean, renewable energy sources to prevent the complete depletion of other non-renewable resources (Kataruka, 2021).

Since green technology provides alternative energy sources, supports biodegradable materials, encourages recycling and is sustainable, many developed or developing countries are switching to this technology to protect themselves from the harmful effects of climate change (Alsmadi, 2007). With air pollution causing the death of many people, green technology has become more critical and has been rapidly adopted by countries.

- Aids in the recycling and management of waste materials.
- Due to its environmentally friendly nature, it releases minimal or no harmful substances into the environment.
- The upkeep of Green Tech is highly cost-effective.
- Green Tech contributes to energy conservation.
- It also plays a role in restoring the health of our ecosystem (Sharma and Joshi, 2016).

Industries Implementing Green Technology:

a) Energy Industry: Presently, a significant portion of global energy is produced through the combustion of fossil fuels. Green technology offers alternatives for more eco-friendly fuel sources than fossil fuels, which typically generate waste as a byproduct. Renewable sources like solar, wind, and hydroelectric power are preferred as they are cleaner and do not emit harmful by-products.

b) Transportation Industry: Traditional fuel-powered vehicles are major contributors to global greenhouse gas emissions. As a result, numerous companies are integrating Green Tech into their transportation systems and vehicles, including electric vehicles and buses powered by compressed natural gas.

c) Waste Management Industry: Green Tech is utilized in the waste management industry for the transportation, storage, and recycling of waste materials.

d) Water Treatment: Globally, green tech is extensively used for water treatment. In regions with limited water resources, it is employed to purify contaminated water or desalinate seawater, thereby enhancing the availability of potable water.

e) Air Cleaning: Green technology is applied to purify polluted air by reducing carbon emissions and other gases emitted by industrial activities.

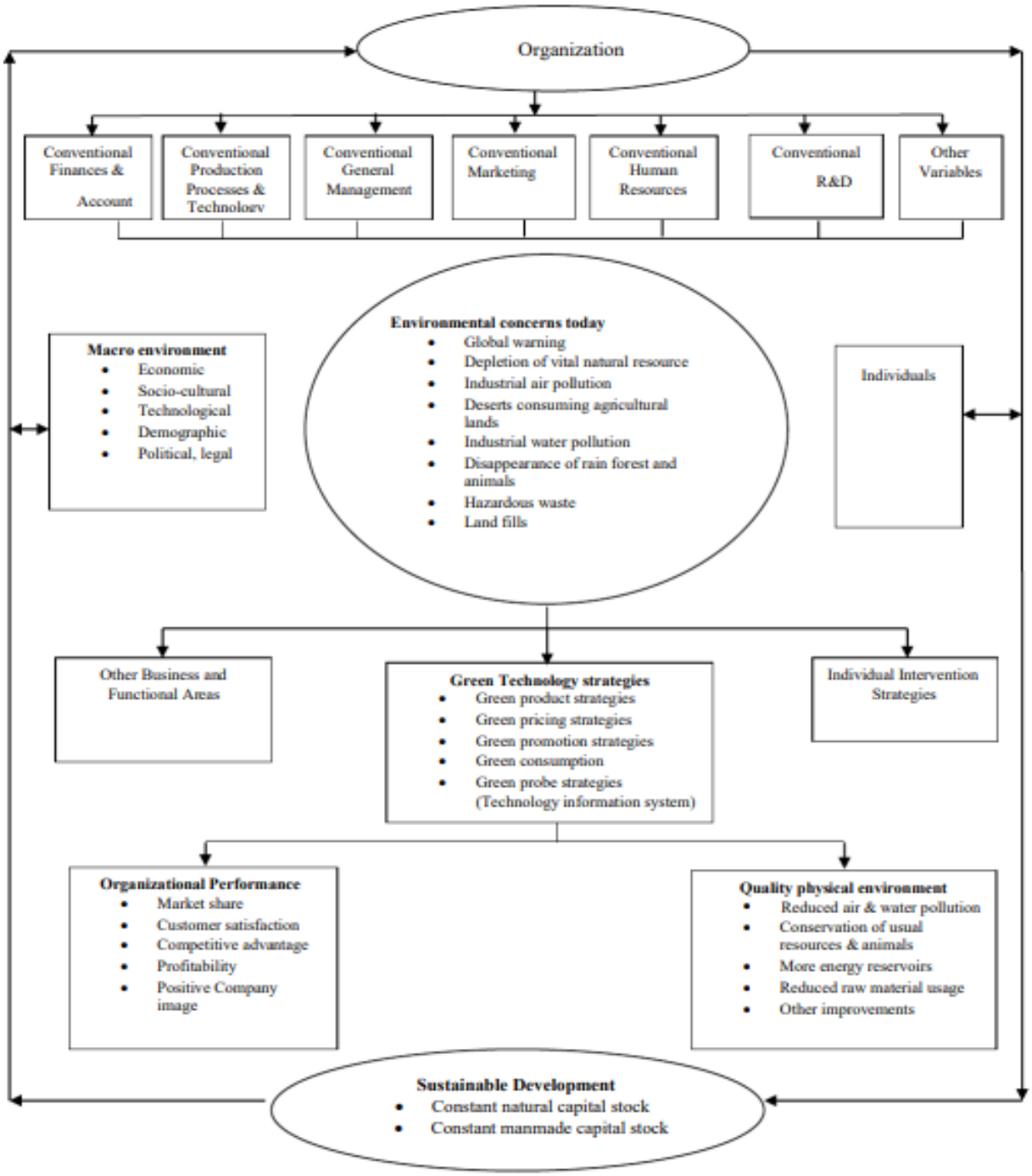

Figure 1: The relationship between Green Technology and Sustainable Development
Source: Das et al., 2018.

Contemporary key technologies, including those in aviation, automotive, biotechnology, computing, telecommunications, internet, renewable energy, atomic and nuclear fields, nanotechnology, and space exploration, can be adapted to adhere to green technology principles (Iravani et al., 2017). These environmentally friendly adaptations of existing technologies can play a significant role in addressing societal challenges faced by both basic and advanced civilizations. The goals of implementing green technologies in various fundamental and advanced societal sectors are detailed in Table 1.

Table 1: Objectives of green technologies in various areas of the society

	Area	**Objectives of green technologies**
1	Agriculture	To avoid environmental degradation in agricultural processes.
2	Food Processing	To eliminate poisonous contents in food and to avoid green gas emission and environmental degradation in all food packaging processes.
3	Potable water	To large scale filter used water and sea water through green processes without environmental degradation.
4	Sustainable Energy	To develop technologies for harvesting potential natural energy sources to generate required energy to human civilization without degrading environment.
5	Consumer products	To produce variety of new generation consumer products without side effects and without degrading environment in any production, packaging and in actual use by consumers.
6	Automobiles	To produce energy efficient, zero emission automobiles using renewable energy processes.
7	Construction	To build environmental friendly, energy efficient, smart buildings.
8	Industrial Automation	To develop industrial processes which are environmental friendly, no green gas emission, recyclable waste products using green energy.
9	Computer and Information Communication	To develop and utilize environmental friendly, recyclable electronic and computer components which uses renewable energy and efficient performance.
10	Education	Use of green technology in all education services.
11	Health	Use of green technology and green processes in all health and medical services.
12	Aircraft & Space Travel	Use of green energy and green materials and environmental friendly processes in air and space travel.

The primary goal of green technology is to mitigate global warming and diminish the greenhouse effect. Its core philosophy revolves around creating innovative solutions that preserve natural resources, thereby minimizing harm to humans, animals, and the overall health of our planet. It's becoming increasingly clear that our world is struggling under the burden of our waste production (Kunapatarawong and Martínez-Ros, 2016). However, with determination, we can significantly reduce this issue. The effective implementation of green technologies plays a crucial role in cutting down emissions. Consequently, numerous advanced and some emerging nations are shifting towards this technology, aiming to shield themselves from the detrimental effects on the climate (McCranie et al., 2011; Ali et al., 2019).

3. Advantages of Green Technology

- ✓ ***Reduces energy consumption***

Green technology helps to reduce energy consumption by considering energy efficiency in every aspect of the product life cycle. Efficient machinery reduces the energy required for production, while implementing sustainable product design to minimise the energy consumption of the finished product, resulting in savings for both businesses and consumers. In addition, thanks to technologies such as solar panels, hydroelectricity or wind turbines, green technology helps to reduce the use of non-renewable energy sources (Calel and Dechezleprêtre, 2016). For example, hydropower is one of the first technologies utilised by mankind and has contributed greatly to reducing dependence on fossil fuels. Businesses and households save money on their energy bills by using green technology solutions.

- ✓ ***Reduces waste***

Recycling is an important green technology that helps to reduce waste and at the same time allows the recovery of raw materials that can be used to create new products. Recovered materials reduce the amount of solid waste reaching landfill sites, while at the same time reducing the need to constantly extract new raw materials from our planet. In this way, green technology helps recycling and the conservation of natural resources (Mu et al., 2022). Examples of this green technology include paper recycling, which significantly reduces the felling of trees.

