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PREFACE

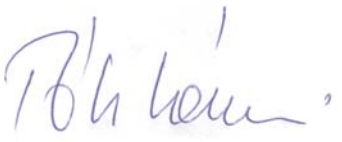
In the name of the Committee of Agricultural and Biosystem Engineering of the Hungarian Academy of Sciences we would like to welcome everyone who is interested in reading our journal. The Hungarian Agricultural Engineering (HAE) journal was published 33 years ago for the very first time with an aim to introduce the most valuable and internationally recognized Hungarian studies about mechanisation in the field of agriculture and environmental protection.

In the year of 2014 the drafting committee decide to spread it also in electronic (on-line and DOI) edition and make it entirely international. From this year exclusively the Hungarian University of Agriculture and Life Science's Institute of Technology (former Szent István University's Faculty of Mechanical Engineering) took the responsibility to publish the paper twice a year in cooperation with the Hungarian Academy of Sciences.

Our goal is to occasionally report the most recent researches regarding mechanisation in agricultural sciences (agricultural and environmental technology and chemistry, livestock, crop production, feed and food processing, agricultural and environmental economics, energy production, engineering and management) with the help of several authors. The drafting committee has been established with the involvement of outstanding Hungarian and international researches who are recognised on international level as well. All papers are selected by our editorial board and a triple blind review process by prominent experts which process could give the highest guarantee for the best scientific quality.

We hope that our journal provides accurate information for the international scientific community and serves the aim of the Hungarian agricultural and environmental engineering research.

Gödöllő, 20.06.2021.



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ASSESSING THE DEGREE OF COMPLIANCE WITH TQM PRACTICES: STUDY OF BANKING SECTOR IN PALESTINE

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Abstract: Employing firm's resources in a way can satisfy the unexpected needs of customers in less costs, which helps a firm to achieve a competitive edge against competitors considers the main goal for any business director. From other side, customers would prefer to deal with firms that offer goods and services with high level of quality, reliability and those at par with international standards. This has given the birth to the concept of TQM in service sector after proofing success in industrial sectors. The aim of the paper is to investigate the level of compliance to TQM practices in Banking sector in Palestine. In the beginning researcher reviewed literature studies to develop a knowledge about TQM practices (Leadership and Human resources development & management) in specific. and try to investigate the relationship between TQM practices and bank's efficiency. Then, researcher have prepared a questionnaire to measure the level of compliance of Palestinian banks to TQM practices. 100 questionnaires have distributed for the bank employees, who work in different positions and departments. The results showed that less concern to TQM practices in leadership system, human resource development and management. Finally, researcher recommended that banks should give more attention to motivate employees through satisfying them financially and activate their role in decision making and work in a team soul.

Keywords: total quality management, leadership skills, communication channels, international standards, performance

1. Introduction

Today, customers have a wide choice of service providers and they would opt for only the best service providers in terms of quality, reliability, and profitability and who are at par with international standards. (Talib et al. 2012). Therefore, the whole focus is now concentrated on providing services to customer beyond his expectations. This concept is applicable to all service industries and has given birth to the concept of TQM in service sector. (Selvaraj, M. 2009). TQM is a people-focused management system that aims to increase a customer's satisfaction in less costs by involving firm's resources in effective way. (Evans, J. 1992), under the banner of TQM, efforts were specifically directed at improving: (1) leadership; (2) strategic planning; (3) customer and market focus; (4) information and analysis; (5) human resource development and management; (6) process management; and (7) business results. (Curkovic et al. 2000).

The Palestinian economy is dominantly service activities, about (73.2%) of the Palestinian (GDP) contributed by this sector. Therefore, considered to be one of the vital components of its economy. The Banking sector is key part of the Palestinian economic system, which it influences and can be influenced by its developments and changes. Many economic writers agree on the important role of financial intermediary in economic development in general. Therefore, the safer, sound and healthy the banking sector is, the more it is capable of affecting and stimulating economic activity in general and investment in specific, which would assist the development process. Palestine Monetary Authority (PMA), (2017). Therefore, given the importance of the banking sector and its direct impact on the economy in general, it is necessary to study the processes and practices that can have a clear impact on the development of efficiency and quality of this sector and the services it provides, thus improving the organizational performance on various levels (operating, financial, and market performance). Hence the importance of this study and the need for it, to

understand to which level Palestinian banks complain with TQM practices in their work, by focusing on two factors: Leadership and HR development & management.

2. Literature review

In today's competitive global economy, TQM has experienced a radical shift. The concept is no longer restricted to the manufacturing sector; in fact, it has been extended to service companies and non-profit organizations such as health care, government, services, education, and financial institutions. (Sirvanci, M. B. 2004), so the TQM principles and practices have been embraced by many quality managers and practitioners from different sectors and have earned the attention of many researchers from diverse areas (Talib et al, 2013).

TQM frameworks

(Kaynak, H. 2003) argue that there are seven TQM techniques, they are management leadership, training, employee relations, quality data and reporting, supplier quality management, product/service design, and process management, and these techniques is same as those mentioned by (Saraph et al.1989). Meanwhile, the second study of the European Centre for Total Quality Management-university of Bradford, have a wider domain of items, which include corporate quality culture, strategic quality management, quality improvement measurement systems, people and customer management, operational quality planning, external interface management, supplier partnerships, teamwork structures, customer satisfaction orientation, communication of improvement information. (Black, S. 1995).

As a result of the importance of the TQM theory, and the large number of studies prepared specifically on this theory, which include its practices, effects, dimensions, etc., a set of quality award models has begun to appear in different countries of the world, such as Malcolm Baldrige National Quality Award, European Quality Award, The Deming Prize and Kanji Business Excellence Model, which provide a useful benchmark framework for industries and help in implementing TQM as well as evaluating their business performance results (Talib et al. 2013).

Service quality in banks

Service quality is regarded as a critical success factor for organizations to differentiate from competitors, and it's defined as the degree of discrepancy between customers' normative expectations for service and their perceptions of service performance (Lau et al. 2013).

In view of the banking sector, when reviewing previous studies at the level of neighboring countries as well as the countries of the world, which focused on assessment of the service quality in this sector, these studies confirmed that for survival of the banking sector, it is mandatory to provide best service quality and it is also viewed as pre-requisite to success, and to achieve service quality in the banking sector, the TQM is highly essential. (Al-Shobaki et al. 2010), and some studies went for more, where confirmed that in banking quality means not just meeting but exceeding customer expectations. For this reason, service quality is viewed as an important aspect in the banking industry. Further, it is evident that over the years, bank customers' perception of service quality has been changed tremendously. Today, quality includes a commitment towards continuous improvement and service relationships with customers. Also, the need for technology based services, new and improved product services, and e-services are also viewed as important aspects of banking service quality that supports improved and superior quality services provided to customer. Hence, these are the areas where banks have to focus upon in order to satisfy their customers. (Qureshi et al. 2012).

3. Research questions

Q1: What is the level of Leadership Implementation (as TQM Factor) in the Palestinian Banks.
Q2: What is the level of HRDM Implementation (as TQM Factor) in the Palestinian Banks.

4. Research methodology

The research was a quantitative cross-sectional study design; it describes the population (the bank employees) trends and opinions about the quality practices used in the banking sector, and the quality of the banking

services provided, by studying a sample of that population - Bank employees, in addition to this, the study uses a cross-sectional survey method, so the data collected at one point of time.

There are 100 questionnaires distributed for the bank employees, who work at different work levels, and with different branches and offices all within Ramallah, and only 86 Questionnaires were retrieved. The questionnaires distributed on four banks, two foreign banks (Arab Bank, Cairo Amman Bank), and in the other side, targeted two local banks (Bank of Palestine, Al Quds Bank). A 5-Likert scale questionnaire was prepared to collect the data. It should be noted that the category of management excluded from this study, as it is focusing on the rest of the employees.

Table 1. Likert scale

Mean range	it's mean (Represent)
1.00 - 1.80	Completely disagree
1.81 - 2.60	Disagree
2.61 - 3.40	Approximately agree (neutral)
3.41 - 4.20	Agree
4.21 - 5.00	Highly agree

5. Results and analysis

As mentioned previously, this study and the questionnaire prepared to answer the questions of this study were based on the (MBNQA) framework.

"Leadership"

Table 1. Results of the first contruct items

	Leadership	Mean	Overall Mean
1	All members of my department participate in planning for quality	2.28	3.17
2	I am actively engaged with co-workers to improve overall customer satisfaction	2.36	
3	I make and implement quality improvement suggestions	3.04	
4	I know the bank's quality goals	3.11	
5	My boss keeps me informed	3.15	
6	All members of my department are actively engaged in joint problem solving	3.21	
7	I am encouraged to participate in community activities	4.07	
8	Top administration is committed to quality service and products	4.13	

When looking at the overall mean of this section, we find that the participants who filled out the questionnaire are not confident in the system of leadership of the banking sector, although some experts and quality researchers believe that an inefficient leadership system can be the first obstacle to the application of TQM.

The first two sentences of this section; the mean of each of them reflects that the participants did not agree with their content, this reflects the poor involvement of staff in the planning process in general and quality planning in particular, which undoubtedly affects directly the satisfaction of customers, as staff - especially Front office, are the direct point of contact with customers, and thus the process of involving them in the process of quality planning ,as well as listening to the feedback from them, will have an impact on the evolution of quality of service and thus increased customer satisfaction.

For the third to the sixth sentences; the mean for each of them relate that the respondents have a neutral opinion, they did not agree or dis-agree with the content of each of them, and this also reflects a problem in the leadership system, specifically in the process of employee participation. Employees are not sufficiently familiar with the Bank's quality goals, and are not properly involved in the process of joint problem solving.

For the last two sentences, their mean reflects that the participants are somewhat agree to their content. The first sentence is about the extent to which management encourages employees to participate in community activities, taking into account that encouraging employees to participate in community activities is an important part of the active leadership system, and the other sentence is reflecting the commitment of top management toward the services with good quality, and this is also an important part of the leadership system.

"Human resources development and management"

Table 3. Results of the second contruct items

Human resource development and management		Mean	Overall Mean
1	Salary increases are related to my performance	3.21	3.24
2	Consideration for promotion are tied to my performance	3.29	
3	I know that I am valuable to the bank	3.35	
4	I know the key indicators of my job performance, and what the quality trends are in my department	3.38	
5	I know what our service standards are	3.58	
6	Managers notice when we meet our quality goals	3.59	
7	"Quality Service" is part of my performance evaluation.	3.72	
8	The bank cares about employees.	3.88	
9	Our training to improve quality of service is one of the Bank's most important priorities	3.89	
10	I am treated by my manager with dignity and respect	3.98	
11	I have adequate authority to bend rules to satisfy my customers.	4.07	
12	I have a good work environment	4.16	
13	I have been trained to respond to my customers' problems.	4.56	

After evaluating this section as a whole by looking at the overall mean, the mean is equal to 3.24, which means that the participants were not sure enough that the banking sector takes Human Resources properly into consideration, and manages them in a better way, which ensures better quality and thus better customer satisfaction. It is also worth noting that Human Resources in the banking sector or any other sector have a very important role. It is the direct point of contact with customers most often. If the customer finds that the employee cares about him and his service, he provides the service in the best way, and provides solutions and answers to his questions and problems, He will definitely want to continue dealing with the same bank, and not to move to any other competitor may provide the same services and the same prices, but have better human resources at all levels. Therefore, attention to Human Resources is no longer an option for banks or any other service sectors. Rather, it has become a necessity that must be taken into consideration in order to develop the service and thus improve performance.

The mean of the first four sentences reflects the participants' dissatisfaction with their contents. They have a neutral opinion of each of them. And by reviewing the content of the sentences, we find the following:

- The participants are not convinced that the increase in salary or promotions is directly linked to the performance of employees, and by asking some of them, they believe that the salary increase and promotions are more related to the number of years of experience within the bank, in addition to employee relations within the bank, whether with executive management or the board of directors.
- The employees are not entirely convinced that they have value at the bank. They consider that, despite the management's interest in them, treating them well, and trying to train them on many things, it is easy to accept the resignation of any employee, which makes them feel that they have no value. It should be noted that the sample that filled out the questionnaire is of all functional categories at the bank, except for the category of managers, who may look at this point in a different way.
- Employees are not sufficiently familiar with the most important key indicators on which their performance is assessed, and are not familiar with the trends of the department in which they work generally, and specifically in the area of quality, as employee knowledge of these details is important,

and should have an important impact on the quality of service provided and thus customer satisfaction.

The rest of the sentences, specifically from the fifth to the thirteenth, reflect the participants agree on the content of all of them, which reflects the relative attention to Human Resources, we find that the management treats employees with dignity and respect, and pay attention to their performance and achievements, as well as adequate training for employees, as training is considered one of the priorities of the banking sector. In addition, participants believe that the work environment is a good environment. As providing a good working environment is one of the most important aspects of Human Resources management and development.

6. Recommendations

The Leadership section achieved an overall mean of 3.17, and therefore the first question that the banks in Palestine adapt focus on Leadership as a factor of Total Quality Management was not confirmed, therefore it is assumed to work on the handling of the leadership system. Thus, researcher recommended that:

- The system of leadership in the banking system must be strengthened, especially with regard to the quality of the service provided, and therefore must be started by participating Bank's employees in planning, especially in matters related to quality.
- Identify the quality goals of the bank, disseminate them to employees, and ensure that employees are interested in achieving these goals.
- The need for the participation of employees working in the same department in joint problem solving.

From other hand, The Human Resource development and management section achieved an overall mean of 3.24, which reflect that the participants did not agree with that the banking system focus on human resource development and management, and therefore the second question that the banks in Palestine adapt focus on Human Resource development and management as a factor of Total Quality Management was not confirmed, so it is assumed to work on the handling of this factor. Thus researcher recommended that:

- More attention should be given to the human resources development and management factor, as the continuous emphasis on human resources is the foundation of the success or failure of any organization or company, and banks are supposed to start with the following:
- There must be a clear relationship between the performance of employees, and achieving their services with the required quality, and between their promotion, and salary increase.
- Try to promote the principle that the employee is the most valuable thing.
- Management should not only pay attention to employees who achieve their quality goals, or that the quality of service provided is part of the employee's evaluation, rather it is supposed to translate these into incentives that motivate employees to achieve more.

7. Limitations

This study highlights the commitment of banks operating in Palestine in the Total Quality Management, and hence the quality of services provided. The importance of this study is that no one has ever studied this subject within the banking sector in Palestine, which is clearly growing sector, but we believe that this study faces a number of limitations, which should be mentioned, and if any future researcher wishes to study the same subject at the same sector, he can focus more on these limitations;

- It was emphasized that the TQM theory and under the framework we used in research (MBNQA), consisted of seven factors, but only two of these factors were studied and examined (Leadership and Human resources development & management), however, the other factors have never been addressed, since those factors requires a more extensive questionnaire, and needs to be distributed to specific parties that are able to assess this particular factor.
- It was pointed out that the questionnaire was distributed to a sample of bank employees. And it was emphasized that the senior management was excluded, and it should be emphasized here that the studies conducted within the same subject at the same sector in neighboring countries such as Jordan or foreign countries, usually they study the subject from three different aspects (three different samples, three different questionnaires), first; bank employees excluding senior management, second; senior management, and third; bank customers.

- The study of these samples gives a better perception of the quality of banking services provided, and since this study has focused on the employees, it is better in the future to study the remaining two segments (senior management, bank customers).