- ✓ ***Improves product design and performance***

Public awareness of sustainability and environmental challenges, together with market competition, has led to increased interest in efficient and sustainable designs. The development of efficient and sustainable designs improves not only product performance but also manufacturing processes, material selection and design methodologies. Modern product design leverages innovative technologies such as digital twin and machine learning to optimise product performance, longevity, manufacturing process and life cycle (Orsatti et al., 2020). The use of green technology enables the creation of more environmentally friendly products with a lower carbon footprint. With these ever-evolving technologies, new performance and environmentally friendly targets are achieved and the digital tools used become more environmentally friendly thanks to green computing. The combined use of machine learning and digital twin minimises electricity consumption and improves product design/performance (Wang and Yang, 2021).

- ✓ ***Savings and competitive advantage***

Although the cost of switching to green technology is initially quite high, it provides significant savings and competitive advantage in the long run. The main reasons for savings and competitive advantage are that green technology is designed to use energy and resources more efficiently and to provide new capabilities. For example, thanks to solar panels, households can generate their own electricity, resulting in significant economic savings and greatly reducing environmental pollution (Stucki and Woerter, 2019).

- ✓ ***Facilitates nature-friendly agriculture***

The scarcity of fresh water on our planet is one of the biggest concerns for agriculture. Green technology benefits agriculture by developing more environmentally friendly methods for growing crops. For example, hydroponics is a green technology that benefits agriculture by helping to reduce water consumption. Through this technology, less water is used compared to the amount required in conventional agriculture, making it more efficient to grow crops. Another green technology that can provide a solution to the freshwater problem is wastewater

recycling systems. With these systems, water is recovered without the need for new freshwater resources. This method is suitable for urban, industrial and agricultural use (Obobisa et al., 2022).

- ✓ ***Reduces air pollution***

Traffic and industrialisation are the main factors causing air pollution in urban areas. The use of green technologies such as hybrid and electric vehicles is encouraged to reduce air pollution in cities. When the power required for the operation of vehicles is provided from renewable and clean sources and electrification of transport technologies is realised, it will be possible to reduce air pollution (Naqvi et al., 2022). Another green technology that helps to reduce air pollution in cities is sustainable urban design. Through sustainable urban planning and design, it is possible to increase green areas with trees and improve air quality (Wicki and Hansen, 2019).

- ✓ ***Reduces carbon footprint***

The accumulation of greenhouse gases in the atmosphere causes climate change to be felt much more severely. The way to prevent this change, which makes it difficult to grow agricultural products, negatively affects human life and leads to the deterioration of the natural balance, is to reduce the carbon footprint. From green energy to recycling and more rational use of natural resources, green technology plays a major role in reducing the carbon footprint (Zhang and Fu, 2022). Many new green technologies are being developed for this, from carbon capture and storage to biogas. Using renewable energy sources, protecting/increasing green areas and carrying out the recycling process efficiently help to reduce carbon emissions. Another issue where green technologies can help reduce carbon footprint is that many industries voluntarily offset their carbon emissions by purchasing carbon credits (Du et al., 2019b).

4. Conclusion

Green Technology, represents environmentally friendly technology that reduces ecological harm caused by chemicals and machinery for human benefit. These systems support the use of renewable, carbon-neutral energy sources and aim to prevent greenhouse gas emissions. Green innovations ensure no environmental degradation occurs. Furthermore, green technologies assist in addressing a wide range of public policy issues, from fundamental to complex.

Green technology, also referred to as sustainable technology or sustainable energy, is defined as technology that is eco-friendly, designed and used in ways that do not damage the environment and conserve natural resources. The objective of green technologies is to meet societal needs while preserving the natural resources of the planet. The aim is to address present requirements without compromising quality, focusing on the development of materials that can be completely recycled or reused. Minimizing waste and emissions by changing production and consumption patterns is a key focus of green technology. It's essential to develop alternatives to assess the health impacts, as well as the advantages and limitations of green technology. Recent studies have investigated the implementation of green technology across various sectors and its effects. The findings suggest strategies for achieving sustainable development and its importance for the future. The research concludes that the role of green technology as a crucial component of the clean energy sector in the sustainable technology movement is paramount. Embracing green practices is vital to mitigate the current environmental challenges.

For monitoring sustainable development and green growth, nations require clearly defined action plans and metrics. Transitioning to green technology is intended to balance global advancements aimed at enhancing people's well-being and societal wealth, while reducing environmental impacts. A particularly attractive aspect of green technology is its ability to enable individuals to lead a lifestyle that is more in harmony with the environment. Green

technology encompasses a broad array of devices, enabling everyday life to be conducted with greater environmental awareness. The following steps and recommendations can be considered to implement green technology:

- Education and Awareness: Educational programmes and campaigns should be organised to inform the public about the importance and advantages of green technology. This encourages individuals and businesses to make more sustainable choices.
- Transition to Renewable Energy Sources: Reduce dependence on fossil fuels by utilising renewable energy sources such as solar, wind and hydropower. This will help reduce greenhouse gas emissions.
- Improving Energy Efficiency: Raise energy efficiency standards for buildings, lighting systems and electronic devices. Using energy efficient appliances will both reduce costs and reduce the impact on the environment.
- Sustainable Transport: Encourage the use of electric and hybrid vehicles, improve public transport systems and invest in alternative modes of transport such as bicycle lanes.
- Waste Management and Recycling: Improve waste management and promote recycling programmes. Composting organic waste and separate collection of recyclables can reduce environmental impact.
- Green Buildings and Ecological Design: Construct environmentally sensitive buildings by using sustainable materials and implementing energy-efficient designs.
- R&D Investments: Investing in research and development activities in the field of green technology enables the development of new and more effective solutions.
- Government Policies and Incentives: It is important for governments to provide tax breaks, subsidies and other incentives to encourage the transition to green technologies.
- Sustainable Agricultural Practices: Adopting methods to increase agricultural productivity without harming the environment helps conserve natural resources.
- Public Participation and Co-operation: Cooperation and coordination between governments, business and civil society organisations is necessary for the successful implementation of green technology.

These recommendations can form a basic roadmap to ensure effective implementation of green technology and contribute to environmental sustainability.

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Polymathic Approach Enterprise Transformation Projects- Extracting and Improving Business Models

Antoine Trad[1]

Abstract

A Polymathic Enterprise Transformation Projects (PETP) need an adapted and automated Extraction and Improvement of Business Models (EIBM) mechanism. The EIBM supports and ensures Enterprise's Architecture (EA) Business and Financial Coherencies (EABFC) which are very important for the enterprise's business survival, sustainability, and operational validity. Knowing that PETPs are complex and most of them fail because of various types of problems and complexities, like the lack of cross-functional analysis and design, Polymathic EA, EIBM, and EABFC capabilities. For the EIBM based EAAC, the author adapts and presents the Applied Holistic and Poly-Mathematical Model (AHMM) for EIBM based PETPs (AHMM4PETP). The EIBM primarily needs a successful finalization of the Multi-Dimensional Enterprise Unbundling for Business Process(es) for PETP (MDUP4PETBP); where the MDUP4PETBP needs many years of iterative and coherent transformation processes. This research article and associated experiment are a part of the author's Research and Development Project (RDP) and is another brick or linear continuation of his previous articles and works, which main's aim is to offer an uncommercial Polymathic transformation framework; and it also includes the latest version of such a framework and different topics related to EIBM based EABFC, and PETPs.

Keywords: PETP, Cartography, Business Transformation Processes, EDC based EAAC, Unbundling and Refinement, Enterprise Architecture, Development and Operations, Decision Making Systems, and Knowledge Management Systems

1. Introduction

There are many PETP complexities and are they are related to the: 1) Incoherent usage of commercial products; 2) Simplistic gap/ statuses' evaluations; and 3) Incapacity to automate the generation of PETP's cartography… That is why there is a need for an In-House Implemented (IHI) methodology and framework for a PETP, to counter such problems and complexities. IHI based PETP solutions take time to become mature and the EDC based EAAC (EDCbEAAC) propose a credible concept that is based on:

- Defining the skills' set and PETP profiles; and their respective interactions.
- The AHMM4PETP that is based on an on original mixed -method that uses qualitative holistic reasoning-tree(s) which can call quantitate functions [1].
- The application of the Technology Common Artefacts Standard (MDTCAS).
- The MDUP4PETBP and its embedded Refinement Processes (RP) [28,34].
- EDC's basic components like the DataBases (DB) or Relational DBs (RDB).
- The EDCbEAAC integration in PETPs.