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SUBSIDY AND ITS EFFECTS

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Abstract: Governments follow a subsidy policy to encourage the use of certain goods by some consumers. Subsidy can be explained as also that firms-producers sell the determined goods at a cheaper price than the market price and subsidizing government collects the difference. They are tools which are widely used in the hands of governments and can be allocated to various economic issues. In general, it is used as a policy of price policy and anti-inflationary policy in the classical sense. In the modern sense, it used for the purpose of general equilibrium, in other words, to equalize trade balance such as lowering prices and controlling inflation, preventing the long-term decline of industries. However, there are many significant negative effects of subsidies such as increase in taxes, leading to inefficiency of local industries, increase in borrowing, and disruption of identity between buyer and vendor prices in markets. One of rules set on subsidies is SCM Agreement. In the Agreement, subsidies were identified and rules were set on subsidies which could impact international trade. Since there are many types of subsidies, there should be more strict rules and policies about their implementation in order to eliminate and avoid potential barriers in international trade.

Keywords: subsidy, international trade, price discrimination, trade balance, export subsidy

1. Introduction

Subsidy terms - General overview

Subsidy is extensively applied by governments and it is a type of non-trade barrier. In other words, subsidies are state expenditures which are applied with the purpose of supporting production of goods and services. Since subsidy is state expenditures, it can be argued that state duties such as fire-fighting or police organizations are also subsidies. However, they are justified state practices, but not subsidies. So, the basic state duties cannot be considered as subsidy. Moreover, excluding state duties, a state should benefit from its expenditures. If a state provides assistance to its market economy within accepted competition conditions and that state does not benefit from this assistance, it cannot be considered as a subsidy.

After World War II, it was unrealistic to change and ensure world goods exchange without unclear definitions on the GATT premise. In this way, an alternate meaning of the subsidy is required to be utilized in the field of global trade law. Despite the fact that a few kinds of subsidies were out of line in the worldwide exchange strategy for over a century, there was no definitions of subsidy concept in the GATT time frame covering 1947-1995. This came about because of the multifaceted nature of the issue and the complexity in recognizing justified state practices and subsidies which were barriers in international trade.

Subsidy definitions

In 1994 Uruguay Round when GAAT was transformed into WTO, important changes with respect to subsides were introduced. As a result, new Agreement on Subsidies and Countervailing Measures, also called Subsidies Agreement was adopted. The ultimate objective SCM was to strengthen discipline on trade distorting subsidies that governments use to provide unfair competitive advantage for their firms. The definition of subsidy is first set out in the annex of the WTO Establishment Agreement and SCM Agreement. The definition of subsidy on SCM is determined as “a financial contribution by a government or any public

body within the territory of a member which confers a benefit". Apart from this concept, the definition of subsidy can be set in many different forms indicated below:

- The unequal financial aid given in the form of money by the State to influence production or export in various ways by taking into account the interests of society and in order to protect and promote producers or is called subsidy.
- Subsidies are supports and cash aids for the promotion and maintenance of the production of private and public undertakings by the state. With the coupon method, the state provides for the promotion and maintenance of the consumption of certain consumer segments to certain goods and services, while state support the production activities of certain producer groups in various ways. Subsidies are also called financial aid.
- Subsidy is referred as any financial contribution directly or indirectly provided by the exporting country.
- Subsidy exists if there is a direct transfer of funds, withdrawal of government revenues that must be paid, a financial contribution such as the provision of goods or services outside the general infrastructure, or financial or other income or price support by government or a public body.
- Provision of subsidy by a state can be expressed as money in order to influence production or export in various ways without any compensation by considering the interests of the society and to protect and promote producers and exporters.

Subsidy elements

There are two key elements that should exist in order to consider an incentive as a subsidy. They are:

- Financial assistance, income or price assistance by a state,
- Benefit to which the assistance is made.

Above mentioned two elements should coexist in order to mention about a subsidy. If there is no benefit provided to the assisted or supported party, a financial assistance cannot be considered as subsidy.

2. Types of subsidies and their effects

One of the important types of subsidy is defined according to types of grant in the financial assistance in SCM Agreement. These types could be subsidies made by a state or through third person or institution in the form of direct fund transfers, government revenues, and government procurement explained below

Types of subsidies based on types of grants

In SCM Agreement, one of the main types of subsidies is identified based on types of grants provided during financial assistance. They are:

- Direct fund transfers: If a state provides direct transfer of funds (aid, credit and equity capital) or debts (loan guarantees) and benefits from this assistance, it is considered as subsidy. An example of direct fund transfer is that if a government pays debt of its local export company to the bank instead of the company.
- Government revocation: This type of subsidy is considered in case a government gives up some taxes which actually have to be collected from a company or an individual. It should be emphasized that benefit element of subsidy should exist if the state gives up the collection of taxes.
- Government procurement: This type of subsidy appears when the sales of goods provide more revenue for the seller than they would earn under normal market conditions. It happens when a government is buyer and pays more for the purchase of certain goods to support that seller company. When the government pays the difference between a producer's actual income and a certain target income support is defined through government procurement. This type of subsidy is applied in order to protect the income levels of some companies in a particular sector, in other words, provision of income or price support.
- Financial assistance through a third party: Sometimes, the financial assistance is not carried out directly by a government. A government might pay for a fund mechanism and instructs it to execute special campaigns and functions in order to provide support industries. Even though such assistance is not provided directly by government, it is considered as a subsidy if there is a benefit provided based SCM Agreement. In some cases, a state may apply to support certain firms or sectors without direct payment, contributing to a specific fund, rather than directly providing financial contribution. In accordance with

WTO rules, such practices are also considered as financial contributions. Moreover, financial assistance through a third party can be delivered through a number of private legal persons or entities.

Types of subsidies based on scope of implementation

The other types of subsidies are defined regarding the scope of subsidy effect and implementation. Subsidies are divided into three groups according to its field of implementation

Company specific subsidies: These kinds of subsidies are assistance provided to a company or a holding that includes a group of companies aiming to increase competitiveness. Usually subsidized companies are perspective ones which might bring benefit to government if efficiency is increased.

Industry specific subsidies: Financial assistance provided to a particular industry. The main sectors which this kind of subsidies are applied is agriculture and energy sectors. Mainly the industries which have comparative advantage over competitors are applied subsidies.

Region specific subsidies: Subsidies provided by government to a specific geographical region. If there are subsidies provided only for the companies or industries in the borders of a specific region by the government, it is considered as region specific subsidy. However, there are some exceptions on this type of subsidy based on the assistance provider. For instance, if an authority which is responsible for a specific region and that authority provides any kinds of subsidies for all companies or industries inside the borders of it, it is not considered region specific subsidy (Didier, 2007).

Types of subsidies based on its implementation

The other types of subsidies are defined based on purpose of implementations. In SCM agreement, subsidies are divided into three groups based on the purpose they are implemented. They are forbidden subsidies, actionable subsidies, and non-actionable subsidies.

Forbidden subsidies

The other name given to forbidden subsidies are “Red” subsidies. In case of identification of such subsidies which are listed in SCM Agreement, they should be released or stopped immediately. According to the WTO, they are divided into two types as export subsidies and domestic input subsidies.

Export subsidies

The subsidies which are given with the purpose of specifically to increase export performance of a country are called export subsidies. The purpose of export subsidies is to reduce the price paid by foreigners by providing cost advantage to domestic producers and thus to encourage the export of the country. As a result, consumers in foreign countries are preferred to domestic consumers because the external price of subsidized exports is lower than the domestic price of the product. Most widely applied export subsidy types and their effects are mentioned below.

Direct subsidies for export performance: a subsidy program which entitles exporters to pay a certain percentage of their export amounts falls into this group. This type of export subsidy is the most widely used one.

Advantageous exchange rate applications: In this group, the subsidies are granted to the foreign currency obtained by the export by applying a more advantageous exchange rate than the market exchange rate. In order to analyze the effect of such subsidies, we can indicate an example. For instance, in a free market where 1 US dollar corresponds to 100 units of national currency, a subsidy program is stipulated if government purchases 1 US dollar for 120 national currencies. Government might be willing to apply this kind of subsidy because foreign exchange obtained from the action of export is more valuable for the state. This action might affect the international trade. The exporting companies can sell the products at a cheaper price and might go ahead of the competitors which can be considered an indirect violation of trade law (Didier, 2007).

Goods or services at advantageous prices: Providing electricity energy for some industries or companies which are exporting at lower prices can be stated as an example of provision of goods and services at advantageous prices. However, there is a point on this matter. If the price of products sold by export companies is less than the market price, in this case subsidy provision can be mentioned. Otherwise, if the price is the same with market price, then subsidization issue cannot be raised. In this example, it can be said

that it is not affecting international trade since there is no unfair pricing in the market. So, subsidy provided by government in the means of advantageous priced services can be a trade barrier for other competitors if they have a lower price than the market price.

Effects of export subsidies

The implementation of the export subsidy has two main direct effects on the domestic economy:

- Trade balance change effect,
- Export income effect.

As an export subsidy decreases the external price compared to the domestic price, the terms of trade are against the country. However, low external prices increase exports. If the elasticity of the demand for export goods of foreign countries is quite high, the export revenues of the country will increase. The foreign prices of these goods will decrease by a percentage and there will be a percentage increase in the quantity of exports which will be more than the price percentage which was decreased for foreign buyers.
Since export subsidies can be considered as a hidden trade barrier and they affect industries of foreign countries, implementation of export subsidies is undesirable and rejected by trade parties in global market. The export mechanism of export subsidies is considered to take the pulling power of resources from low-productivity areas to high-efficiency areas. Indeed, subsidized low-yield producers can also consume. Despite the potential benefits to domestic exporters and foreign consumers, export subsidies adversely affect the well-being of domestic consumers. First, domestic consumers pay a higher price than foreigners for the same goods that are subsidized. Secondly, as domestic taxpayers, consumers are also obliged to bear at least a portion of the financing costs of export subsidies provided to domestic producers because subsidy cost is provided by taxes collected from local consumers.

Domestic input subsidies

Domestic input subsidies are the other type of forbidden subsidies. According to 3.1 (b) article of SCM Agreement, interventions which prohibit usage of imported input products and policies require use of indigenous inputs rather than imported ones are considered domestic input subsidies. Such subsidies encourage the use of domestic inputs in the production process of a given product instead of imported inputs. Such subsidies block imports of input products and leads to the usage of domestic ones. Domestic input subsidies provide advantages for domestic manufacturers. However, from the perspective of international trade, such subsidies affects foreign industries as their sales to subsidizing countries will decrease.

Actionable subsidies

Actionable subsidy is “bounty, grant, or subvention enjoyed by the exporters of a country that may be challenged by an importing country if it injures its domestic industry” (WTO, 1995). Actionable subsidies are assistances which have negative impact on trade, however, with actions and countervailing measures by governments their impact can be decreased or abolished. In WTO reports, actionable subsidies are not listed. However, they are defined as if there is an adverse effect on a member country of WTO when it is implemented. WTO panels have stated that there are two conditions should exist in order to address actionable:

- Specificity: If granting authority limits the subsidy for other enterprises, it can be considered specific.
- Negative impact: According to SCM Agreement, it should be proved that the subsidy granted by a WTO member state has a negative impact on the interests of other WTO members so that an actionable subsidy can be mentioned. There are three types of negative impact which are damaging the domestic production branch of a WTO member state, eliminating or weakening the interests of other WTO member states in the framework of GATT 1994, and exposing the interests of another WTO member to serious effect.

Free subsidies

Free subsidy also called as non-actionable subsidy is called provision of financial assistance or benefit by government or an authority with the purpose of social benefit. They are also known as “Green” subsidies. Under certain conditions, subsidies implemented for the development of disadvantaged regions, development of underdeveloped regions, or for the support of industrial R&D activities and protection of the environment,

fall under this category. Such subsidies have positive effects on society. Any subsidy provided with the purpose of protection of environment is considered free subsidy. According the SCM Agreement, such subsidies are considered aids to adapt to environmental conditions. Mainly, such subsidies are provided for anti-pollution activities. The main character of this kind of subsidy is the benefit which is in favor of all humanity. Since, it benefits not only a country's environment, but also overall nature, any subsidy used with this purpose is acceptable by WTO. The main forms of free subsidies are:

- Subsidies for research and development activities;
- Subsidies for the development of less developed regions;
- Subsidies for environmental protection.

3. Conclusion

In this research, the impact of non-trade barriers on international trade was shown through analysis of subsidy. After 1995, new rules were set on non-trade barriers. One of such rule bases was SCM Agreement. In the Agreement, subsidies were identified, and rules were set on subsidies which could impact international trade. The more extensive conclusion that can be drawn from this analysis is that there are some benefits, however there are even more problems and challenges in case of non-trade related incentives including subsidy implementation. After the research, as a recommendation, I consider that since subsidy has positive effects as well, it should be applied on mainly infant industries without affecting international trade. For instance, subsidy can be granted to decrease the costs of production, however, the price should not be below the market price or it should not restrict any trade activity. In any 59 case, subsidy grant should not affect international trade.

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APPLICABILITY OF ORGANIZATIONAL PERFORMANCE INDICATORS

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Abstract: Today's changing environmental challenges and accelerating technological advances over the past decade have presented companies with new challenges. There is an increasing emphasis on human resources, which can give companies a real competitive edge. At the same time, the focus is on the development of HR systems and their connection to other systems that determine how companies operate. Individual performance evaluation, in close connection with other HR functions, nowadays, in addition to evaluation, which may have a development or remuneration function, is linked to the performance of the organization. Accurately defining the latter and developing its measurement methodology, though not primarily as an HR function in most cases, is essential in the pursuit of effective operation. It is worth defining the indicators that may apply to a particular organizational unit and, at a higher level, to the whole company. The definition, implementation and measurement of indices and KPIs presupposes that the specified qualitative and quantitative indicators provide an appropriate framework for the evaluation of real performance. The performance of individuals determines the performance of an organizational unit, which in aggregate also predicts corporate-level performance.

Keywords: performance management, individual performance, organizational performance, KPI, metrics

1. Introduction

In order to get to know and measure individual performance, one has to determine the organization's expectations regarding the system, paying special attention to the basic tasks of the organization. In modern corporate operations, both organizational-level performance measurement and individual performance measurement are integrated into management functions in a professional approach.

Organizations, tools developed to measure the performance of larger and smaller organizational units, are becoming more widely used as HR functions expand and their role grows. Applying an organization-wide, all-inclusive performance appraisal system requires a lot of energy and time from those involved. In order for performance indicators at the individual level to be effective and to support the achievement of goals, the commitment of the participants is essential. Nowadays, based on already established international experience, managerial leaders have realized that human resources can be a real benefit to them and to their organization. After all, if

their employees are well-trained and motivated, which gives the company a competitive advantage;
employees are task-oriented and committed, which increases productivity and satisfaction;
the organization operates along these principles, making it easier to obtain and retain the necessary workforce (Dara, 2011).

Managers are responsible for providing cost-effectiveness indicators, but it should also be part of the daily routine to ensure that employees have responsibilities. In addition to providing the physical environment (office, computer, equipment), there are factors that are most influential to the driver and have a major impact on work efficiency. Managers need to find a method that specifically approaches the performance appraisal system with knowledge of employee skills and competences.

As early as the mid-20th century, american authors have pointed out that applying and setting inappropriate goals can keep motivation levels low or, on the contrary, reduce them (Stedry-Kay, 1966) (Figure 1.). In

order for an employee to perform at the highest level of motivation, challenging goals must be set that presuppose that they are employed in the right job.

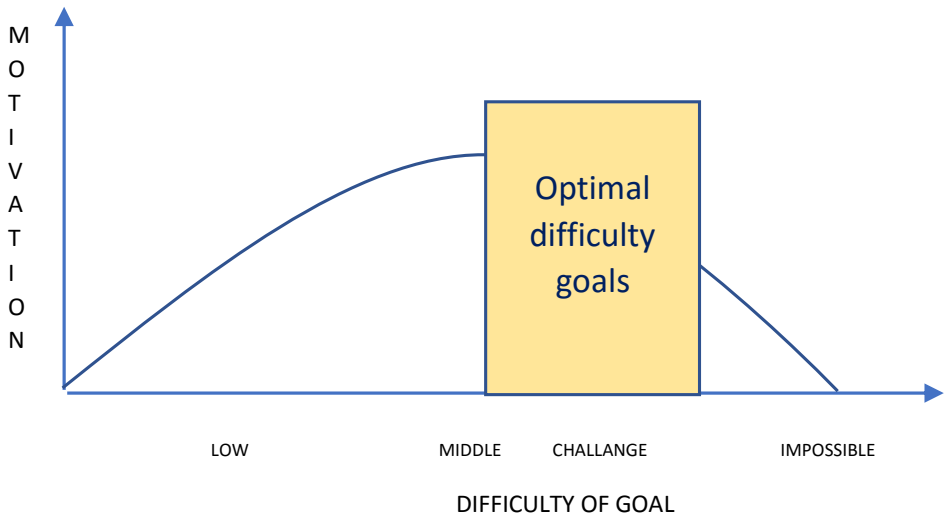

Figure 1. Setting Individual Performance Review Goals (Source: based on Stedry-Kay, 1966)

Generally speaking, performance evaluation is the process of measuring employee performance on an individual or group basis (Deák et.al, 2013). It can be formal or informal, but in each case its primary purpose is to get feedback on the performance of the employees. The purpose of performance evaluation is to measure the individual's performance and motivation, and to determine development goals. In the long run, it can also lead to an improvement in the manager-employee relationship and appropriate goals - which are realistic and achievable - can increase employee satisfaction and commitment. Opportunities for personal and professional development, and participation in training and professional programs, are clearly emerging as an opportunity for employees (Szabó, 2016: 439-450).

"For a long time, knowledge, ability and motivation, as well as their interaction, have been considered as the main influencing factors of individual performance. However, more and more people are now recognizing that a third element in the creation and enhancement of individual performance is the elements of the delivery environment (including the nature of the job, physical and non-physical environments, such as clear work expectations, goals, rules, norms, and support from a leader) is also critical. As a result, more and more people believe that performance is not just a matter of evaluating, but also of planning, managing" (Karoliny-Poór, 2010: 283).

Performance dimensions

A well-chosen metric and a formulated criteria system can motivate individuals to perform better, but the multiple negative impact of this can be achieved by a poorly formulated measurement system. Given the fact that not all are measurable objectively, we need to be able to determine the level of expectation at which we already accept that our evaluation system will support the achievement of the set goals. Benchmarking can measure results, either in absolute terms (eg. sales) or relative (through indicators such as number of customers) or even against benchmarks (based on results at a given time). However, in some jobs the results are not so easy to grasp, in which case it is worthwhile to evaluate the behaviors, activities and the rate at which they are achieved. In order for the employee to behave as expected, he / she must have certain abilities, habits (eg. enthusiasm, intelligence), so by assessing personality traits we can judge his / her competence set and attitude towards work (Veresné-Hogya, 2011).

Individual performance can be approached from three sides, and it is through the interaction of these three components that the actual performance is created. Based on these, the three dimensions are attribute, behavior and result. The combination of the three dimensions is illustrated in the Figure 2. below:

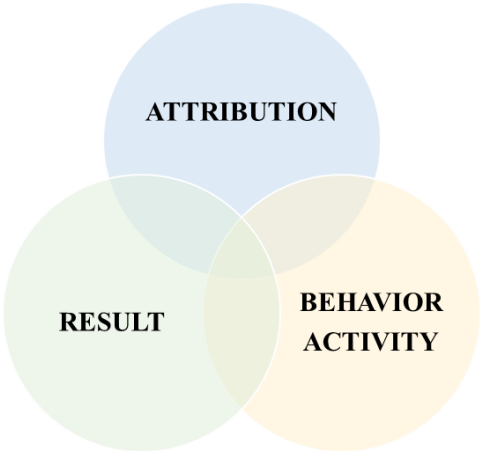

Figure 2. Dimensions of performance (Source: based on Karoliny-Poór, 2010)

The interaction or balancing of the three dimensions is crucial. Without basic knowledge, enthusiasm cannot lead to excellent results, or failure to put existing knowledge into practice can achieve the desired result.

The attribution dimension defines the general characteristics, such as the individual's adaptability to the organization, to work, the individual's initiative, general knowledge, job knowledge, creativity that he or she can apply in his or her work.

The dimension of behavior, activity, shows the manifestations directly related to the performance of tasks in the job, such as managing problems or following instructions. It also points out the person's attitude, ability to collaborate with the group, and provides information about, for example, accuracy at work.

The result dimension shows quantifiable information such as a quantity or cost page. Measuring the performance of an individual along this dimension is more accurate than measuring the first two dimensions because performance is measured on the basis of objective information. We can really measure this by using indicators (Karoliny-Poór, 2010).

2. Organizational Performance

A prerequisite for the effective operation of performance measurement systems is that in the hierarchy of goal setting, the goals of each organizational unit are defined from strategy-based goals. Their interrelationship and interactions with each other are clear, and their interdependence can be the basis for deriving specific goals from individuals. Goals for individuals and the tasks involved in achieving them must be challenging and realistic. Through exact formulations, addictions, deadlines, individuals can be motivated to perform high quality work. The success of an organization and the performance of the organization is the sum of the individual performance. However, its definition is not based on a simple mathematical formula.

Organizational performance is generally the result of qualitative and quantitative performance in the accomplishment and execution of tasks defined to achieve the goals of an organization (Bakacsi et al., 2006: 184). Quantitative indicators such as sales, profit, and EBITDA can be used to measure the fulfillment of expectations based on objective parameters. When defining quality indicators, the goal can be to measure productivity, efficiency, and cost-effectiveness, by which organizations can designate a framework within which they can measure factors that are more difficult to quantify. To determine and measure all these indicators, it is necessary to consider the life cycle of the organization, the culture of the organization and the activities of the company (Poór, 2004). It is not possible to apply the same indicators to standards of general application in the case of a technology software company founded a few years ago and a large state-owned venture operating in a stable market. For the former, the life cycle of an organization influences profit and revenue from quantitative indicators, but quality indicators can be a good direction for the management of the company to see if the vision of the company can be realized with the launched business. For the latter company, they are among the core values of stability and security, so the company's organizational culture

can influence whether the performance of an organization can be measured and validated, for example, by the application of a performance indicator based on its ability to innovate.

KPI stands for Key Performance Indicator, which means "key performance indicator". KPIs are a measurable metrics of how well a company is working towards its goals. Companies look at different KPIs at multiple levels to see how effective they are in achieving those goals. High-level KPIs show the performance of the company as a whole, while lower-level indicators show the effectiveness of smaller organizational units (eg, production, sales, marketing, HR, etc.). A KPI can only be as valuable as the activity or process measured by the KPI. It can be a fundamental mistake to use industry benchmarks as your own index, which runs the risk of leading to useless data that does not help the company achieve its goals (Matthew, 2017).

An effective KPI is that it contains concise, clear and relevant information that is clear to stakeholders, because without it, meeting its associated goals will not achieve the expected impact. To use effective performance metrics, you must have a thorough understanding of the organization's goals and who is responsible for achieving those goals. The operation of defined and accepted indicators is a process that builds on feedback from participants and modifies the content of performance indicators as needed.

It may also be suitable for measuring performance and thus monitoring the applicability and effectiveness of performance indicators. The SMART method, which means "smart" in English, however, can help you measure KPIs as an acronym when using performance metrics by answering the following questions:

S - Is the goal specific?

M - Is the process by which we achieve this goal measurable?

A - In the actual situation, can this goal be realistic?

R - Is the goal relevant?

T - Can the goal be achieved within the planned time frame?

When defining performance indicators, it is a prerequisite that it is related to the business objectives, which is to control critical business processes. To determine a good KPI, we need to know what the end result we expect, along with why achieving it in the life of the company, is paramount. It is necessary to determine in what way, by what means we can measure progress, whether we can, and if so, how, to influence the achievement of the result. For each indicator, it is necessary to record in advance who is responsible for what he / she can do and what to do to achieve the goal. Beyond defining the time needed to reach concise, relevant goals, it should be made clear at what intervals and by what method we will measure progress.

A well-chosen and well-developed performance indicator system is an essential tool for managing a well-structured company. The need for and usefulness of indicators can be monitored by examining several factors. In all cases, the indicators should aim to measure the fulfillment of the strategy. Ownership expectations, strategy formulation are not enough, they need to be measured. KPIs can provide guidance as a management tool to help eliminate employee or process errors, and do not fall into the mistake of covering routines in a daily routine. A good indicator can give you a warning right from the start when errors occur, so they can be handled and problems resolved faster. The indicator provides an opportunity to develop actions at an early stage of problem solving and, if necessary, to synthesize or even harmonize the information available to us for success. It is also a good tool to link organizational and individual goals through KPIs, and to define the tasks and levels of responsibility to be accomplished at different levels of influence over achieving the same goal. Based on this, it provides objective feedback to individuals, offering opportunities for repair in case of errors, and opportunities for improvement and recognition for good performance.

Besides, if we do not develop a system of performance indicators, if its operation is only a disguise to hide the inefficiency of the organization or processes, its negative consequences can even be a strong demotivating factor in the life of a company. Stakeholders, like the benchmark for success in individual benchmarking, must be aware of the realistic goal to be achieved, be aware of the tools of implementation, feasibility, have the necessary competencies and, if successful, be recognized if their organization is measured along KPIs. their performance as well.

We can define performance indicators in quality, production, sales, HR, operations, and a range of other areas, but we should always strive to identify and relate to each process, regardless of which process, organization or function a system of criteria by which they can be linked to individual performance requirements.

As a summary of the above, whether you want to determine an organizational or individual performance indicator, the following factors should be considered:

Whether the indicator can be used, the results are used by the organization for development or bug fixes.

Is the indicator economical, operating and measuring it outweighs the invested resources?
Is the content, conceptual framework and operation of the organization detailed and comprehensible to its stakeholders and does its operation and measurement meet its needs?
Whether the indicator is measurable, has IT support for measuring, recording and sharing information.
Are the individual indicators comparable, support the dismantling, realization of the strategic goal in their context and operate according to a general set of rules regardless of the area?
Can we define them as realistic and independent indicators, taking into account their interaction and interrelation.

The lack of fulfillment of these criteria calls into question the applicability, effectiveness and acceptance of performance indicators. For each metric, it is worth examining, along with the questions above, whether the goal, the metric, and its stakeholders are the most appropriate form to monitor performance.

Balanced Scorecard

The Balance Scorecard business performance model can be a good tool to measure organizational performance by turning a high-level strategy into operational and achievable goals, following a step-by-step logical process. Most organizations formulate their mission and, at the bottom, formulate goals for employees based on the company's core values (Kaplan-Norton, 2004). The model provides feedback on operation and guarantees performance measurement based on objective metrics. It breaks down mission and strategy into specific goals and indicators and organizes them into four different perspectives - financial performance, customers, operational processes, and learning and development. In its application, we align financial goals with strategy. All of these indicators are part of a chain of causation that ultimately culminates in improving financial performance. The Balanced Scorecard should reflect the corporate strategy: starting with long-term financial goals, then combining them with the series of actions needed to achieve the desired long-term performance in financial processes, customers, operating processes and ultimately systems and employees (Gupta, 2015). As a result of developing a customer perspective, an organization must have a clear view of its target customers and market segments, and their selected key performance indicators in terms of market share, customer retention, acquisition, satisfaction and profitability. These scorecards determine the goals to be achieved along the processes associated with each function. From the operational process point of view, executives identify critical processes in which the company must excellent in meeting the goals of its owners and target customer segments. The application of BSC enables the company to drive the demand for operational process performance from the expectations of individual external stakeholders, thereby integrating the development process into the operational perspective. Beyond defining the needs, designing and creating individual products and services is an important step, providing opportunities to enter new markets as well. In addition, the organization must identify the cost, quality, time, and performance characteristics that enable the company to deliver excellent products and services to its current target customers. Finally, the process of post-valuation services enables the company to prioritize, when available, the feature of the service that occurs after the purchased product or service reaches the customer. The BSC's final point of view includes objectives and indicators related to organizational learning and development. Goals based on financial performance, customer and operational processes determine where the organization needs to excel in order to achieve breakthrough performance. The aims and indicators of the learning and development perspective provide the backdrop (infrastructure) to achieve the ambitious goals set in the other three areas. Organizations also need to invest in infrastructure - people, systems and procedures - to achieve their long-term development goals.

The application of BSC can provide an answer to the evaluation of the performance and the adequacy of the processes, subdividing the opportunity and the adequacy into elementary parts. In any case, performance indicators should be linked to a specific task or process, with specific and comprehensible criteria to be used as an objective measure of evaluation.

3. Summary

The use of performance indicators in the life of companies should be closely linked to the company's strategy, which, given the external and internal factors affecting it, can be used successfully to measure both organizational and individual performance. Individual performance appraisal method is a real added value for business organizations. A well-chosen methodology, well-formulated goals can support individual

engagement and provide a competitive advantage at individual and organizational levels. For companies built on an economic basis, operating efficiently in a market environment, they must have a track record of employing employees, retaining workforce, and personal development, one of the key elements of which is performance measurement. In addition to following technological developments, the added value of individual benchmarking is also reflected in economic indicators. The assessment of tasks, tasks and individual competencies also provide excellent support for meeting the challenges of the latest age.

If the business has a clear vision and mission that is embedded in a strategy that is well known and accepted, we are likely to set a framework within which we can link relevant, measurable, and realistically measurable indicators to organizational-level goals. Organizational performance is made up of the performance of individuals, given that the independence of the two rating systems must, in fact serve the same purpose. The common goal is for the company to operate efficiently, utilizing environmental opportunities, reducing potential risks, and maintaining employee motivation and satisfaction at the level of economic and efficiency.

Organizational developers, consultants, and economists share a common mission in research and practical experience to improve performance, seeking and offering new types of incentive to 21st century employees. The goal is the same, finding untapped capacities in human resources, encouraging them to experience a shared success, and stepping out of the ordinary, looking for the most appropriate methodologies and evaluation systems to meet the challenges of the age. The key to organizational performance and success lies with our employees, who, through their actions and attitudes, can make our business a success or move the company in the opposite direction. It is a lot of tasks but nice tasks and a real challenge for today's managers.

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THE IMPACT OF TRAINING ON BANKS EMPLOYEE PERFORMANCE

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Abstract: The main aim of conducting this research work is to explore the impact of Training on Employees Performance in the banking industry in Palestine. The Data for this study were collected from the permanent staff working in banks in Palestine through a questionnaire designed to achieve the objectives of this study as the main instrument to gather the primary data; 10 banks have been selected for this purpose. The result shows that there is a significant relationship between Training Material and Employee Performance, and also a significant relationship between Training Delivery and Employee Performance, while the study revealed that there is no significant relationship between (Training Design and Training Content) and Employee Performance. The researcher recommended banks to focus on giving useful and easy to read and see the material, handouts, and activities in training. Moreover, Banks should consider focusing on training that best helps employees in applying and learning various types of knowledge and skills, providing clear instructions for all activates, and providing trainings with reasonable time duration.