The EDC's RP is a set of unbundling actions that are done on the legacy or transformed Information and Communication System (ICS), to automatically update the EAAC and enable a successful PETP. An enterprise (simply an *Entity*) is a set of oorganizational Units (simply a *Unit*), and each *Unit* owns a *Unit* Dedicated Platform(s) (UDP). The MDUP4PETBP refines *Unit's* structure, UDP(s), and all related resources [28,34]. The AHMM4PETP checks PETP's iteration's integrity [1], where the PETP can be used in any APplication Domain (APD). The MDUP4PETBP unbundles *Entity's* functions and structure(s) into Building Blocks (BB) which can be to reused to (re)engineer/transform the *Entity*, ICS, and *Units* (and its UDPs). *Units* can be (re)assembled, checked, and interrelated by the AHMM4PETP, to deliver a new transformed and more efficient *Entity*. As already mentioned, PETP's are complex and they depend on

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MDUP4PETBP's successful termination(s) [2]. To apply the EDCbEAAC the MDUP4PETBP must be terminated and the legacy ICS(s), *Units* and UDPs are transformation ready. An IHI MDTCAS is needed to enable the interfacing of MDUP4PETBP's elements [34]: BBs, Composite BBs (CBB), Organizational BBs (OBB), and Micro-Artifacts (MA) (simply *Blocks*). The EDC is applied to automate the extraction of EA (and other design) models and cartographies from various *Entity's* and ICS' parts, *Blocks*, and components like: 1) Networks and nodes; 2) Various types data-sources (like DBs/RDBs); 3) Applications, software parts/components and libraries; 4) Methodologies, like the: Unified Modelling Language (UML), Archimate language, Object Oriented Methodology (OOM), and other; 5) Interfaces, Gateways, Application Programming Interfaces (API), and other; 6) Processes, Scenarios, Transactions, and other; 7) Security, Governance, Audit, and other; 8) Actors, delimiters, or other; 9) Decision Making System (DMS), Knowledge Management System (KMS), or other; 10) Control, Monitoring, Tracing, or other; 11) Applications and data services; and any other ICS' parts; and 12) Functional and unfunctional requirements…

PETPs and their processes like the EDCbEAAC are of strategic importance and thy can guarantee the *Entity's* long-term business sustainability, but such transformations are complex. Mainly due to the lack of Polymathic/cross-functional skills and concepts like the EDCbEAAC and can be defined as a highly Polymathic concept; which has to be implemented in all ICS's levels. It is highly Polymathic because it combines various domains related to EA, RP, *Entity's* (re)organization, project management/audit, societal changes, business/financial, Artificial Intelligence (AI), and complex contexts, AHMMs, and other [30]. This article needs to prove the applied Research and Development Project's (RDP) for PETP's (RDP4PETP) feasibility by using a Proof of Concept (PoC).

2. The RDP4PETP

2.1. A Polymathic Reseach Model

PETP's main aim is to identify, evaluate, and assess strategic, and critical risks and to assure *Entity's* activities, by using the AHMM4PETP. For a specific PETP requirement (and its related problem type), the AHMM4PETP based DMS uses an initial set of Critical Success Factors (CSF), Critical Success Areas (CSA) Key Performance Indicators (KPI), and embedded concrete ICS variables (simply *Factors*). These *Factors* are used by an IHI Heuristics Decision Tree (HDT). The Polymathic RDP4PETP maps *Factors* to requirements and the generated sets of *Blocks* [30]. All RDP4PETP steps are shown in Fig. 1, in which the unbundling and transformation of legacy *Unit's* and ICS components results in sets of *Blocks* which support the PETP. And in this article the focus and emphasis are on the Viewpoint "C".

The PETP's and EDCbEAAC's author's related articles and works are: 1) Using Applied Mathematical Models for Business Transformation [11]; 2) Applied Holistic Mathematical Models for Dynamic Systems (AHMM4DS) [1]; 3) Business Transformation ETPs-The Role of a Transcendent Software Engineering Concept (RoTSEC), [12]; 4) Business Transformation ETPs-The Role of Requirements Engineering (RoRE) [13]; 5) Business Transformation ETPs based on a Holistic Enterprise Architecture Pattern (HEAP)-The Basic Construction [14]; 6) Integrating Holistic Enterprise Architecture Pattern-A Proof of Concept [15]; 7) A Transformation Framework Proposal for Managers in Business Innovation and Business Transformation ETPs-Intelligent atomic building block architecture [16,17]; 8) A Transformation Framework Proposal for Managers in Business Innovation and Business Transformation ETPs-An Information System's Atomic Architecture Vision [16,17]; 9) Organizational and Digital Transformation ETPs-A Mathematical Model for Building Blocks based Organizational Unbundling Process [4]; 10) RDB based ETPs [9]; and many others.

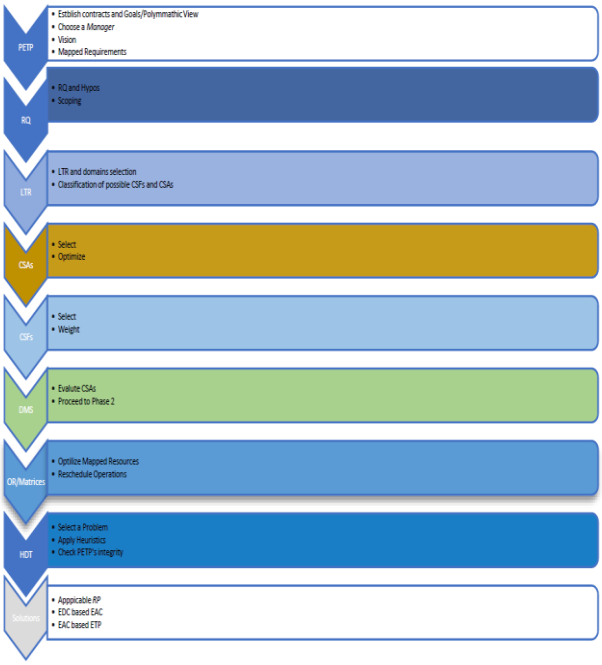

Figure 1: The RPD4PETP phases.

The first RDP4PETP's phase (or step), establishes the Research Question (RQ) and achieves an in-depth Literature Review Process (LRP) for the PETP (LRP4PETP).

2.2. The RQ and the LRP4PETP

The RDP4PETP's RQ is: "Can the PETP, EDCbEAAC, support *Entity's* transformation and automatically EA cartographies and artefacts?". Where this article's auxiliary RQ is: "How can the PETP support the synchronization of various EA domains by using automated cartographies?". Knowing that the RDP4PETP uses EA, ICS/RDB related concepts, AHMM4PETP, Transformation Research Architecture Development framework (*TRADf*), and an adapted KMS/DMS. The EDCbEAAC uses an adapted EA and related cartography technics, which is the Transformation Development Method (TDM). LRP4PETP's in-depth checking and analysis showed that are no Polymathic and similar concepts/approaches that use: IHI Transformation Framework (IHITF) (like *TRADf'*), MDUP4PETBP generated *Blocks*, AHMM4PETP, RDP4PETP, and EDCbEAAC... Actually, there are practically no relevant scholar resources that can be associated to basic PETPs and EDCbEAAC. Therefore, the this article and the author's related works, are pioneering, innovative and cover an important PETP gap. PETP related gaps and high failure rates were confirmed by the LRP4PETP [18]. Today, there is an immense lack of Polymathic-holistic approaches to PETPs and to EAACs. The LRP4PETP uses the following resources: 1) Articles and resources related to EAAC, EDC, RP, ICS reengineering, and PETP's; 2) The author's RDP/LRP works, and *TRADf'*; 3) PETP's feasibility; 4) Initial sets of CSAs/CSFs; and 5) RDP4PETP's use of the Empirical Engineering Research Model (EERM). The RDP4PETP proved the existence of an immense gap and the necessity to deliver PETP solutions and recommendations. The gap is due that there nothing similar to the proposed approach; but there are some basic approaches that concern exclusively basic EA concepts.

2.3. The EERM and RDP4PETP Phases

RDP4PETPS' phases are: 1) Phase 1 (represented in decision-Tables), forms the empirical part of the RDP4PETP; which checks this article's CSAs, which are: a) The RDP4PETP, which is synthesized in Table I; b) The EDCbEAAC's initial setup, which is synthesized in Table II; c)

The MDUP4PEP finalization; d) Advanced management and the Etalon Mapping Bus (EMB) which can be partially based on the Etalon RDB's (ERDB) integration-and Solutions, which is synthesized in Table III; d) Automated cartographies, which is synthesized in Table IV [9]; and f) This article's RDP4PETP outcome, which is synthesized in Table V. *TRADf'* supports the PETP to be finalized and the RDP4PETP to deliver a set of (managerial and EA/technical) recommendations, concepts, solutions, and an adapted strategy; and 2) Phase 2, solves a concrete EDCbEAAC problem instance, by the use of the of *TRADf'* and HDT. RDP4PETP's usage of EERM, is optimal and *TRADf'* applies a multi-level mixed-research by applying the HDT; which is very different from conventional mainly quantitative research models, and it includes [19,20]: 1) Heuristics-Basic reasoning (the HDT); 2) Quantitative Analysis for PETP (QNT4PETP); 3) Qualitative Analysis for PETP (QLT4PETP) research methodologies, to deliver empirical concepts as a possible approach for complex mixed-methods research concepts; and 4) An HDT based Learning Process, which was mainly inspired by Action Research (AR) learning processes. The AHMM4PETP simulates functions to support PETP's empirical actions and the HDT based DMS/KMS.