Keywords: instructor-led training, virtual instructor-led training, e-learning, blended learning

1. Introduction

Nowadays, we see that every organization has a critical issue to deal with which is the best way to manage its human resources. It is a must for organizations to increase the employee's productivity and efficiency level to maximize their wok outputs (Ayman, 2016). The crucial issue with any organization is to maintain its survival among the massive competitiveness in the market; which it comes from its ability to train the human power to be more, inventive, innovative and creative; these features will enable the organization to enhance its performance which leads to raising its competitive advantage among other rivals. (Lawan, 2018). Furthermore, human resources considered a main strategic resource to create a sustainable and competitive advantage (Sekantsi, 2018).

So, organizations encouraged to focus on training their employees because it is one of the most important ways to equip them to be aligned to work incentives and enhancing their work performance to a higher level (Bhat, 2017). Organizations need to know that the common evidence about knowledge growth in the business world can't be ignored, they need to reserve a place at this fast pace. It is important to know that this growth didn't bring by either production factors or technology while it evolved through the development of human resources in the organization (Engetou, 2017). Moreover, it is a must that organizations need to enhance the career performance for its employees by implementing specific, specialized, adequate and well-organized training programs; these movements considered the most important step that organizations need to achieve.

This study investigated different factors that influence employee's performance; but training still the main pillar that is significantly predicting employees' performance, it enhances their capabilities, capacities, competencies and their recognition for their works and duties (Kenny, 2019).

Training defined as an organization's efforts has been initiated to boost the learning level among employees, and the other side which is the development, it defines as an effort that focuses on broadening and improving the employee's skills for upcoming responsibility (Afroz, 2018). Training considered the main reason behind employees' development and growth in work, and it is responsible in creating positive work attitudes and better behavior in the work atmosphere, and we should not forget that training is not a prestigious tool used to improve the corporate image; on the contrary, it is highly associated with work efficiency and effectiveness

which leads to higher work productivity (Kumar, 2016). The main objective of the training is to boost the individuals and the organization's performance; that's why organizations need to concentrate their efforts on, sometimes their employees left behind the job goals and objective because they are not well-equipped to handle these objectives and achieve it. Zafar (2017) expressed that training is a systematic method depends on analyzing work progress; assigning the work goals and milestones, in other words, what owed to be done to achieve higher performance that meets the expected organization performance level.

The significance of this study is to discover the associated relationship between employees training and work performance; it is most demanded issue by organizations managers because current trends in business require higher work efficiency, more accuracy and effective work processes and procedures which are associated with time and cost reduction in different work roles and processes; it is the only method to achieve these goals through designing, developing and deploying the best in class training programs and to deliver it to the involved employees (Salah, 2018). The employees became more interested in their work when the organization introduce various training programs; they will have the passion to raise their knowledge about their work tasks; it will help them to gain more work incentives and promotions; on the other side, training has a significant impact on employee's commitment and their performance (Bhat, 2017).

2. Literature Review

Training

Authors and human resource management experts have different and various definitions of training in Literature. According to Donkor & Banki (2017) training as a concept leads to human development and human resources is the key pillar for all organizations. For Ibrahim et al., (2017) training is the key tool that helps the organization in achieving the highest work performance.

Singh (2017) found that training is crucial and key tool to enhance the human power performance and it will increase the organization overall worth; but the most important hint must be taken in consideration that the organization must balance between training value and the expenses, the findings from this study show that the training impact is varied according to different industries.

Effective training plays a significant role in an organization through creating the required and the most competitive competencies required for the employees and the organization at all to accomplish and being pioneers in their work tasks, moreover; it has a significant impact on the organization structure (Scettri, 2019). Kumar, Anitha (2016) stresses that Training is a development tool combined from skills, attitudes, and knowledge of employees to perform their work in the right manner.

Training Factors

Training Delivery classified through five different categories such as, instructor-led training (ILT), virtual instructor-led training (VILT), E-learning, mobile learning, and blended learning which is a mix of these types of training based on the organization training objectives (Gautam, 2019). Training Design factors are course lifetime, needs, participants, intangibles, evaluation, resources, learning objective, and content (MIT, 2019a). Furthermore, Training Content concerned about the training topic itself; if its relevant, timely, and up-to-date content, how long this content will be relevant (MIT,2019b). Training Materials defined as recorded or printed information used in training such as; training activities, warm-up activities, flashcard, games, paper clips, etc. (Briscoe, 2019).

Important of training

According to Duron et al. (2018), Recently organization heavily invested in training which leads to a competition among these organization about the best practice in training that influence their success and increased their performance in the market, while Daudt, Archangelo & Duquette (2017) investigated that training must be a continuous process because of the rapid technological enhancement in the organizations systems which is the success edge for them. Rutledge & Cathcart (2019) claimed that the training and employee development is useful for both individuals and organizations at all; when the organization focuses on employee training and development it will raise the organization's profitability either tangible or intangible profit. Furthermore, training helps employees in their decision making process and solving the work problems

in an effective views, and also it helps them in achieving higher self-confidence and development, it also helps in decreasing the work stress, tension, managing conflicts, and in the conclusion increasing their satisfaction in their jobs and being more loyal (Motlokoa, 2018).

(Afroz, 2018), (Bhat, 2017) revealed that training is one of the most effective tools and a fundamental one to achieve the organizational objectives and goals and it will help in achieving the aimed performance and higher work productivity.

Employee performance

Anitha & Kumar (2016) said that the key part of any organization is Employees; the management should invest in this human power as they are the reason behind its success, while Safitri & Lathifah (2019) defined employee performance as achieving and accomplishing specific and well-determined tasks in the organization this happened through their efforts in doing their tasks, all of these tasks will be measured according to well-planned and predefined goals, objectives, measures and KPI's. For Francis & Angundaru (2017) Performance combines from results and behavior, they clarify that Behavior originated from employee performance; and it is a must to transform their performance into action without keeping it as a plan.

Impact of training on employee performance

According to Brittany et al., (2017); training took this importance in human resources management because of its significant positive relationship with employee performance, however, training considered as a fundamental tool in the organizational capacity building to improve its performance and achieving its goals (Sasidaran, 2018).

Kumar (2016) concluded that organizations that pay more attention in training and developing their employees in planned way, it will enable the organization top managers in gaining the confidence from their subordinates, while Afroz (2018) explored that training and employees development is the organization strategic instrument to improve their performance through acquiring and equipping employees with the cutting-edge skills and knowledge along with the right organization attitude by the best practice to do their tasks within the planned goals and objectives, According to Motlokoa (2018) organizations must take an initiation in enhancing employees skills and knowledge through planned trainings to achieve the planned performance expected from their work performance, the most interested results from this study is training has strong impact on employees performance along with it is highly associated with their satisfaction in work and enhance their motivations.

3. Materials and Methods

Data collection and reliability test

The authors used primary and secondary data resources, the primary resource through a well-structured questionnaire which consists of three parts, the demographic dimension, employee performance (Dependent Variable) and training (Independent Variable) while the secondary data resources are previous literature, journal articles, websites, and books. The authors used Cronbach's alpha equation test to check the instrument reliability; the calculation revealed that Cronbach's alpha is greater than 0.70 which is accepted.

Population and Sampling Method

In this research work that the authors chose the banking industry in Palestine, a simple random sampling technique used for this purpose, around 290 employees participated in this work.

The Study Model

The authors in this research work aim to explore the impact of training on employee's performance, so he adopts the following conceptual structure based on the previous literature that constructs the following model.

Table 1. Study Variables

Variable	Type	Sub-Dimensions
Training	Independent	Training Design
		Training Content
		Training Delivery
		Training Material
Employee Performance	Dependent	----

Source: Researchers

4. Results

Study Hypothesis # 1

H0-1: There is no significant relationship between Training factors and Employee Performance in the banking industry in Palestine.

Table 2. Correlations Coefficients (R) between Training Factors and Employee Performance

	Employees performance	Training design	Training content	Training delivery	Training material
Employees performance	1.000	.603**	.595**	.634**	.756**
Training design	.603**	1.000	.578**	.665**	.630**
Training content	.595**	.578**	1.000	.530**	.617**
Training delivery	.634**	.665**	.530**	1.000	.612**
Training material	.756**	.630**	.617**	.612**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Own

The above table indicates the Pearson Correlation Coefficient between the study variables (Employee Performance) as the dependent variable, and (Training factors) as the independent variable, the results show that there is strong positive relationship between employee performance and all the training factors, the highest relationship exists between employee performance and training material where ($R=.756$, $p<0.01$), and the second factor that have the highest impact on employee performance which is the Training Delivery.

Hypothesis # 1 Discussion

The authors concluded that the most important factors affecting the efficiency and the effectiveness of training in an organization which is the training delivery and training material. Training delivery associated with how trainees engaged in training and understand the training materials such as; in-person or virtual training, interactive learning guides, video simulation, group participation, hands-on activities, role-plays and mentor shadowing; while training materials such as questionnaires, discussion questions, exercises, pre-tests, and activities, etc.

Study Hypothesis # 2

H0-2: There is no significant influence of Training factors on Employee Performance in the banking industry in Palestine

Table 3. ANOVA and R-square for Employee Performance Econometric Model

Model	Sum of Squares	df	Mean Square	F	Sig.	R	R Square	Adjusted R Square
Regression	12.288	1	12.288	62.589	.000[b]			
Residual	9.227	289	.196			.756a	.571	.562
Total	21.515	290						

a. Dependent Variable: Employee Performance

b. Predictors: (Constant), Training Design, Training Content, Training Delivery, Training Materials.

Source: Researchers

The above table shows that there is an existed relationship between the study variables; the independent variable (Training Factors) contributes in predicting employee performance, R^2= 0.571 which mean that training factors explain 57.1% of the variation in employee performance, while R=.756 which indicates that there is a significant strong relationship between the independent and the dependent variables.

Table 4. OLS Summary

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.303	.312		4.178	.000
Training Material	.477	.094	.588	5.105	.000
Training Delivery	.208	.087	.274	2.383	.000

Source: Researchers

Multiple regression analysis used to test if training factors significantly predict employee performance, the results as revealed from table 4 indicates that the two variables (Training Material & Training Delivery) explained 57.1% of the dependent variable variance (Employee Performance), the below equation shows the econometric equation in this study.

Employee Performance= 1.303 + 0 .477 Training Material + 0.208 Training Delivery

Hypothesis # 2 Discussion

The above equation means that there is an existing and direct impact between Training Material and Training Delivery with employee performance. These two factors have the most significant impact on predicting the variance in Employee Performance, it means that organizations and companies should focus on these factors to enhance the employee's performance level and improving the organization overall performance.

5. Conclusion

The study shows that there is no significant relationship between training content and design with employee performance; while it shows a clear significant and direct relationship between training material and delivery with employee performance.

Training Delivery and Materials have the most influencing impact on employee's performance. The authors in this study investigated the main reasons that have the direct impact on Banking industry employee's performance from the employees' point of view, it helps in revealing the critical success factors that enhance and improve the employee performance in these sectors.

6. Recommendations

The study recommends that employer should consider focusing on giving useful and easy to read/see material, handouts and activities in training and also the employer should consider focusing on training that best help employee in learn and apply various types of skills and knowledge, and provides clear instructions for all activates, besides, trainings with reasonable time duration, delivering training in the best way that fit employees capabilities and capacities to gain more competencies and understanding in achieving the training goals and objective which lead to higher work performance in the organization.

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HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES
Institute of Technology

APPLICATION OF TWO TECHNIQUES USED FOR MEASURING THE SOIL STRENGTH: A REVIEW

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Abstract: This paper reviews the application of two techniques are used for the measurement of soil strength. The two techniques (cone penetrometer and bevameter) enable measurements to be made in situ. However, the penetrometer is the only equipment that can evaluate soil resistance variation with depth. Neither the cone index nor the gradient that belongs to it concerning the depth is uniquely associated with density or soil cohesion but varies with structural state and moisture content. Moreover, the formation of compaction zones and soil bodies ahead of the cone efficiently alters its geometry, thus the penetration no longer reveals the original characteristics of the soil. Furthermore, the bevameter technique only identifies surface soil properties. Nonetheless, among all the presently available techniques, the bevameter gives the closest imitation of vehicle-terrain interaction.

Keywords: cone penetrometer, bevameter, soil measurement techniques, soil properties, plate-sinkage test.

1. Introduction

The mechanical characteristics of terrains are usually classified into shearing properties in the tangential direction and bearing in the normal direction (Ding et al., 2014). The proper assessment of the mechanical qualities of a given terrain is primary to forecasting off-road vehicle mobility (e.g., motion resistance, gross traction, and net traction). Mechanical features of soils are measured by numerous techniques, two of which involve the bevameter and the cone penetrometer (Mason et al., 2020). In this work, the employment of the cone penetrometer and the bevameter techniques for estimating surface soils' strength/deformation properties are reviewed.

2. Cone penetrometers

Cone penetrometers are part of the simplest and most popularly used instruments for evaluating soil suitability for carrying traffic of ground vehicles. Cone penetrometers supply an indicator for the state of the soil based on cone penetration resistance that relates to shear strength, moisture content, and bearing capacity. They can be utilized to rapidly gather various soil state measurements at different depths in large areas (Goodin et al., 2016)

The cone penetrometer method was developed by the WES (Waterways Experiment Station) of the United States Army Corps of Engineers during the Second World War (Wong, 2010). The aim was to provide reconnaissance personnel and military intelligence with simple field equipment for estimating terrain trafficability and vehicle mobility on a 'go/no go' basis. This cone penetrometer which was developed by WES (Figure 1), has a right circular cone of 30-degree with a base area of 3.23 cm^2 and a long shaft of 15.9 mm in diameter. Also, it contains a proving ring including a handle and a dial gauge are mounted on the shaft's top to show the penetration resistance. Due to the penetration resistance recorded relies on many factors such as shape and size of the cone, surface roughness, and rate of penetration for both convenience

in describing the results and uniformity in testing, the American Society of Agricultural Engineers has established standards for tests of a soil cone penetrometer (ASAE, 1983; Perumpral, 1987). When penetrometer tests are carried out, the dial indicator is firstly set to zero. After that, dial gauge readings are recorded at each 2.5 cm added penetration while the penetrometer is pressed into the soil. During the penetration test, it is arduous to sustain a constant penetration rate (almost 1829 mm/min) manually. Therefore, recording type penetrometers with a suitable mechanism for conserving a penetration with a constant rate have been developed to reduce the manpower needed and to avoid a manual operation (Taghavifar et al., 2017). A parameter called the cone index (CI) can be obtained with the penetrometer. It expresses the penetration resistance into the terrain per unit area of the cone base. The index indicates the combined compressive and shear characteristics of the terrain as well as the fiction and adhesion on the interface of cone-terrain (Wong, 2010).

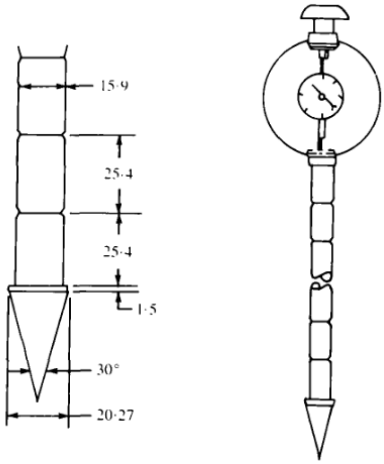

Figure 1. Cone penetrometer (dimensions are in mm) (Okello, 1991)

The measurements of soil strength are influenced by soil water content, clay content (or texture), and bulk density of the soil (Chung et al., 2013). Many studies have employed the equipment to monitor the engineering characteristics of soils and evaluate compaction quality.

Hong et al. (2019) developed a dynamic cone penetrometer (Figure 2) integrated with TDCP (time-domain reflectometry sensors) for estimating the water content of subsurface based on the relative permittivity which compensated by the temperature of the ground and for distinguishing strength via the penetration index. The experimental results were verified and compared to others, as shown in Figure 3.

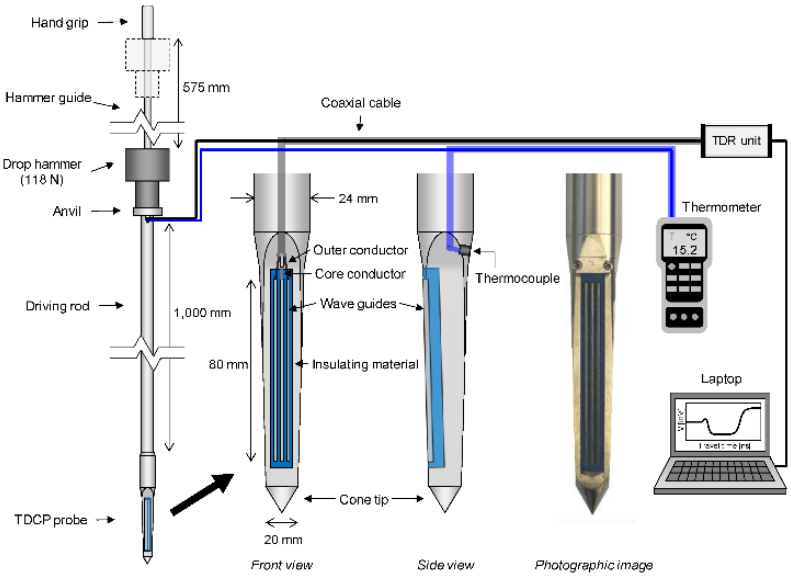

Figure 2. Dynamic cone penetrometer integrated with TDCP (Hong et al., 2019)

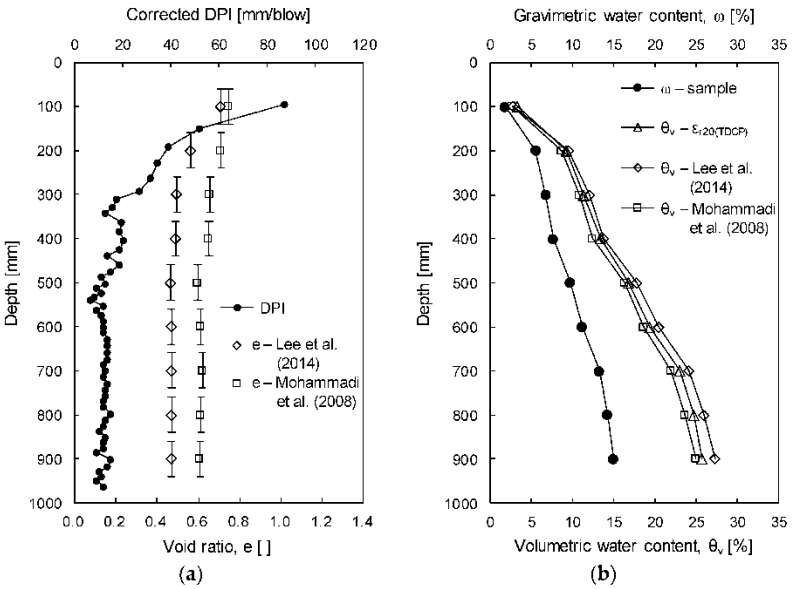

Figure 3. Verifying the experimental results: (a) Corrected void ratio and dynamic cone penetration index (DPI); (b) Estimated and evaluated water contents (Hong et al., 2019)

They concluded that the subsurface volumetric water content can be reliably assessed from the test results of the TDCP. Further, the TDCP developed is a portable apparatus for penetration testing that can distinguish ground strength and moisture content with minimal ground disturbance and high mobility.

To determine the distribution of soil density in sandy loam soil deeper layers, Pillinger et al. (2018) employed the cone penetrometer. Their calculated soil density values based on the depth are shown in Figure 4. They found out that the bulk density can immediately be concluded on the field from the outcomes of CI measurements with a modest interference on the soil.

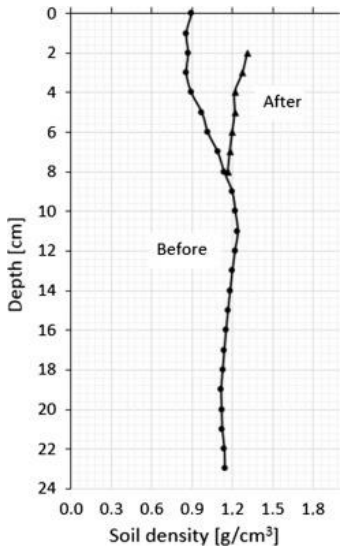

Figure 4. Soil density determined from the cone index (CI) data (Pillinger et al., 2018)

Beckett et al. (2018) used a dynamic cone penetrometer in ripped agricultural soils to detect the compaction after the passage of a heavy tractor, which was ideal for vehicles worked at the test site. Mean penetration resistances as well as their standard deviations at (Test 1) no traffic; (Test 2) agricultural vehicle one pass; and (Test 3) same vehicle five passes are shown in Figure 5. They concluded that dynamic penetrometers are not advised to monitor the compaction of ripped soils for the applied weight of the vehicle. However, the apparatus might be of use when investigating the heavier vehicles' passage.

de Lima et al. (2017) examined the hypothesis that soil matric suction (h) and penetration resistance (PR) do not vary with compactness degree (CD) under various soil textures. Their study explored the agricultural

field traffic effect on the differences in soil compaction indicators, especially, a) to quantify the immediate impacts of field traffic on the compactness degree, penetration resistance, and matric suction (as shown in Figure 6) and b) to assess the behavior of these variables (on soil type oxisols that have various clay contents) as indicators of compaction after traffic. They concluded that at around field capacity, the clay oxisol is further susceptible to compaction than the sandy clay loam. Texture affected penetration resistance and matric suction for compaction detection. The friction effect diminished with increasing clay, and even with compaction, the variations in penetration resistance were not significant.

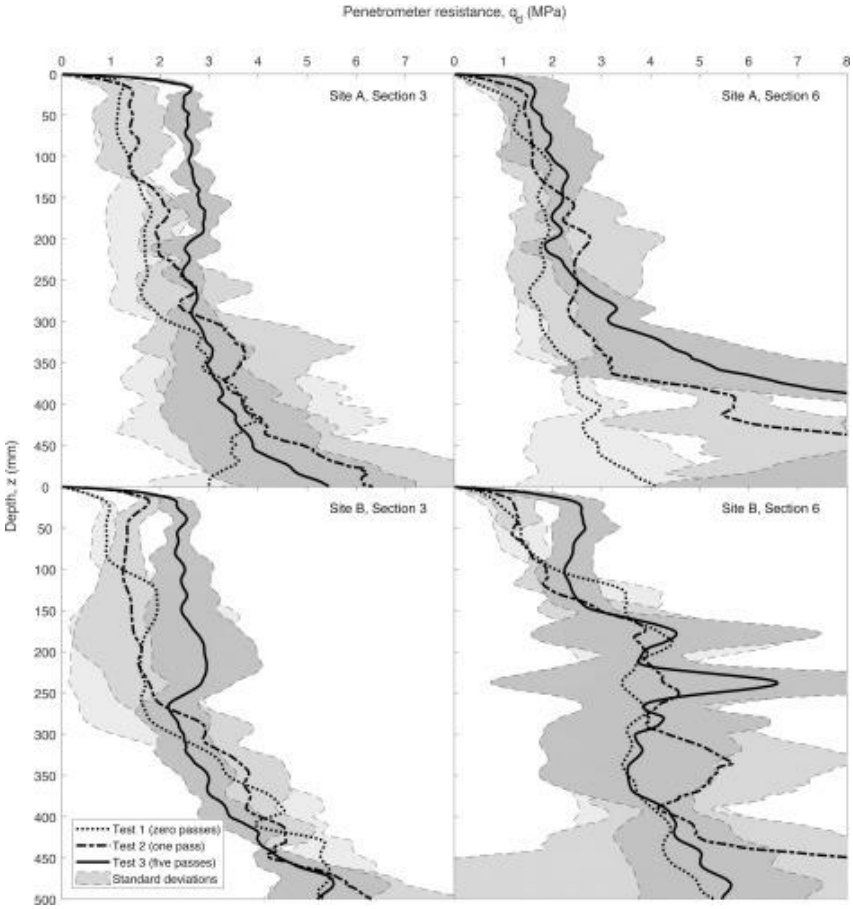

Figure 5. (A) Loamy sand soil [top] and (B) Sandy clay [bottom]: penetration resistance average and standard deviation of tests 1–3 (Beckett et al., 2018)

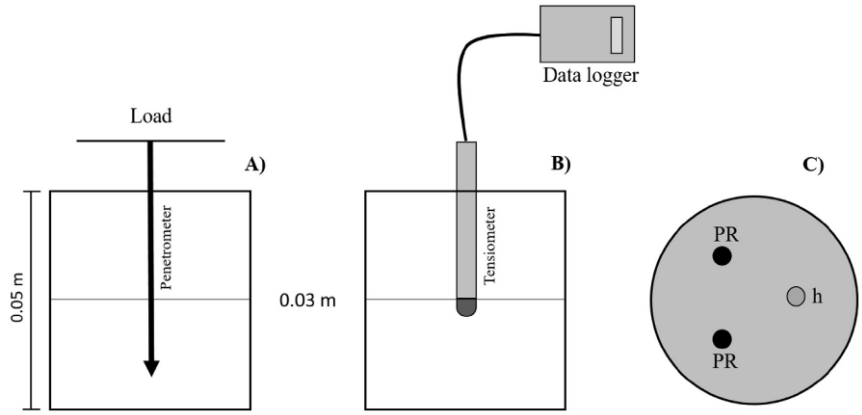

Figure 6. A schematic of the procedure utilized for determining (A) PR and (B) h, both of them were evaluated at a depth of 0.03 m; (C) depicts the soil core surface positions (de Lima et al., 2017)

Máthé and Kiss (2015) used the cone penetrometer to determine the rolling losses of a towed vehicle.

Lin et al. (2014) Validated four of the existing cone index models using a DSVP (developed dual-sensor penetrometer) (Figure 7). The methodology was to utilize the DSVP in order to simultaneously measure volumetric soil water content (θv) and cone index, and subsequently to compare the bulk density core-measured to that model predicted through the DSVP data. Under the laboratory condition, two soil types (clay soils and silt-loam) were examined. They concluded that two out of four models inspected fit the experimental data. Furthermore, the results intimated that the DSVP coupled with two of the models could be employed as an instrument to predict Db when θ and CI are simultaneously measured.

Miyamoto et al. (2012) employed individual probes for water content (θ) and penetration resistance (PR) measurements in the same site by employing a TDR (simple time domain reflectometry) and a conventional cone penetrometer prob. TDR probe mounted on a shaft (Figure 8) was designed for tightly and easily inserting inside the holes that created from the usage of the cone penetrometer.

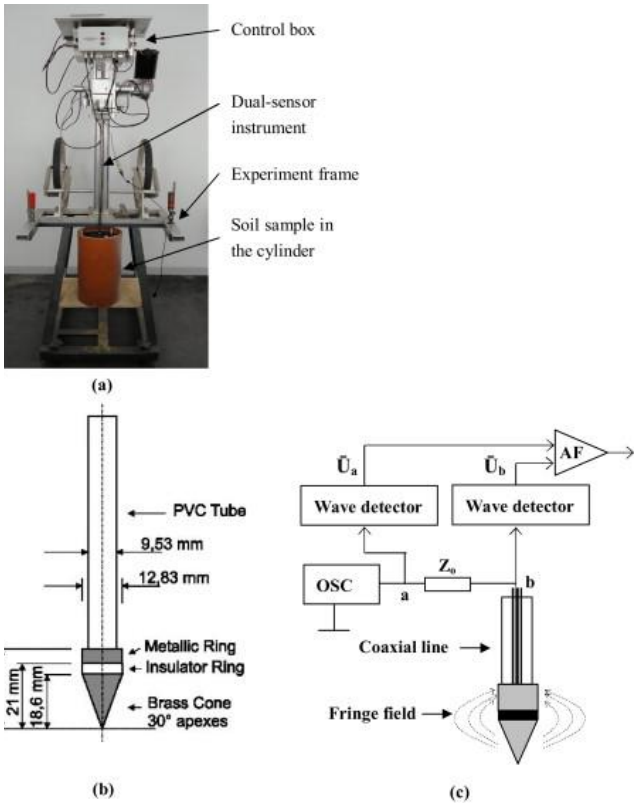

Figure 7. (a) Dual-sensing vertical penetrometer, (b) Soil water content sensor electric layout, and (c) Combined cone dimension (Lin et al., 2014)

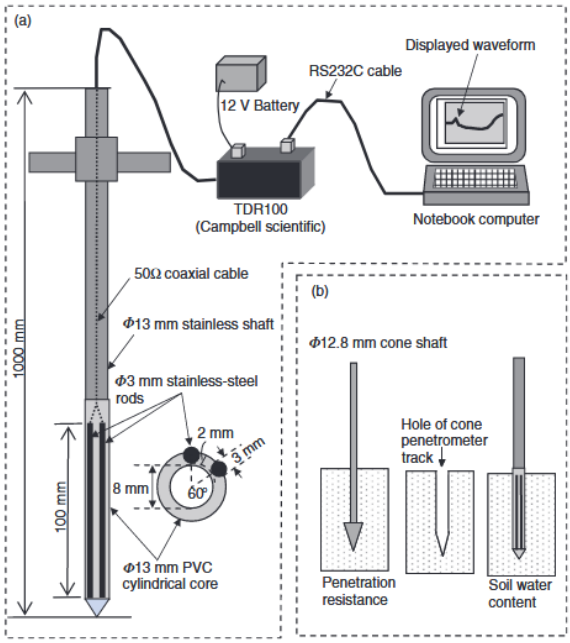

Figure 8. Schematic illustration of (a) TDR probe and measurement system, and (b) TDR measurement utilizing the cone penetrometer hole (Miyamoto et al., 2012)

The results of the PR and θ measurements shown in Figure 9, the field results illustrate that soil water content and PR have three-dimensional variability, besides a notably various distribution pattern between subsoil and cultivated layers in the field scale. They concluded that their method provides results applicable for the field management of water and soil since it is based on an easy and simple technique for the coincident measurement of PR and soil water content.

Gao et al. (2012) investigated the influence of compaction on cone penetrometer resistance in approximately wet soils at not less than −30 kPa matric potentials utilizing five soils with diverse organic matter contents and textures. These conditions of soil moisture are characteristic of the matric potentials to which the southeast of England soils drain in winter. They stated that for five soils with different texture, initial soil water content, and organic matter content, the penetrometer resistance is a function of the slope of the compression and the precompression stress characteristic.