2.4. The AHMM4PETP

AHMM4PETP's nomenclature is presented in a basic form to be understandable by the valuable readers and researchers. The EDCbEAAC uses the AHMM4UP that is formalized as follows:

- ICS Unbundling actions = supports MDUP4PETBP operations, Implementation activities, and finalizing the UDPs.
- EAAC sets = ∑ EA models (from EDC, ICS, *Blocks*, and its infrastructure/networks)
- PETP parts = ∑ UDP (for the ICS, *Blocks*, and its infrastructure/networks).
- EMB4(Categories) = Transformation of PETP's parts + the defined goals of PETP operations.
- PETP(Iteration) = includes PETP's parts + ∑ EMB4(Categories).
- AHMM4PETP(APD) = ∑ PETP(n).
- TDM(APD) = TDM + EAAC sets + AHMM4PETP(APD).
- PETP = TDM(APD) + GapAnalysis(Iteration).

2.5. The RDP4PETP Factors' Evalutions

Table 1: This CSA's average is 9.63.

Critical Success Factors	KPIs	Weightings
CSF_RDP4PETP_Polymathic_Approach	Proven	From 1 to 10. **10 Selected**
CSF_RDP4PETP_Factors_Integration	Proven	From 1 to 10. **10 Selected**
CSF_RDP4PETP_ MDUP4PETP_Integration	Complex	From 1 to 10. **08 Selected**
CSF_RDP4PETP_EERM	Feasible	From 1 to 10. **09 Selected**
CSF_RDP4PETP_AHMM4PETP_Usage	Feasible	From 1 to 10. **09 Selected**
CSF_RDP4PETP_EDC/EAC_Concepts	Complex	From 1 to 10. **08 Selected**
CSF_RDP4PETP_IHITF_TRADf	Possible	From 1 to 10. **09 Selected**
CSF_RDP4PETP_LTR4PETP	Proven	From 1 to 10. **10 Selected**

a. valuation

Based on the AHMM4PETP, LRP4PETP and KMS/DMS, for this CSA's CSFs/KPI were weighted and the results are shown in Table I. This CSA's result of 9.63, which is very high, and that is due to the fact that the EDCbEAAC simplifies RDP4PETP and it is possible to be implemented. And the next step is to analyze EDCbEAAC's initial setup.

3. EDCbEAAC's Initial Setup

3.1. Main Objectives

EDCbEAAC's setup needs the following set of actions: 1) That the MDUP4PETBP was successful and the resultant *Blocks* are integration ready; 2) Implement an IHITF and IHI MDTCAS; 3) To use the confirmed EA and an Architecture Development Method (ADM) based TDM [3]; 4) Implementing an EMB which can be an ERDB to support basic mapping operations [9]; 5) Enable EDC operations; and 6) Offer a coherent EDCbEAAC.

3.2. MDUP4PETBP's Succeful Termination and MDTCAS

The MDUP4PETBP is a set of RPs, which disassemble Legacy *Units*', Organizational administration's, Resources', Applications', and ICS components; into *Blocks*. RPs need to define the right levels of granularity and mapping concepts [4,34]. The IHITF supports the PETP, ADM based TDM, and MDTCAS [3]; and te TDM manages PETP's activities and the EMB supports future APD's activities that includes the EDC. *Blocks* based EAAC can be used in APD modelling activities, which needs Polymathic approach [5]. The AHMM4PETP enables RPs by using the MDTCAS and TDM to integrate standard methodologies, like The Open Group's (TOG) Architecture Framework (TOGAF) and its ADM [3]. Where MDTCAS is a combination of methodologies and concepts like: OOM, UML, structured legacy methodologies (like the Structure Analysis and Structured Design-SA/SD), Archimate, Decision Making Notation (DMN), Entity Relationship Diagrams (ERM), and Process/collaboration Models (UPM), /Business Processes (BP) and their Models (BPM), and others. For all mentioned the methodologies and concepts, the OOM can the fundament for the MDTCAS and *Blocks'* design, as is shown in Fig. 2.

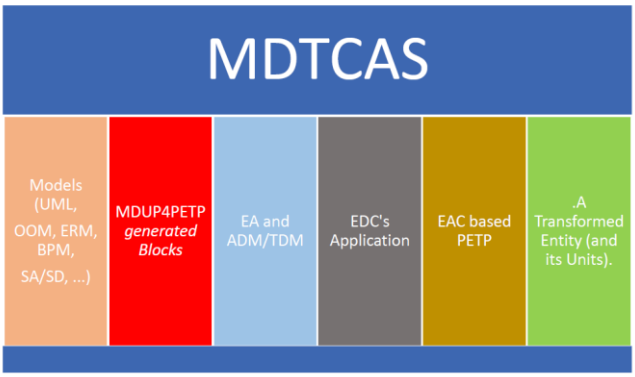

Figure 2: The IHI MDTCAS.

The EDCbEAAC supports all PETP's EA and design operations, like the case of generation of EA diagrams, catalogues, and matrixes. *Factors* based risks mitigation controls are integrated by using the ADM based TDM, which supports it in the automation of EDC's generation activities. The PETP is agnostic to any specific APD and methodology/technology independent. The EA and TDM map to *Entity's* and PETP's cartography of applications. Where applications are classified as follows: 1) Classifications can be done by EA capacities like TOGAF's Application Communication Diagram (ACD), which depicts its used models and mappings related to communications between applications and modules, in form an *Entity's* metamodel. It presents applications, components, and interfaces (between various components); 2) Interfaces may be associated with data classes, applications can be related to *Blocks*; 3) ACDs can represent an existing applications' cartography, or a logical architecture of the transformed end-system. *Blocks* based EAAC is privileged; 4) *Entities* have hybrid (mixed) applications, EMB compatible repositories and new *Blocks*-based EAACs; 5) In the case of using *Blocks*

based application components, should be structured according to their nature and their EA level; 6) *Blocks* based components are related by services, which use connectors; 7) A dimension of the applications' cartography should be dedicated to TDM's usage; 8) An EMB can generate PETP's application's cartography; and 9) As shown in Fig. 3, the EA/TOGAF's like the EAAC concept are layered, and the interaction component layer is on top, process-based components in the middle, and entity components on the bottom. The TDM superposes existing architecture standards, like TOGAF, as shown in Fig. 4. *TRADf* is a tailored adoption of TOGAF, by using EDCbEAAC and MDTCAS. The EA concept has the following layers: Business Architecture; Data Architecture; Application Architecture; and 4) Technology Architecture [3,4,6].

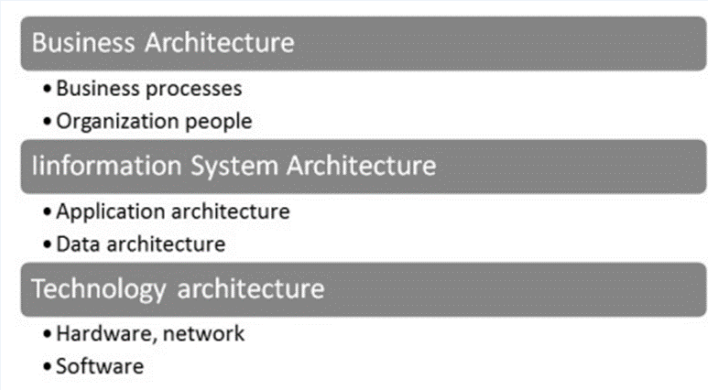

Figure 3: The used EA and EAAC concepts are layered.

3.3. The IHITF and the EMB

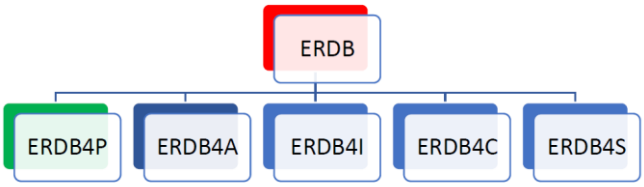

Figure 4: The ERDB [9].

The IHITF (like *TRADf*) supports PETPs and avoids expensive external products. The EMB can use the ERDB (or other mapping mechanisms) to enable persistence activities like [7,8]: Multidimensional conceptual viewing, Accessibility, Generic Dimensionality, Unrestricted cross-dimensional operations, and EDCbEAAC's interfacing. There are various viewpoints and concepts that abstract EAACs by using an ERDB [9].

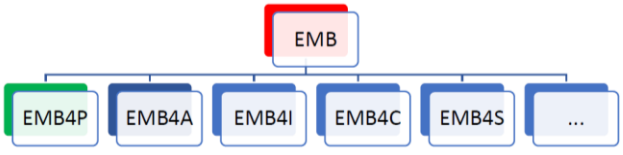

Figure 5: The EMB.

As shown in Fig. 4, the ERDB is used to abstract and interface/map the following various ICS categories and components like [9]: 1) ERDB for Platforms (ERDB4P), which includes: Networks, DBs and nodes; 2) ERDB for Applications (ERDB4A), which includes: Applications, Software (components and libraries), BPs/Scenarios, Transactions, Methodologies (like UML, Archimate, OOM, and other); 3) ERDB for Interfaces (ERDB4I): Interfaces, Gateways, API, Actors, Delimiters, and other; 4) ERDB for Control (ERDB4C): Security, Governance, Audit, Monitoring, Tracing, or other; and 5) ERDB for intelligent

Systems (ERDB4S): like DMS, KMS, BPM based systems, or other. The EMB as shown in Fig. can use the ERDB (and its subcomponents) but it also uses many other features.

3.4. The EDCbEAAC Initial Setup Factors' Evalutions

Based on the AHMM4PETP, LRP4PETP and DMS, for this CSA's CSFs/KPI were weighted and the results are shown in Table II. This CSA's result of 8.80, which is in a comfort zone, and that is due to the fact that setup is feasible. And the next step is to integrate the MDUP4PETBP.

Table 2: This CSA's average is 8.80.

Critical Success Factors	AHMM4CBB enhances: KPIs	Weightings
CSF_Initial_Setup_Unbundling_Termination	Complex	From 1 to 10. **08 Selected**
CSF_Initial_Setup_MDTCAS_Implementation	Feasible	From 1 to 10. **09 Selected**
CSF_Initial_Setup_TDM/ADM/EAAC	Feasible	From 1 to 10. **09 Selected**
CSF_Initial_Setup_IHITF	Feasible	From 1 to 10. **09 Selected**
CSF_Initial_Setup_EMB_Setup	Feasible	From 1 to 10. **09 Selected**

valuation

4. THE RP BASED MDUP4PETBP

4.1. Viewpoints

The MDUP4PETBP are (re)used *Blocks* in *Unit's* UPMs to reorganize the *Entity* [35]. As shown in Fig. 6, PETPs depend on *Entity's* structure which need MDUP4PETBP's feasibility and the application of selected Viewpoints. The PETP has various types of Viewpoints, like: "O" for Organizational, "S" for Security, "F" for Financial, "I" for Integrity checking, "C" for EA's Cartography … The PETP is primarily Viewpoint "C"; and "O" as the second objective.

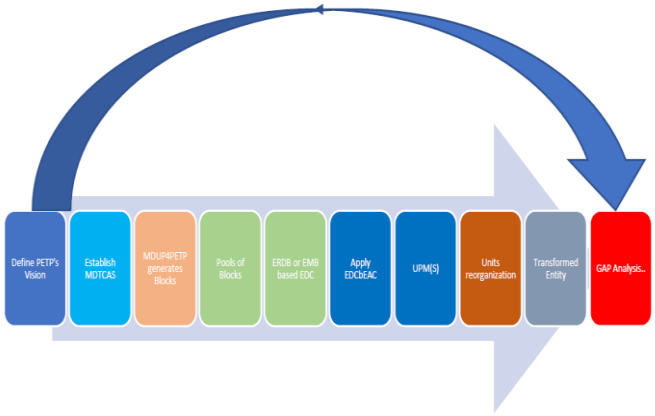

Figure 6: PETP's phases.

The EMB based EDCbEAAC needs IHI solutions and concepts can be iteratively built without colossal investments on external commercial products. The EDCbEAAC concept tries to show it can support an PETP which adopts a Polymathic-holistic approach.

4.2. EMB for Platform's

The EMB for Platforms (EMB 4P) serves the PETP by reflecting the status of the progress of the transformation of various ICS components or elements like the following ones: Networks, (R)DBs, and platform nodes. The EMB4P can use the ERDB4P [9]. The EMB4P is used for EDCing ICS's hardware components like: Integrated Network Management System (NMS) that provides the interfaces between all functions of the NMS and ICS' nodes. The EMB4P manages the needed levels of availability and delivery of needed information. The EMB4P

enables interfacing of any type of data-source [10]. The management of NMS' data-source, support the persistence of ICS' activities.

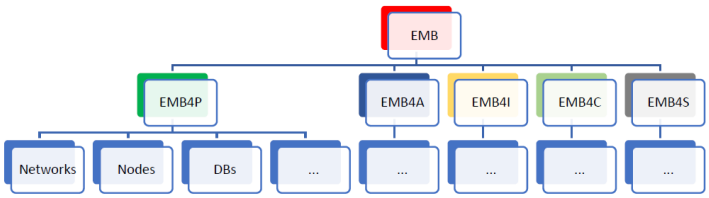

Figure 7: The EMB4P.

4.3. Setting up the EMB4A

The EMB4A as shown in Fig. 8, serves the PETP by reflecting the status and progress of the transformation of various ICS components or elements like: Applications, Libraries, BPs/Transactions, Methodologies, and other. The EMB4A uses concepts, which various persistence concepts, like standard data access operations. EAAC artefacts can be mapped to MDTCAS equivalents and then persisted.

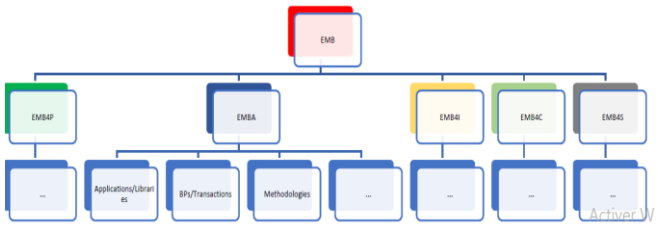

Figure 8: The EMB4A.

4.4. Setting up the EMB4I

The EMB4I as shown in Fig. 9, serves the PETP by reflecting the status of the progress of the transformation of various ICS components or UDP elements, like: Interfaces, Gateways, APIs, Actors, Delimiters, and other. The EMB4I use existing persistence concepts, like API Platforms (APIP). Which is a platform that supports the access, distribution, control, and analysis of APIs, that are used by PETP engineers. APIPs benefit EDCbEAACs by centralizing API's management [21]. EDCbEAAC's interfacing and mapping is done by the MDTCAS.

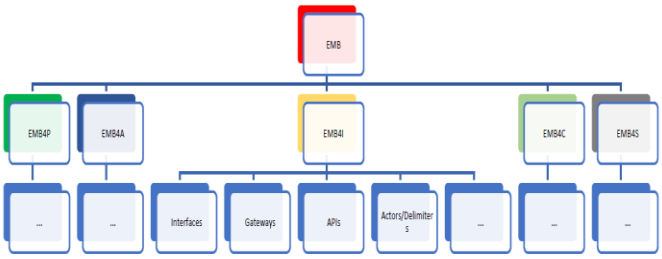

Figure 9: The EMB4I.

4.5. Setting up the EMB4C

The EMB4C as shown in Fig. 10, serves the PETP by estimating the statuses of the transformation of various ICS and UDP components (or elements) like: Security, Governance, Audit, Monitoring, Tracing, and other. The EDCbEAAC uses EA and TDM, which facilitate Sherwood Applied Business Security Architecture's (SABSA) integration [8]. That supports security, which depends on *Entities* and the selected CSFs, and there are established sets of best practices that can influence the EMB4C, like the ones offered by the National Institute of Standards and Technology (NIST). The NIST has created the necessary steps for an *Entity* to self-assess its ERDB4C preparedness and to apply adequate control measures. These principles are built on the NIST's five pillars of a security framework. Another framework that can be used by the EMB4C, is the Cloud Security Posture Management (CSPM) which is designed to tackle common ICS flaws [22]. The use of control frameworks, like SABSA, facilitates to ERDB4C interfacing.

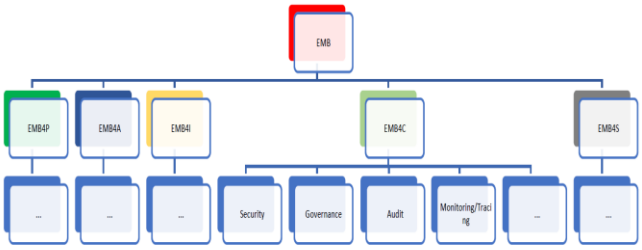

Figure 10: The EMB4C.

4.6. Setting up the EMB4S

The EMB4S as shown in Fig. 11, serves the PETP by reflecting the status of the progress of the transformation processes related to ICS and UDP components (or elements) like: DMS, KMS, BPM based systems (BPMS), and other. The BPMS manages tasks and processes related to the ICS; and it includes: 1) A BPM designer and implementer; 2) A BP instances engine that manages BP tasks; 3) BPM and data management tools; and 4) A PETP reporting engine for monitoring BP and services activities. The BPMS supports BPMs' implementation by the ICS team(s) [23]. The EMB4S artefacts can be mapped to the MDTCAS.