To efficiently remove the hardpan, S. Gorucu et al. (2006) developed an algorithm for defining the depth of optimum tillage from the measurements of a soil cone penetrometer. The results of Dothan loamy sand

soil showed six main patterns of penetrometer profiles. They affirmed that the location and the thickness of the hardpan could be determined from the data of the soil cone penetrometer. They have observed a variation in the thickness and the depth of the hardpan (almost 4 to 25 cm) and in the depth of optimum tillage (about 25 to 45 cm).

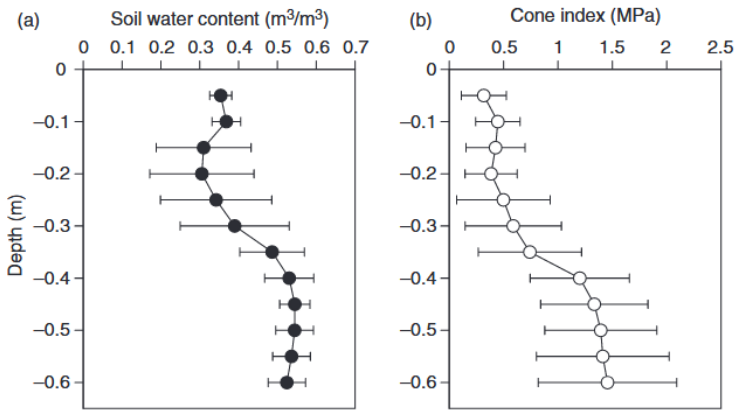

Figure 9. Averaged profiles of (a) Soil water content and (b) Penetration resistance. (Miyamoto et al., 2012)

Herrick et al. (2002) developed a dynamic cone penetrometer (Figure 10) with a durable, low-cost, and reliable alternative to strain gauge-based instruments. They found out that it is particularly suitable for almost all applications that the static penetrometer could be used in a manual operation. Moreover, it is especially useful for implementations in which the conditions of soil are highly unsteady or the operator consistency is questionable. Nevertheless, it is sensitive to variations in soil texture and moisture and could not be utilized as a substitute for soil bulk density direct measurements. Furthermore, the penetrometer could be used to monitor alterations in the condition of the soil in response to management as well as to identify areas where it is required more detailed measurements. Additionally, It could also be utilized to locate potential zones for compaction rapidly within areas and a profile of compaction inside a field.

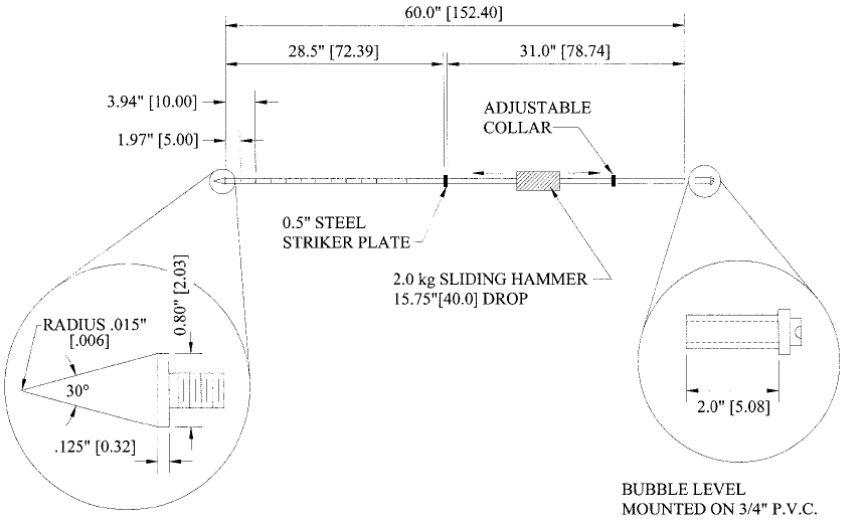

Figure 10. Dynamic cone penetrometer design (the dimensions are in inches [cm]) (Herrick et al., 2002)

Hernanz et al. (2000) utilized the cone penetrometer to construct an empirical model capable to accurately evaluate the bulk density of well-drained loamy soil as well as can be employed to obtain other variables (such as the water accumulated within the soil profile). Figure 11 presents the measured and predicted bulk density profiles during the growing season of the year 1994/95 of the conventional tillage system. They reported that their model has provided good outcomes under field conditions and accurately estimated the accumulated water profiles and soil bulk density profiles.

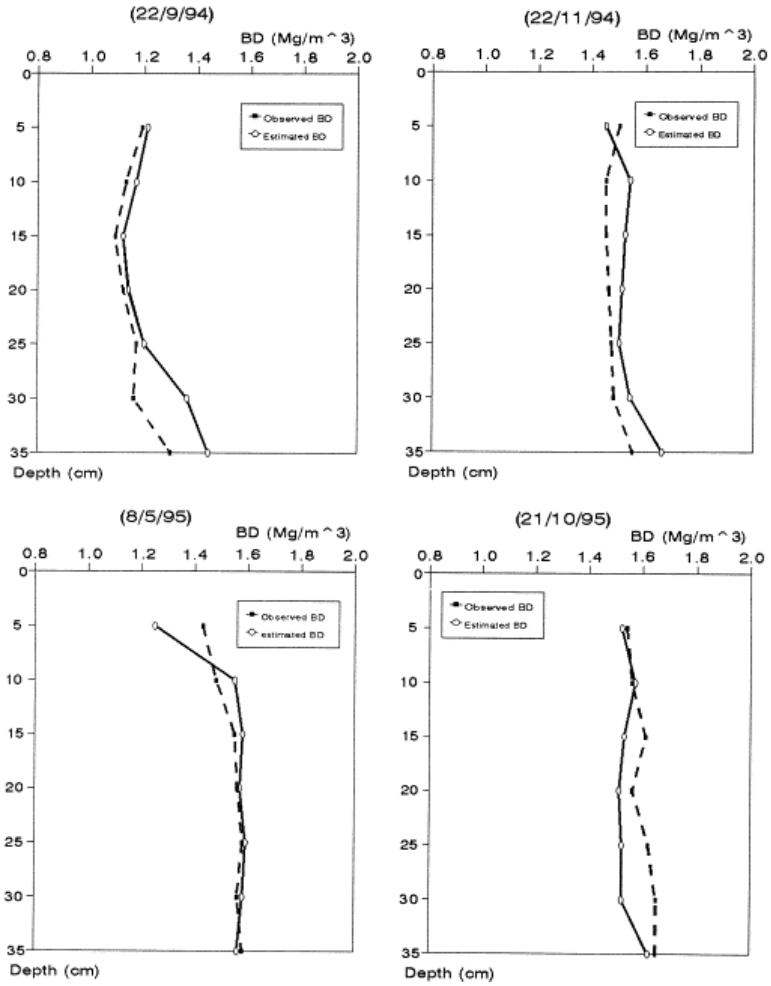

Figure 11. Different soil bulk density profiles measured under the field conditions and investigated with the proposed model (Hernanz et al., 2000)

3. Bevameter technique

Bekker (1956) developed the bevameter technique to simulate the forces encountered by a wheel following typical loading conditions through applying standard mechanical loads in soil test beds. Two kinds of tests are usually conducted: the shear test and the plate penetration test. A plate penetration test is useful in estimating a wheel response to a normal load by means of pressing a flat plate on the soil by a piston and then measuring the response by a vertical motion displacement transducer and a load cell. The soil pressure-sinkage relationship is measured throughout the penetration test. Through a shear test of bevameter, an annular shear ring under pre-selected normal stress mimics the vehicle running-gear shearing action by rotating over the terrain surface. The corresponding angular displacement and the applied torque are measured during the test (Edwards et al., 2017). Janosi states, "the bevameter is the standard method for scientific and engineering exploration of soils and off-road vehicle design" (Mason et al., 2020). Figure 12 shows the original bevameter which was built at the Newcastle University, upon Tyne, England, and extensively modified at the University of Carleton, Ottawa, Canada (Wong, 2010). Several studies have developed and used the device to measure the terrain properties under loading.

Mähönen et al. (2021) modified a portable bevameter (shown in Figure 13) to estimate the snow's mechanical properties. The aim of the bevameter was to measure the properties of snow which could be utilized to simulate the interaction between soft snow and a snowmobile. Figure 14 demonstrates the result of pressure-sinkage of plate diameters of 200 mm and 300 mm. They reported that the built bevameter is a tool that could be used for the measurements of the field to estimate snow properties for the simulations of the snowmobile-size vehicle by sensor ranges: Force: 0-2 kN, Torque: 0–200 Nm, and Distance: 0–600 mm, which cover a broad range of typical snowmobiles. Furthermore, the constructed equipment could be utilized to classify different sorts of snow and to recognize hard layers.

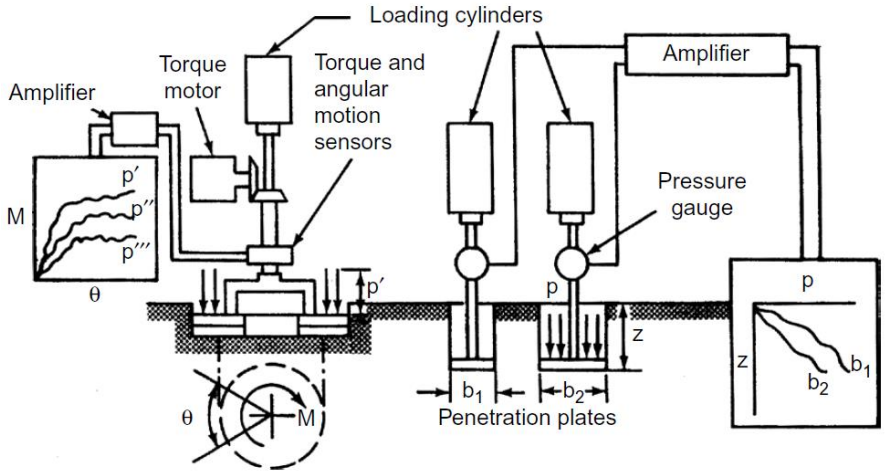

Figure 12. Bevameter schematic diagram (Wong, 2010)

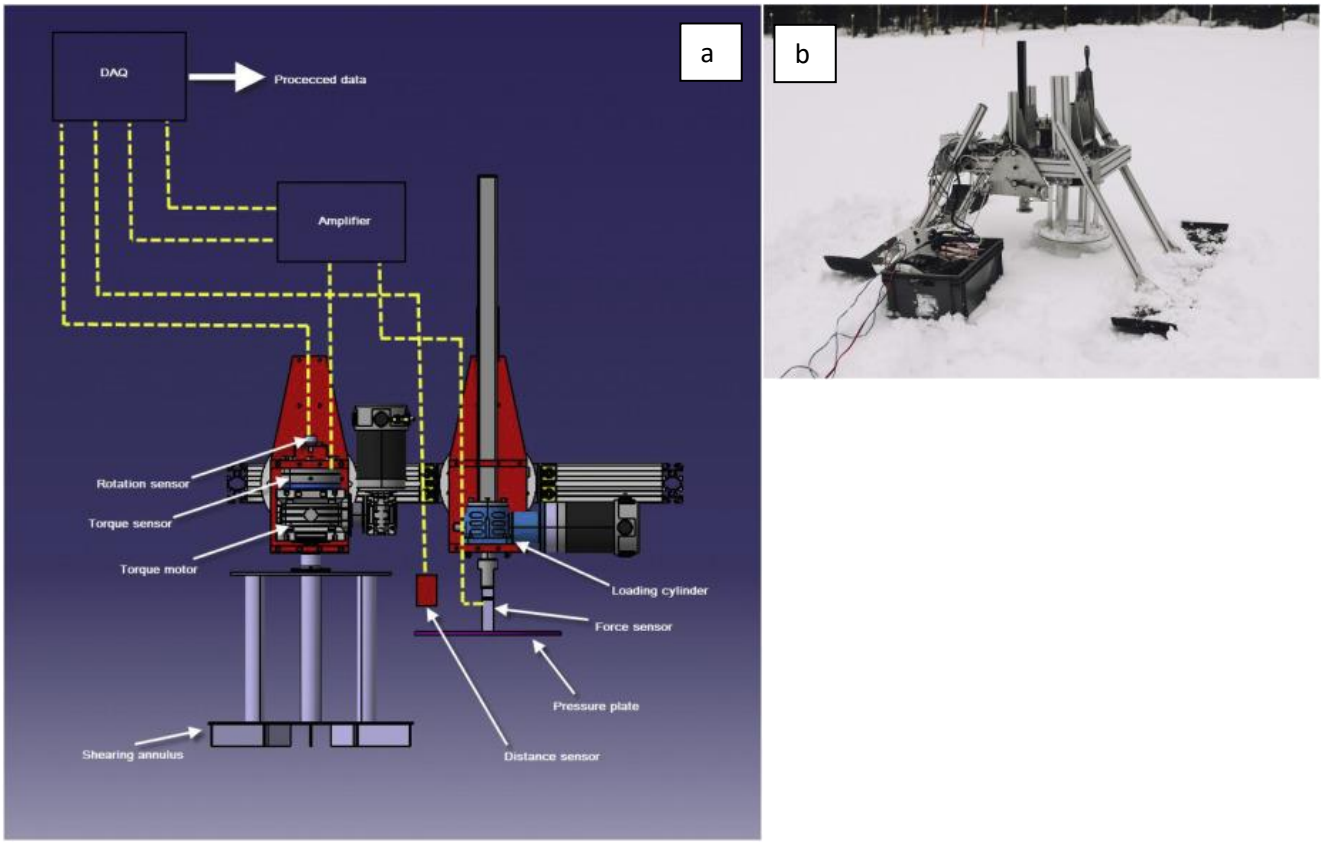

Figure 13. (a) Bevameter schematics. (b) testing of bevameter (Mähönen et al., 2021)

Massah et al. (2010) designed a tractor-mounted bevameter (shown in Figure 15) with various shapes and sizes of plates (rectangular, circular, and oval) and examined it in a loam soil type field. By employing statistical analysis and diagrams produced from collected data, they found out that the sinkage plate shapes had a considerable impact on the soil parameters. Further, the vertical deformation of the soil is influenced by the sinkage plate shape. Moreover, the values of soil parameters are affected by the values of dimension plate and pressure-sinkage.