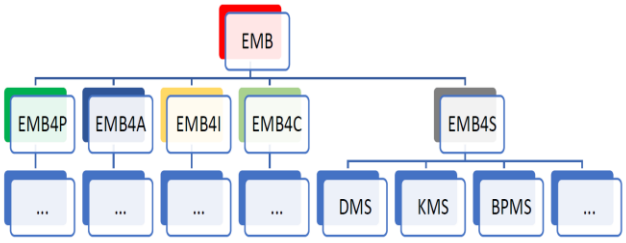

Figure 11: The EMB4S.

4.7. Other EMB Possibilities-Asset Management

The EDCbEAAC can use the *Entity's* alignment of its assets or the Enterprise Architecture Methodologies (EAM), which uses [36]: An EAM concept, ICS' integration, Legal/ governance aspects, Financial background, and a holistic (centralized) EAM. EAM's integration is complex and needs and integration and EA pattern that uses: 1) Information Technology Asset Management (ITAM); 2) Hardware Asset Management (HAM); and 3) Software Asset Management (SAM). There are commercial tools like the Oracle SAM… The problem lies in

integrating commercial tools in the ICS, might create an unmanageable ICS and UDP hairball. Building the right EDCbEAAC can enable and EAM and vice versa.

4.8. Other EMB Possibilities-Enterprise Data Management (EDM)

The EDCbEAAC can use Cloud Platforms (CP) data management capacities, like Google's CP's (GCP) as shown in Fig. 12: Cloud Bigtable, Cloud Data Fusion, Cloud Data Transfer, Cloud Dataflow… The EDM can include [29]: 1) CP Storage for media content storage and delivery… 2) Cloud SQL mechanisms for Managing and maintenance of RDBs; 3) Usage of *Datasets* support operations use a collection of tables in the Cloud; 4) EDM can be used to support automated AI operations…

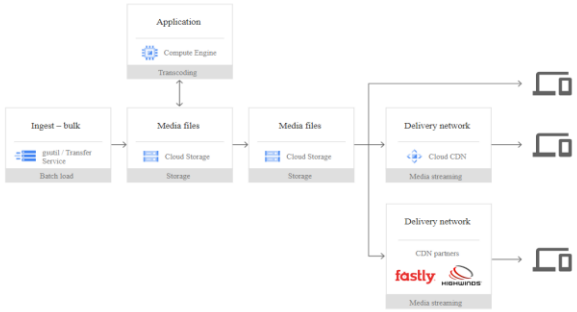

Figure 12: GCP's EDM [29].

The EDCbEAAC Initial Setup Factors' Evalutions

Based on the AHMM4PETP, LRP4PETP and DMS, for this CSA's CSFs/KPI were weighted and the results are shown in Table II. This CSA's result of 8.75, which is in a comfort zone, and that is due to the fact that setup is feasible. And the next step is to inspect advanced management.

Table 3: This CSA's average is 8.75.

Critical Success Factors	AHMM4CBB: KPIs	Weightings
CSF_Initial_Setup_MTDCAS	Feasible	From 1 to 10. **09 Selected**
CSF_Initial_Setup_EMB_P/A/I/C/S	Complex	From 1 to 10. **08 Selected**
CSF_Initial_Setup_ERDB	Feasible	From 1 to 10. **09 Selected**
CSF_Initial_Setup_EDM	Feasible	From 1 to 10. **09 Selected**

valuation

5. EDCbEAAC's Advanced Management

5.1. The APIP's Discovery and Management

APIPs and mainly REST based, as shown in Fig. 14. An APIP is a bridge that is used to access APIs and other services. EDCbEAAC can use the flows between APIP clients/interfaces and *Blocks* servers to discover EA models. And other various types models. APIP's management include DevOps lifecycle, monitoring performance, and managing patterns [14, 15, 16]. APIP's perspective enables PETPs unbundling and it publicly exposes *Blocks* with centralized governance. The EDCbEAAC has to englobe existing patterns by using the Enterprise Service Bus (ESB) Patterns (ESBP).

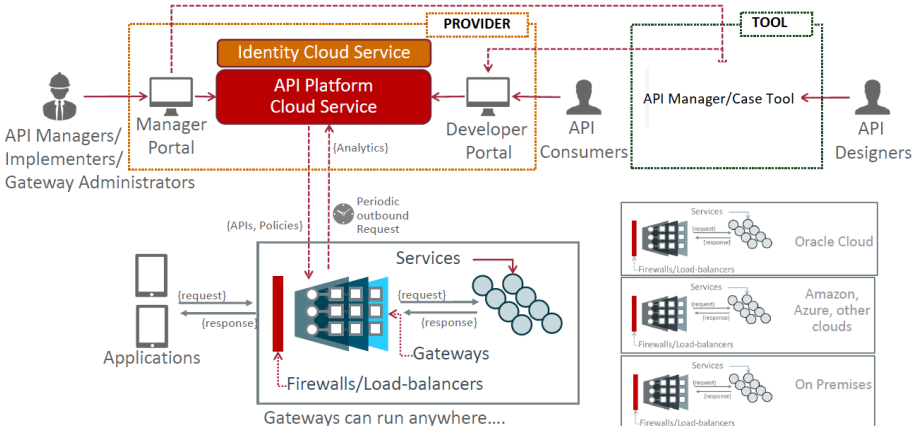

Figure 13: APIP-Provider [14,16].

5.2. Patterns Management

The EDC identifies the sets of used patterns and related *Blocks*. But there are many pattern sets like: Generic, GoF, BPM, API, SOA, ESB, Enterprise Applications Integration, Cloud Computing Design, Organizational, EA/Architecture, REST, MicroServices, Messaging, IHI Composite Patterns, and many others… The EDCbEAAC classify discovered patterns in the *Entity's* Continuum.

5.3. Continuum, Reference Models and a Meta-Model

EA (like TOGAF's) Technical Reference Model offers an interface to manage entries, like patterns. To EDCbEAAC artefacts the PETP uses existing standards and methodologies [24]. EDCbEAAC discovers analogous models, concepts and terminology, and offers a reusable holistic concept, which can support the *Entity's* Meta Model (EMM), as shown in Fig. 15. The EMM uses the Virtual Meta Model (VMM), which is an UML profile [25,26]. The EMM is an ontology for EAAC that can be based on existing EA frameworks. The EAAC integrates EA artefacts in *Entity's* Continuum, to support various Views and the TDM.

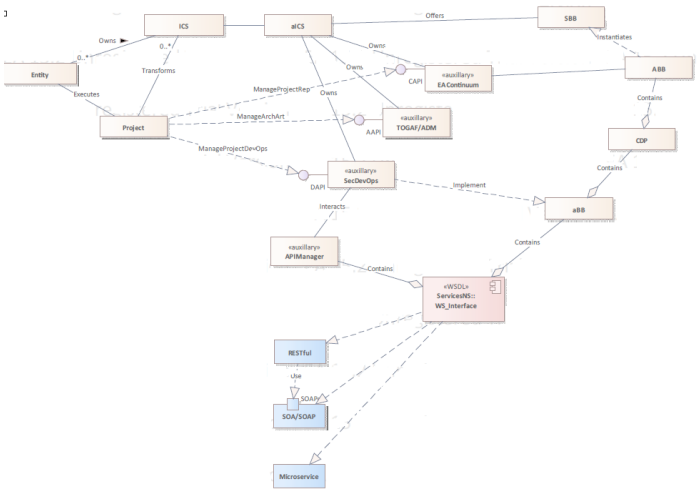

Figure 14: The EMM.

Entities can use the Strengths (S), Weaknesses (W), Opportunities (O), and Threats (T) (SWOT) to minimize EPTP risks.

5.4. Risks Management

SWOT based PETP risks' management is crucial for the implementation of risky projects and SWOT can be applied in all PETP's levels and phases. From the strategy-definition's phase, going through the requirements engineering phase, and until the implementation phase. SWOT based PETP identifies sets of *Factors*, to be used by the DMS and maps *Factors* to *Blocks* and requirements [54,55,56]. Knowing that a PETP uses an agile upstream approach that adapts to the EDCbEAAC [31].

5.5. Using Workflows

BPM or workflows manage orchestrations that use services' technologies which can apply [32]: BPM based applications; BPM are serverless, and scalable; A BPM can be executed from a client interfaces; A CP scheduler can be used to execute a BPM instance; Authentication and access controls can be used for BPMs; EDCbEAAC can generate BPM artifacts and diagrams; Can be accessible from anywhere, at any time; Supports agility and connectivity; Improves security, concerning on-premises data security; Offers business advantages and models [34,37,38].

5.6. Using Entity Logging Mechanism

A PETP implements an EMB based logging server (Logserver), to support monitoring, diagnosing, and troubleshooting activities. Such activities are key activities for the *Entity's* PETP and TDM lifecycles. The EDCbEAAC delivers messages to the Logserver and logging mechanisms adapt to PETP's requirements. The EMB supports the sending to various destinations and that needs the implementation of a logging concept [25].