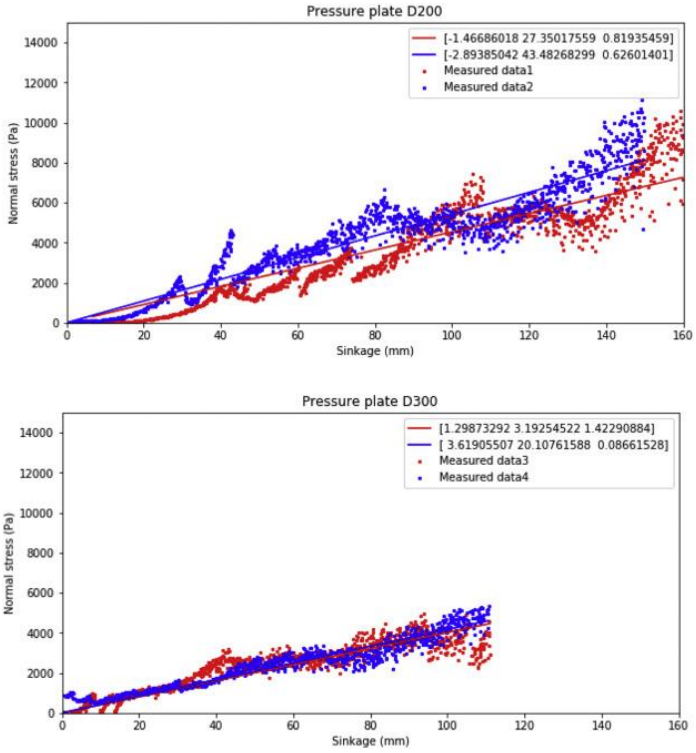

Figure 14. Pressure-sinkage data as well as its fitted curves (Mähönen et al., 2021)

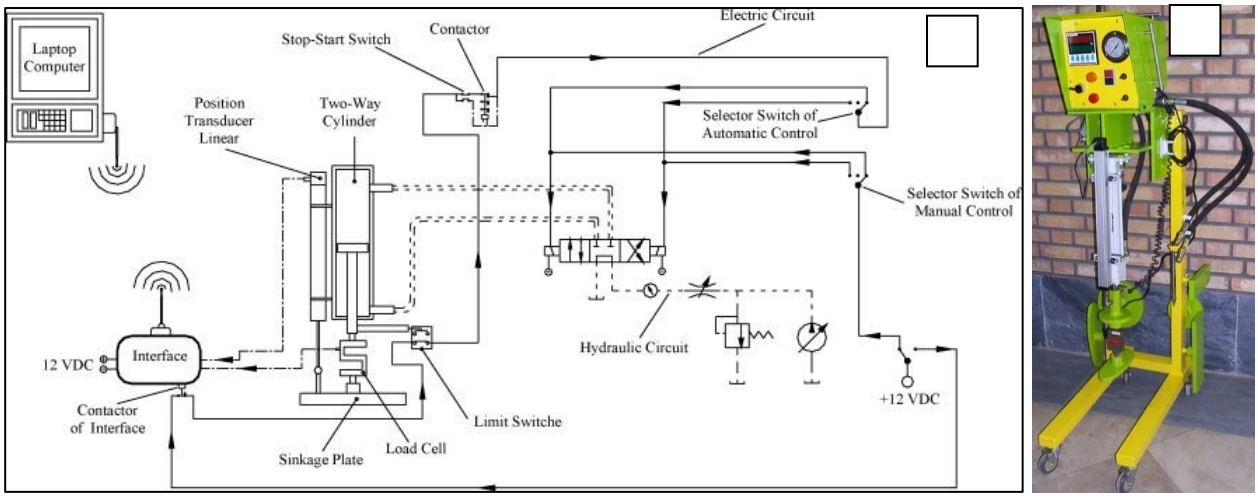

Figure 15. (a) Schematic of bevameter control system, (b) Tractor-mounted bevameter unit on a carrier (Massah et al., 2010)

Zeleke et al. (2007) determined in situ mechanical characteristics (of two types of forest soils in Ireland) that could be used for their pressure-sinkage properties prediction. The plate sinkage test (Figure 16) was utilized to determine the forest floor mechanical properties. The stiffness values of Young's modulus, the underlying weak peat substrata, and surface mat were determined from the experimental data of an in situ load-sinkage obtained from the sites. They developed a non–linear model by which the pressure-sinkage characteristics were predicted for the forest floor with an error rate of less than 19%. The non-linear model application for the potential site damage prediction by extraction machinery traffic and timber harvesting was exemplified. They observed that such model application has an advantage in which it only requires the soil Young's modulus and the configuration of harvesting machine to be known.

Gotteland et al. (2006) presented a new method for the soil penetration tests modeling by using an experimental device named DECART (shown in Figure 17) as a result of the experimental investigation of

three standard soils. These soils were chosen to represent the mechanical characteristics of a range of soils: silty sand of cohesive frictional soils, sand for frictional soils, and silt for cohesive soils. The models take into concern the soils' mechanical behavior in which a small vertical sinkage could be assumed comparable to elastic behavior, while the analogy being with plastic behavior in the case of large sinkage. They concluded that the new model permits the pressure-sinkage curves prediction for different plate diameters. It is supposed that this model permits a realistic extrapolation for the bearing surface of a vehicle.

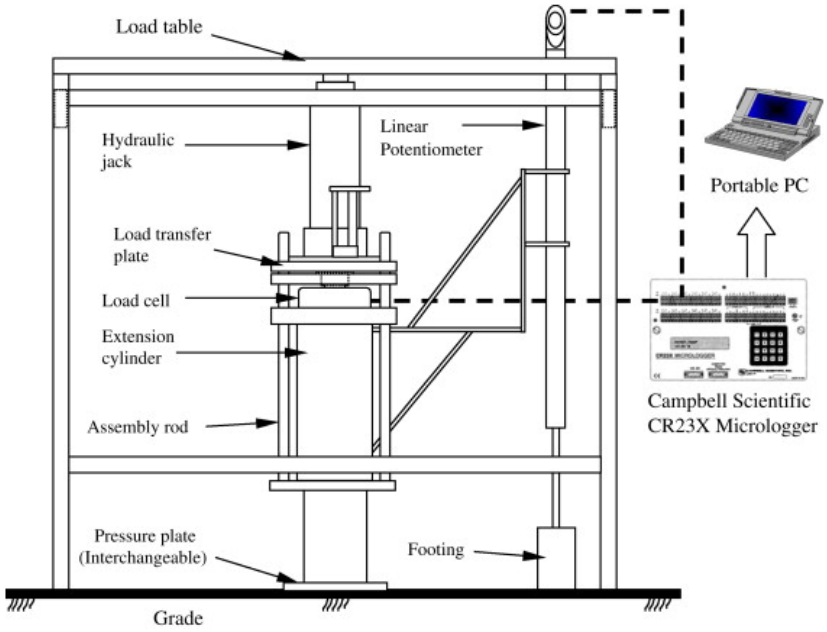

Figure 16. Schematic of the plate–sinkage data acquisition system (Zeleke et al., 2007)

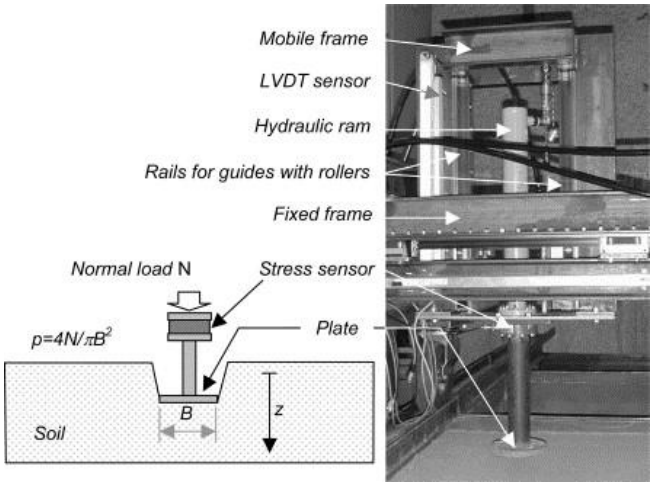

Figure 17. Sinkage-plate equipment (Gotteland et al., 2006)

In order to predict the soil compressibility of the in situ, Mosaddeghi et al. (2006) evaluated two methods confined compression test (CCT) and plate sinkage test (PST). For conducting the in situ CCT and PST, quasi-static loading equipment was designed as shown in Figure 18.

They stated that the PST results can be applied in sustainable soil management in the region concerning trafficability and the influence of different tillage/management systems on soil behavior. The measuring of pre-compaction stress, water content, and cone penetration resistance relationships was recommended for the series of important soil in the region of the test. Also, for practical applications, it was advised to include the soil maps.

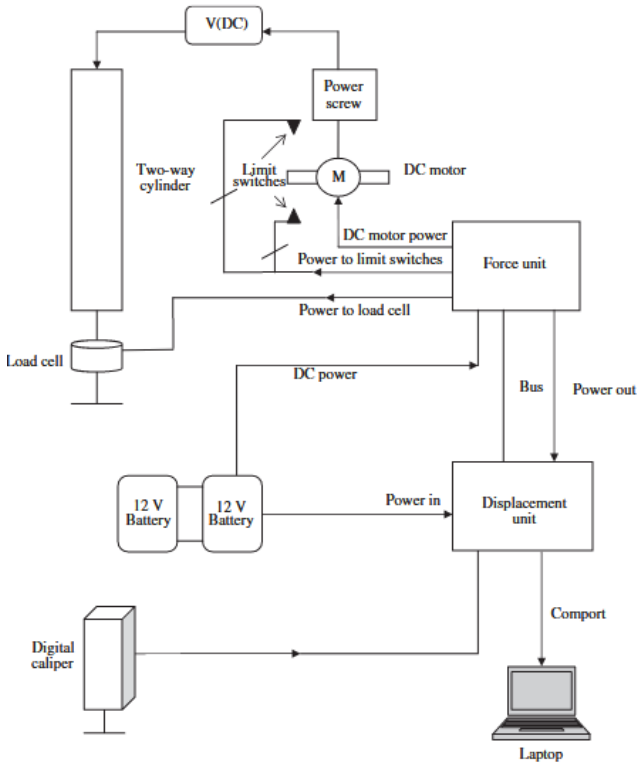

Figure 18. Schematic of an in situ tester of soil compressibility (Mosaddeghi et al., 2006)

To measure soil characteristics relevant to traction, Upadhyaya et al. (1993) developed a fully instrumented apparatus. The equipment could measure soil sinkage parameters (exponent and sinkage constant) employing sinkage plates and soil shear parameters (shear modulus and maximum shear stress) using grouser plates. Furthermore, this device could be utilized for measuring soil cone index. The field tests have been conducted using three various rectangular plates (sinkage tests) and five various rectangular grouser plates (shear tests) in a tilled and a firm Yolo loam soil. The outcomes of these tests confirm that the device serves well in all examined modes.

Alexandrous et al. (1995) proposed a technique that proved its capability of identifying the field soils' pre-compaction stress in situ with good accuracy utilizing the results of the plate sinkage test. This technique included the use of the plate sinkage equipment of tractor-mounted and thus was somewhat cumbersome for general usage. The results were only valid for specific soils tested and cannot be extrapolated to another condition. Later, the author (Alexandrou et al., 1998) determined the relationship between initial dry bulk density, pre-compaction stress, and volumetric water content was examined by employing the data results of the proposed device.

Golob (1981) developed a bevameter that could perform both shear and pressure-sinkage tests by a single hydraulic cylinder, besides could store digital data instead of analog data.

4. Conclusion

As demonstrated by the literature search described in this study, the cone penetrometer has been widely employed in numerous varied implementations. Their popularity could be ascribed to the subsequent reasons: they are easy, quick, and economical, they supply test data that could be analyzed easily, and they are good means for examining sands where the undisturbed sampling is hard. In spite of the popularity of utilizing a cone penetrometer, It is generally admitted that the cone index solely is not sufficient appropriately to define the terrain mechanical properties that are relevant to vehicle mobility.

The bevameter technique seems to be the most proper method for soil strength evaluation. This is mainly due to it does not demand soil parameters interpretation via a model such as proposed for the cone and, maybe more importantly, it represents the technique that most nearly simulates the real situation. Further, it characterizes the parameters of soil directly that cut out errors caused by such interpretation. In addition, the bevameter is the only apparatus that can give a maximum value for the soil shear at the topmost layer that is

in contact with the vehicle. Moreover, the bevameter provides more information about soil properties that could be employed in the prediction systems, which is based on more analysis. In conclusion, the bevameter and cone penetrometer have remained the most common instruments for soil characterization.

Acknowledgment

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HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES
Institute of Technology

A RECENT MACHINE LEARNING TECHNIQUES FOR FAILURE DIAGNOSIS OF ROLLING ELEMENT BEARING

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Abstract: Rolling element bearings are critical components of rotating machines, and fault in the bearing can cause the machine to fail. Bearing failure is one of the leading causes of failure in various rotating machines used in industry at high and low speeds. Fault diagnosis of various rotating equipment plays a significant role in industries as it guarantees safety, reliability and prevents breakdown and loss of any source of energy. Early identification is an essential element in the diagnosis of defects that saves time and expenses and avoids dangerous conditions. Investigations are being carried out for intelligent fault diagnosis using machine learning approaches. This article gives a short overview of recent trends in the use of machine learning for fault detection. Finally, Deep Learning techniques were recently developed to monitor the health of the intelligent machine are discussed.

Keywords: machine learning, rolling element bearing, failure detection, artificial intelligent method, deep learning

1. Introduction

Rotating machines are widely used in industrial environments because of their cost-effectiveness, performance, and durability. They are frequently exposed to harsh working environments such as higher load, higher speed, and restricted lubrication. Rolling element bearings are the most vulnerable component of a machine. However, they are frequently operated in harsh and hazardous conditions, resulting in component failure during operation, jeopardizing worker safety and resulting in economic loss. Over 42% of mechanical failures are due to bearing failure (Singh et al., 2019).

According to Heng (2009) the primary cause of mechanical failure was bearing failure, which resulted in an increase in warranty and maintenance costs. In some instances, bearing failures can result in the total failure of the machinery. This has risen to prominence as a critical subject area as a result of the ease with which the health of rolling element bearings can be determined using specific techniques such as machine learning. The vibration signature reveals, there is a symptom indicating early that information, it serves as a crucial indication of a problem within them. The main failure reasons of rolling element bearing are imbalance shaft faults, ball bearing defects, inner race faults, outer race faults, and cage faults.

A bearing consists of an inner, outer race and rollers, but in many cases is made up of more than one type of each of these. The geometry of the bearing can produce a unique frequency for each bearing. The outer race of rolling element bearing is typically stationary, with most of its faults occurring in the load zone. As a result, the defect impulses will not be modulated in the manner depicted in Figure 1. In comparison, the defect impulses for inner race faults and rolling elements are modulated at shaft frequency and FTF as they pass through the load zone (Robert B Randall, 2004). Additionally, even harmonics of the BSF are frequently dominant, as the rolling element's fault engages the inner and outer races once per revolution.

The traditional methods of detecting the presence of a bearing fault solely rely on the frequency characteristics. When we examine the data signals closely, we notice that they contain a hidden pattern that is difficult for humans to identify. As a result, researchers began developing machine learning algorithms

such as ANN, KNN, and SVM. These algorithms analyse the data pattern and make an intelligent determination regarding the presence of a bearing fault. The majority of these algorithms produce satisfactory results in classifying bearing faults with greater than 90% accuracy. Over the last five years, deep learning techniques have been used to improve and increase the accuracy of fault classification.

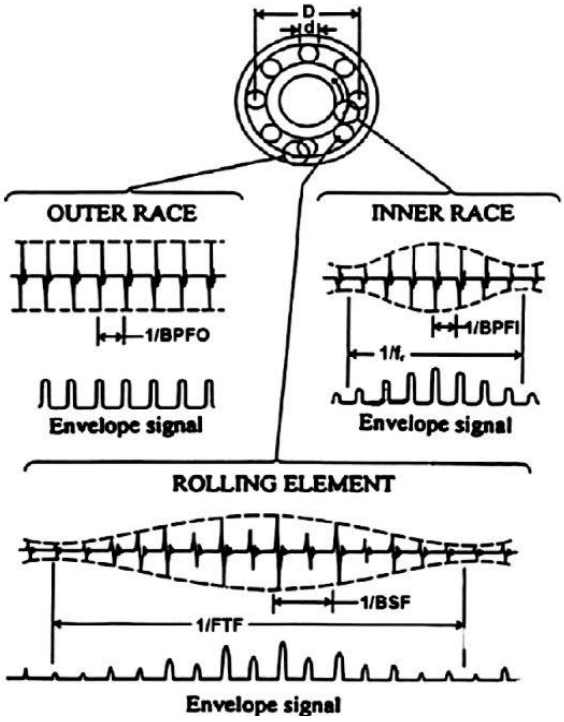

Figure 1. Rolling element bearing vibration signal characteristics due to local faults (Robert B Randall, 2004)

The purpose of this article is to provide an overview of recent trends in research on rolling element bearing failure diagnosis by using machine learning techniques and also Deep Learning techniques and their benefits.