5.7. EDCbEAAC Advanced Solutions Factors' Evalutions

Based on the AHMM4PETP, LRP4PETP and DMS, for this CSA's CSFs/KPI were weighted and the results are shown in Table III. This CSA's result of 9.0, which is in high result, and that is due to the fact that the EDCbAEAC's integration is possible. And the next step is to analyze cartographies' solutions.

Table 4: This CSA's average is 9.0.

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_EDCbEAAC_Advanced_Management_APIP	Possible	From 1 to 10. **09 Selected**
CSF_EDCbEAAC_Advanced_Management_Patterns	Possible	From 1 to 10. **09 Selected**
CSF_EDCbEAAC_Advanced_Management_Contiuum	Possible	From 1 to 10. **09 Selected**
CSF_EDCbEAAC_Advanced_Management_Logserver	Possible	From 1 to 10. **09 Selected**

valuation

6. EDCbEAAC Cartorgaphies Solutions

6.1. Setting up Edequate Factors

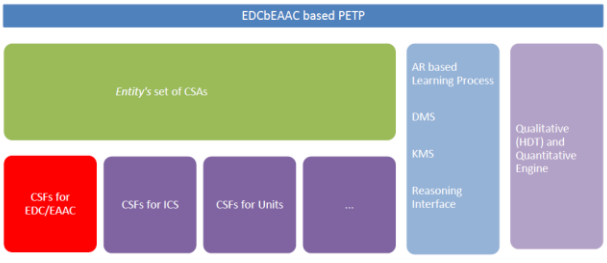

Figure 15: The Factors workflow.

As already mentioned, a CSA is a category (or set) of CSFs ich are selected by the PETP team for the EDCbEAAC, as shown in Fig. 16. A CSF is a set of KPI, where a KPI corresponds to an PETP requirement and/or feature. A KPI can be related to a software (or application) variable or EMB attribute. For a selected PETP requirement (or problem), the IHITF identifies the sets of Factors, to be processes by the HDT based DMS/KMS. These Factors also map to the MDUP4PEPTP generated *Blocks*. So the Factors are important for the mapping between the requirements, knowledge constructs, *Blocks*, Units/UDPs, ICS, and DMS/KMS [24]. Hence, Factors that meet the main strategic EDCbEAAC goal, and that is to offer measurement's technics (which are provided by *TRADf*). These technics

evaluate PETP's performance for each CSA, where CSFs can one of the following: 1) The status; 2) Mapping levels of resulting *Blocks* and EDCbEAAC outcomes; 3) Gap analysis; 4) TDM phase's integrity; and 5) DMS/KMS requests calls. KPIs can be integrated in *Blocks*, so HDT's based evaluation processes can automatically estimate the values of CSAs, and CSFs [4].

6.2. Gap's evaluations

The EMB enables Gap Analysis (GA) on various PETP parts, EDCbEAAC, and ICS components. GA will show in each TDM's phase, if there is progress or important regressions. For example, in the case of EDCbEAAC, GA can report how many EA artefacts and diagrams were automatically generated and if the PETP has a sufficient level of coherency; by using EMB technics.

6.3. Generated Reference Models and Methods

The EDCbEAAC uses the concept of Architecture Capability Maturity Models, techniques to develop IHI models. Which can include [39,40]: 1) Architecture Maturity Models, that develops *Entity's* maturity model; 2) Architecture Project Management, that supplements the ADM/TDM with Project Management and PETP techniques; 3) Architecture Skills Framework, which provides a view of needed skills for EDCbEAAC and EA; 4) Digital Business Reference Model (DBRM), that defines common core components that are needed to support *Blocks*. *Blocks* are needed for digital enterprise transformations; 5) Government Reference Model (GRM), describes APDs and their EA models. It gives the possibility to plan, implement, and execute PETP related changes; 6) Microservices Architecture (MSA), guides technics to develop, manage, and govern MSAs.

6.4. Applying the EDCbEAAC

The EDCbEAAC generates, develops, and maintains EA models; rather than just statically drawing them. The outcomes can be used by existing EA frameworks but the main problem lies in these models' maintenance, up-to-date Cartography, that is a real challenge that increases with the PETP. PETP has a long-time perspective and targets the evolution of *Entity's* ICS, IHITF, and EA frameworks/ notations. The EDCbEAAC delivers a catalogue of models, patterns, principles and methods. The EDCbEAAC generates automated cartography concepts and links them to principles. Where Enterprise Cartography (EC) design has to be linked to ICS' reality [41].

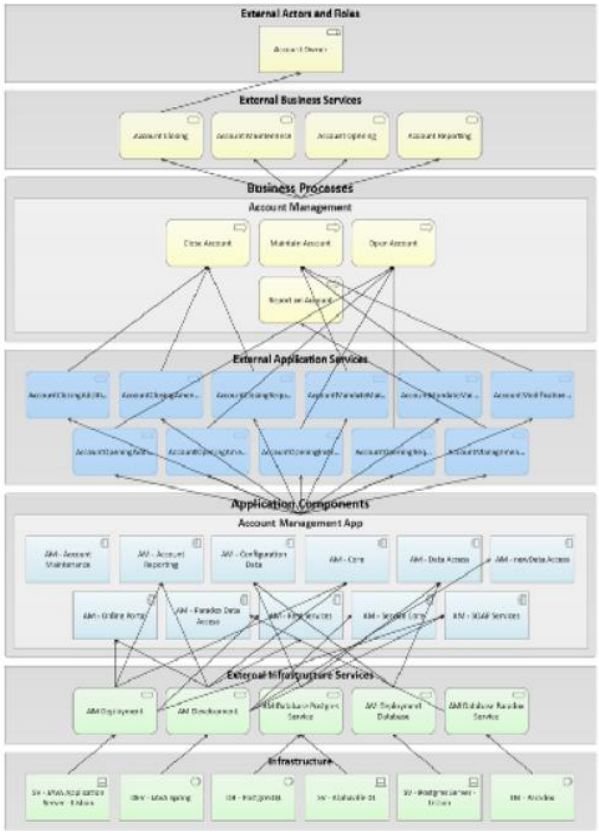

Figure 16: Generated EA map [41].

6.5. Advanced Solutions Factors' Evalutions

Based on the AHMM4PETP, LRP4PETP and DMS, for this CSA's CSFs/KPI were weighted and the results are shown in Table V. This CSA's result of 8.75, which is in a limit result, and the next step is to execute the PoC.

Table 5: This CSA's average is 8.75.

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_EDCbEAAC_Advanced_Solutions_Factors	Mature	From 1 to 10. **10 Selected**
CSF_EDCbEAAC_Advanced_Solutions_GA	Possible	From 1 to 10. **09 Selected**
CSF_EDCbEAAC_Advanced_Solutions_Generation	Complex	From 1 to 10. **08 Selected**
CSF_EDCbEAAC_Advanced_Solutions_EC	Complex	From 1 to 10. **08 Selected**

7. THE POC

7.1. Basic Preparations

As shown in Fig. 14, the first step is to prepare the PoC's environment by setting-up the Vision, MDTCAS/TDM, and extracted *Blocks* generated by the MDUP4PETBP. And afterwards start the phases of EMB's integration.

Figure 17: The PoC's basic preparation steps.

Many of this PoC's modules were already used in previous *TRADf'* related development and PoCs [4]. The MDUP4PETBP based EDCbEAAC enables automated EA modelling.

7.2. Feasibility and Integration

This PoC uses *TRADf*'s mature modules (mainly the author's previous work that is related to the EDC, EAEC, and *Blocks'* management). *Blocks* are generated and reassembled to offer an EA Transactions (ATR) artefact. The ATR artefact. The ATR artefact maps to various types of diagrams and artefacts. The ATR artefact generation proved also that the granularity level can be used to refine the "1:1" mapping [26]. A logical view of the ATR artefact is shown in Fig. 19, and its usages of *Blocks*, in the form of a universal activity diagram.

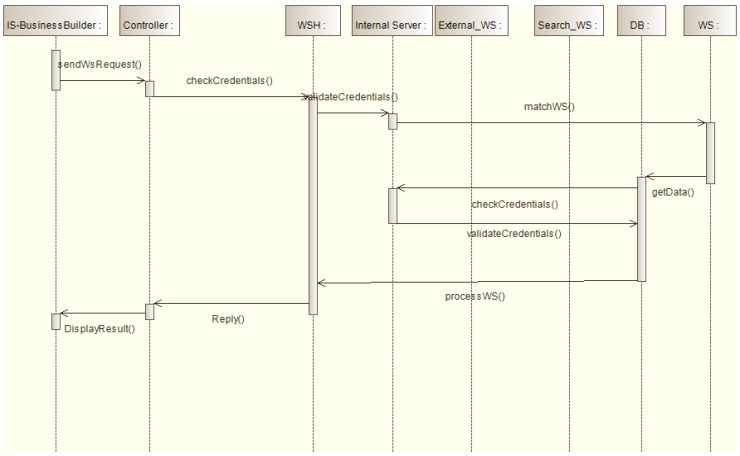

Figure 18: The ATR artefact universal activity diagram.

The ATR artefact uses a set of generated Blocks which are assembled using MDTCAS. The ADM based TDM's phases are used to integrate needed MDTCAS based ATR artefacts. A major constraint for the PoC was to adapt existing standards in a very reduced form, what corresponds to the MDTCAS. And the EDCbEAAC transcends MDTCAS and *Blocks*, to generate EA diagrams. The identified sets of Factors that are related to the RQ and PETP's integration were implemented. The PoC used the HDT's mixed qualitative/quantitative methodology. The PoC in the beginning uses Phase 1 that is mainly based on the HDT decision-tables, which use *TRADf*'s Weighting and Rating Concept (WRC). Phase 1 is used to WRC the relative importance of Factors for the usage of the EDCbEAAC and that is done using a decision-tables [27].

7.3. PoC's Phase 1

Table 6: This CSA's average is Rounded 9.0.

CSA Category of CSFs/KPIs	Transformation Capability	Average Result	Table
The RDP4PETP's Integration	Usable-Mature	From 1 to 10. 9.63	1
EDCbEAAC's Initial Setup	Transformable-Complex	From 1 to 10. 8.80	1
EDCbEAAC Advanced Management	Transformable-Possible	From 1 to 10. 9.0	1
EDCbEAAC Solutions	Transformable-Mature	From 1 to 10. 9.00	1
EDCbEAAC Cartographies Generation	Transformable-Complex	From 1 to 10. 8.70	1

Evaluate First Phase

The LRP4PETP's proved the existence of an important PETP and EDCbEAAC knowledge gaps and it's (or Phase 1's) outcome supports RQ's credibility. The use of the LRP4PETP and

TRADf's DB/archive or facts/knowledge-base, of an important set of references, previous author's works, documents, and links.

7.4. Selecting EDCbEAAC's Node

Factors (CSA/CSFs) are linked to various HDT based DMS/KMS scenarios. The PoC is based on the Factors (CSFs') binding to specific RDP4PETP resources, where the PETP was prototyped using *TRADf,* to demonstrate an IHITF. The HDT represents the relationships between this RDP4PETP's RQ/requirements, EDCbEAAC, *Blocks*, and selected Factors (CSAs/CSFs). PoC's interfaces were achieved using Microsoft Visual Studio .NET environment and *TRADf'*. The PETP uses calls to resulting *Blocks,* MDCATS, to execute HDT actions related to EDCbEAAC and EMB requests. CSFs were selected and evaluated (using Weightings, HDT, and DMS/KMS) and the results are illustrated in Table V, which shows that the DMS4PETP is feasible mainly because of EMB and EDCbEAAC maturities. In fact, it is essential for the DMS' risk concept. HDT's main constraint is that CSAs having an average result below 7.5, will be ignored. This fact, leaves the EDCbEAAC's CSAs (marked in green) effective for RDP4PETP's conclusion(s); and drops the CSAs marked in red. Phase 1, shows that the DMS4PETP will probably succeed and that the EMB and EDCbEAAC can be implemented. The PoC can proceed to Phase 2.

7.5. PoC's Phase 2

MDTCAS/TDM's Setup and CSFs' Selection

The Phase's 2 setup includes: 1) Sub-phase A or the Architecture Vision phase's goals, establishes EDCbEAAC's approach and goals; 2) Sub-phase B or the Business Architecture phase establishes DMS' target TDM and related EDCbEAAC's activities; 3) Sub-phase C shows and uses the Application Communication Diagram to describe EAACs and EMB activities; 4) Sub-phase D or the Target Technology Architecture shows the needed DMS' optimal ICS and UDPs landscapes; and 5) Sub-phases E and F, or the Implementation and Migration Planning, presents the transition EMB based EDCbEAAC, which proposes intermediate situation(s) and evaluates DMS' statuses. The HDT based DMS/KMS has mappings to *Entity's* resources and defines relationships between *Blocks, MDTCAS/Models*, MDTCAS' elements, and Requirements/Problems.

Problems Processing in a Concrete HDT Node

The DMS solves *EDCbEAAC*' Problems, where CSFs link to specific EMB or EDCbEAAC Problem type and has a set of actions that are processed in a concrete HDT node. For this goal, the action *CSF_EDCbEAAC_Extraction_Procedure* was called and delivered Solution(s). Solving Problems involves the selection of actions and possible Solutions for multiple PETP *Project* activities. The HDT is on mixed quantitative/qualitative and has a dual-objective that uses the following steps:

- In Phase 1, *TRADf's* interface implements HDT scripts to process the selected CSAs. And then relates PoC's resources to *CSF_EDCbEAAC_Extraction_Procedure*.
- The DMS/KMS is configured to weight and tuned to support the HDT.
- Link the selected node to HDT to deliver the root node.
- The HDT starts with the *CSF_EDCbEAAC_Extraction_Procedure* and proposes Solution(s) in the form of ERDB actions/improvements.

Solution Nodes

HDT scripts support AHMM4PETP's instance that are processed in the background to deliver *EDCbEAAC* risk value(s). The AHMM4PETP based DMS uses *Blocks* and the EDCbEAAC to deliver concrete actions.

8. Conclusion

Legacy ICS' unbundling is complex and causes failures and success rates can be improved by using *Blocks* based MDTCAS, EMB, and EDCbEAAC.

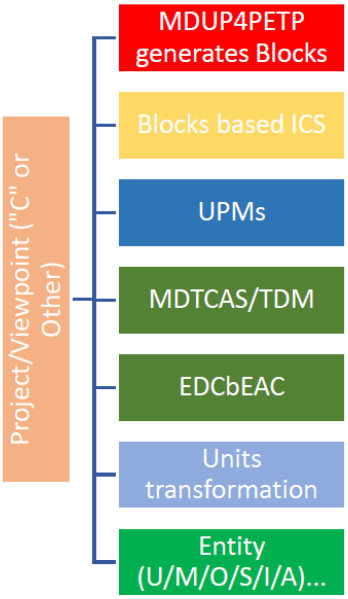

Figure 19: RDP4PETP's similar Factors' flow [22].

EDCbEAAC uses an optimal concept and the PoC proved its application's complexities and possibilities. The EDCbEAAC support *Units* based UDPs and *Entities* and the proposed ERDB is an optimal approach for unifying implementation, integrity checking, and feasibility activities. The EDCbEAAC supports transformation activities; and the LRP4PETP presented a knowledge gap, that is mainly due to the fact that are no similar research approaches and that there is a lack of a Polymathic-holistic approach. The RDP4PETP is a part of a series of publications on PETP's, EDCbEAAC, ADM based TDM, Polymathic EA models… The EDCbEAAC uses the HDT and Factors to support EMBs activities. PoC's Table V result of (rounded) 9.0 that used CSFs' binding to RDP4PETP resources, EDCbEAAC categories, RQ, MDTCAS, shows that the EDCbEAAC is feasible due to EMBs' maturity but the EDCbEAAC is risky. The set of *EDCbEAAC*'s architecture, refinement, technical and managerial recommendations [28]:

- PETP's are important for insuring long-term sustainability and transformational excellence.
- This article presents the possibility to implement the EDCbEAAC and IHI MDTCAS which avoids the financial-only locked-in strategies and ensures PETP's' success.
- The PETP concept adopts a Polymathic-holistic approach, which used iterative change and implementation phases.
- The EDCbEAAC proposes a realistic solution that is based on RDB to transform *Entities*.
- Each *Entity* constructs its own IHITF.
- MDUP4PETBP is PETP's most critical phase.
- The MDUP4PETBP unbundles the legacy-ICS into *Blocks* to support *Unit*'s *UDPs* and the *Entity*.
- *Unit*'s transformation needs an IHI Methodology, Domain, and MDTCAS that manages *Blocks* and EA *Models*.

- An PETP must implement a TDM and MDTCAS to support EDCbEAAC [2]activities.
- The MDTCAS based ERDB fits in the TDM.
- TDM's integration in the EDCbEAAC enables the automation of all EMB's activities.
- EDCbEAAC interface *Entity's* TDM and delivers the pool of *Blocks* based EMB categories.
- EDCbEAAC is *feasible* and will very probably succeed mainly due to EMBs' maturity and cross-functional capabilities.
- Viewpoints "M", "O", "S", and "I" present a structured evolution's roadmap, as shown in Fig. 18. And in this article the focus is on Viewpoint "C".
- All author's works are based on *TRADf*, AHMM, EDCbEAAC, ADM based TDM, and RDP; which are today mature and can be applied in various APDs.
- The EMB can use various technologies and concepts to unify EDCbEAAC.

Acknowledgment

This research article findings presented above were supported by TRADf.

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