2. Modes of Bearing Failure

Different factors such as cracks, mechanical damage, wear and tear, corrosion and insufficient lubrication can cause faulty bearings. The components of the coating are progressively wear deteriorated. As a result of poor lubrication, friction between the contact surfaces increases, leading to increased bearing element temperature (Heng et al., 2009). In the following, most of the failure modes occur in roller bearing as demonstrated Figure2:

1. Fatigue:
   It starts with a small crack on the bearing surface (rollers or races) due to a change in the material structure caused by repeated stress in the contact areas.
2. Wear:
   Wear is produced by dirt or foreign particles inside the rolling in or against the seal rollers because of a deficiency of lubrication or compression.
3. Electric erosion:
   It is damage (in the form of craters) to one of the bearing components (rollers or races) caused by an electric current passing through the bearing.
4. Corrosion:
   Corrosion occurs when water or other corrosive agents enter the bearing through damaged seals, acidic lubricants, or a rapid change in operating temperature.
5. Plastic deformation:
   Plastic deformation occurs primarily when the bearing is subjected to an excessive load, causing the raceways to indent.

6. Fracture and cracking:
Fracture and cracking are the results of stress caused by abrasive treatment (impacts) or cyclic stress. Additionally, high heating can result in fracture and cracking.

a. Fatigue b. Wear c. Electrical erosion

d. Corrosion e. Plastic deformation f. Fracture

Figure 2. Modes of failure of rolling element bearing (Chen and Li, 2017).

3. Machine Learning (ML) Techniques for Failure Diagnosis:

Bearing fault diagnosis uses machine learning and artificial intelligence (AI) to improve the CM system and, as a result, the rotating machine's reliability. A wide range of algorithms are available in machine learning, and the algorithms are chosen based on the application (Raúl et al., 2019). There are three distinct types of machine learning algorithms: supervised, unsupervised, and semi-supervised. Supervised learning entails inputting known data and evaluating it using probability (Jiaying et al., 2019). In contrast, the input data are not known in unsupervised learning, and the algorithm is intended to detect data structures. For semi-supervised learning, input data are an input function of the combination of labelled and unlabelled values, with evaluation being conducted. The application of ML for the purpose of diagnosis and prediction in other fields are studied (Lijun et al., 2018).

Many different types of traditional ML methods are available, including ANN, SVM, Decision Tree, K-Means, KNN and Random Fault Diagnostic Forest Algorithm. The data must be processed with the Feature Engineering and Feature Extraction when the dimension of the data needs to be reduced and the main component analysis is used before transmitting the data to the classification algorithm (Awadallah et al., 2003).

Early detection of incipient defects has shown some research that AIs such as ANN, fuzzy and adaptive fuzzy can be detected (Filippetti et al., 2000) for electrical engines, with characteristics such as frequency spectrums investigated.

3.1 Artificial Neural Network (ANN)

Artificial neural networks (ANN) have recently gotten a lot of attention in the industrial world. Artificial neural networks (ANNs) are supervised ML algorithms competent enough to solve problems such as pattern detection, clustering, classification, regression and nonlinear functional estimation (Jammu et al., 2011). Additionally, ANN is used to process and classify data. Similarly, Jia et al., (2016) presents an AI self-adaptive FDD system inspired by genetic algorithms (GA) and nearest neighbour (NN). To find

approximation coefficients during the feature extraction stage, a two-dimensional discrete wavelet transform (2D-DWT) is used in conjunction with Shannon entropy. Additionally, GA and nearest neighbour techniques are used to determine the histograms of selected coefficients for use as inputs to the feature space selection method. The cost-effectiveness, non-contact, and non-intrusive nature of this method is the primary advantages. The multilayer perceptron (MLP) is a supervised learning neural network with multiple layers (Lei et al., 2011). Wenyi et al., (2011) is describe an approach for identifying FDD bearing faults using ANN for IM. Additionally, the proposed pattern identification approach makes use of two current sensors. Thus, a multilayer perceptron (MLP) is used, which has one and two hidden layers (Li et al., 2019).
Nerella et al., (2018) developed an ANN model to predict the size of defects in cylindrical roller bearings (N312). It was discovered that the experimental data and predicted values for the AE level are highly correlated (6.90 percent of error). Gunerkar et al., (2019) investigated ball bearing ANN and KNN classification of faults using successfully trained and tested wavelet transform data. Five significant features were fed into the ANN and KNN models as inputs. The proposed ANN model demonstrated exceptional efficacy in classifying the multiple faults described in the second fault class. As a result, such an ANN model can be used to diagnose multiple faults and as a novel approach to a particular diagnostic problem.

3.2 Support Vector Machine (SVM)

It frequently combines the wavelet method, empirical mode decomposition (Jiaying et al., 2019; Hinton et al., 2006), and spectral analysis (Lijun et al., 2018) to determine the time domain and frequency domain. The statistical properties of vibration signals, such as root mean square value, kurtosis, power spectral density, information entropy and sideband index, as the main identification targets. Each Statistical characteristics of vibration signals can be used to infer their overall characteristics (Li et al., 2019). However, the local information contained in the signal data will be masked by the statistical features, which cannot accurately reflect the signal's local details. The misclassification ratio is higher for problems involving multiple classifications and insensitive fault features. When dealing with large amounts of data, it's all too easy to fall victim to the disaster of dimensionality. Chen et al. (2021) propose a method for diagnosing rolling bearing faults based on refined composite multiscale fuzzy entropy (RCMFE), topology learning and out-of-sample embedding (TLOE), and a marine predators algorithm based on support vector machines (MPA-SVM). The proposed method was validated using data from Case Western Reserve University and fault diagnosis experiments performed on 1210 self-aligning ball bearings. The results demonstrate the efficacy of the fault diagnosis method, which is capable of diagnosing bearing faults with an accuracy of up to 100 percent.

3.3 Combined ANN and SVM

To achieve high diagnostic performance, it has been proposed to combine ANN and SVM techniques. More precisely, Yu et al., (2019) proposes an fault detection approach for rolling element bearings that is based on the extraction of statistical features from vibration signals. For this purpose, the statistical characteristics are derived using advanced signal processing techniques and central limit theory.
Notably, the output feature vector (statistical feature vector) is used as an input vector for a classifier that uses ANN and SVM to categorize various types of faults. As a result, the authors argued in this study that ANN and SVM could not provide an analytical guarantee for the FDD classifier's accuracy. Additionally, Bertolini et al., (2021) introduces an fault detection method for ball bearings that incorporates both ANN and SVM. Additionally, statistical techniques are used to reconstruct the time domain characteristics of vibration signals. Following this, the classification stage employs ANN and SVM (Li et al., 2020). Kankar et al. (2011) investigated ball bearing fault diagnosis using machine learning methods, the purpose of this research is to determine the cause of ball bearing failures using an artificial neural network (ANN) and a support vector machine (SVM). The results indicate that machine learning algorithms can be used to perform automated bearing fault diagnosis. It was concluded that SVM is more accurate than ANN.

3.4 KNN Based algorithm (kNN)

K-Nearest neighbour (kNN) algorithm is a classification algorithm in which the data are divided into various categories to predict the classification. David He et al., (2011) carried out a full detection of ceramic bearings using acoustic emission-based condition indicators (CI). Classification accuracy was improved by merging

all individual CI's, with this method more than 92% accuracy was accomplished. M. M. Ettefagh et al., (2020) a hybrid method was applied in association with "Genetic Algorithm" (GA) and K-Means clustering was used to find the fault in bearing, it was found that GA-K means algorithm gives better performance than traditional K-means. Jing Tian et al. et al., (2016) fault diagnosis of REB of electric motor was carried out. The extracted vibration signals are developed with the help of spectral kurtosis and cross- correlation, firstly decomposing the frequency domain to sub-signal, if the signals are faulty then envelope analysis is performed to detect four faulty signatures associated with IR, OR, rolling element and cage faulty that would be cited as a base reference signals, if the bearing comes under in any of these reference signals it would identify the signals as faulty and also hidden faults were able to be identified with this method. Thomas W. Rauber et al. (2015) have stated that KNN Based algorithm bearing fault diagnosis technique restricts the process summary to single feature model i.e. not more than one contemporaneous feature model is considered. Hence in this paper, sequence of several feature models with feature selection method is applied that will enhance the classification performance. A process description is carried out extensively and a simple k-NN classifier was able to produce the results. Wang et al., (2020) propose a KNN-based method for real-time online fault diagnosis of rolling bearings. The method is divided into two stages: model training for fault diagnosis and real-time online fault diagnosis. To begin, the vibration signal is pre-processed: classification, cleaning, segmentation, and feature parameter extraction are performed, followed by training and optimization of the fault diagnosis model. The results indicate that the fault diagnosis model based on KNN algorithm outperforms the fault diagnosis models based on C4.5 and CART algorithms, indicating that the fault diagnosis model based on KNN algorithm is more suitable for rolling bearing fault diagnosis. Utilizing this method to diagnose rolling bearings enables predictive maintenance prior to bearing failure and minimizes economic losses associated with unplanned downtime of critical equipment.

3.5 Deep learning diagnosis Techniques

Deep learning (Hinton al., 2006) basically refers to a class of ML techniques, where many layers of information processing stages in deep architectures are exploited for pattern classification and other tasks (Jia F et al., 2016) Deep learning has the potential to overcome the inherent deficiencies of traditional intelligent methods. It has the ability to adaptively capture sensitive fault information and automatically learn valuable fault features from raw data through multiple nonlinear transformations and approximate complex nonlinear functions with a small error. Thereby, they do not only get rid of manual feature extraction but also learn complex nonlinear relationships with ease. A high-level illustration of the basic differences between the conventional ANN and deep learning approach is depicted in figure 16. Deep learning models have several variants Schmidhuber (2015) such as deep auto-encoders (Rauber et al., 2015**)**, deep belief networks (DBMs) (Hinton et al., 2006), convolutional neural networks (CNN) (LeCun et al., 1998) and recurrent neural networks (RNNs) (Funahashi et al., 1993). Zhao et al., (2021) proposed a deep adversarial network with joint distribution adaptation for diagnosing rolling bearing transfer faults. To effectively address the aforementioned fault diagnosis issues, a joint distribution adaptation network with adversarial learning is developed. To begin, they construct a deep convolutional neural network (CNN) to extract features from training and test samples. Second, because the joint maximum mean discrepancy (JMMD) cannot accurately quantify the joint distribution discrepancy between different domains, an improved joint maximum mean discrepancy (IJMMD) is proposed to match the feature distributions the proposed method is capable of accurately matching distributions and extracting category discriminative and domain-invariant features shared by the source and target domains.
Shenfiel et al., (2020) develop an intelligent fault diagnosis method capable of operating on these real-time data streams to provide early detection of developing problems under variable operating conditions. They propose a novel dual-path recurrent neural network with a wide first kernel and deep convolutional neural network pathway (RNN-WDCNN) capable of operating on raw temporal signals such as vibration data to diagnose rolling element bearing faults in data acquired from electromechanical drive systems.

3.5.1 Convolutional neural network (CNN)

One deep learning technique is the convolutional neural network (CNN) approach. CNN is a feed forward neural network of multiple layers, which assumes inputs as images (S. Min et al., 2017). It was inspired by neurons of the human visual cortex that have two features (Y. LeCun et al., 2015). One is local connections,

which means that since images have high correlation within sub-regions, the correlation information is critical in recognizing those images, where the subregions in the previous layer are connected to local patches in the feature maps by filters. The other feature is shared weights, where a pattern can appear in various locations in the images, and by convoluting filters across an image, the pattern can be extracted independent of location. In addition, using the same filter across an image, the number of parameters is reduced significantly. Nowadays, many open-sourced CNN models are available (e.g., GoogLeNet, AlexNet) which make them attractive to researchers. CNN is structured by a series of layers, in which the convolutional and pooling layers come first, and the fully connected layers come last. A descriptive example of the CNN architecture is shown in Figure 3. The convolutional layer is used to detect local correlation from the previous layer (the raw input). It has a number of hyper-parameters, such as the number of filters, the filter size and the stride. Wang et al. (2020) propose a method for implementing CNN in fault classification, this method compresses the time-domain vibration signals of multiple sensors located in different locations into a rectangular two-dimensional matrix and then classifies the signals using an improved two-dimensional CNN. The method was validated using open datasets from Case Western Reserve University, the University of Cincinnati's IMS bearing database, and a dataset from a custom-built bearing fault test rig. It achieved 99.92 percent, 99.68 percent, and 99.25 percent prediction accuracy, respectively.

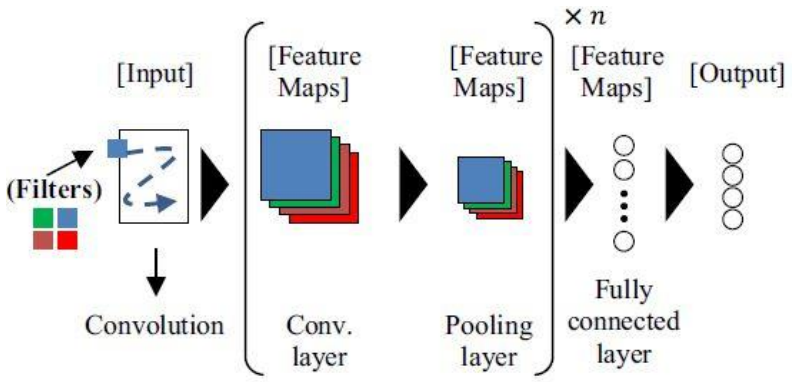

Figure 3. Descriptive example of convolutional neural network (CNN)

3.5.2. Deep belief network

The structure of deep belief networks (DBNs) is composed of a stacked network of restricted Boltzmann machines (RBMs). Each RBM consists of a visible layer (input), a hidden layer and an input layer. The schematic architecture of an RBM consist from v denotes the input layer and h1, h2 and h3 are the hidden layers. v and h1 constitute the first RBM (RBM 1), h1 and h2 constitute the second RBM (RBM 2) and h2 and h3 constitute the third RBM (RBM 3). DBNs are trained in two stages: individual training of the RBM layers step by step in a greedy way, and then, fine-tuning the whole network (parameter adjustment) to achieve an ideal performance (Zhang M et al., 2011). The greedy layer-wise training is a pre-training algorithm that aims to train each layer of a DBN in a sequential way, feeding lower layers' results to the upper layers. Chen et al (2017) proposed a multi-sensor feature fusion technique where two-layer SAEs were used for feature fusion and a three-layer RBM-based DBN was used for classification. Since then, there have been many attractive implementations and uses of DBN in the domain of PHM of REBs. DBNs (typically stacked RBMs) can be used both for classification and as well regression (Xia M et al., 2017), which is an extended form of multi-layer RBM with structures of an FFNN. Shao et al (2015) developed a DBN-based REB fault diagnosis system incorporated with particle swarm optimization. In another work Shao et al (2017), they proposed a dual-tree complex wavelet package to extract fault features and DBN was used to classify multiple types of bearing faults. Gan et al (2016) developed a hieratical structure of bearing diagnosis using ensemble DBN. In the first level, four types of fault- s/health were classified on two layers of DBN, and another two layers of DBNs were designed for fault severity identification. With regard to prognostic problems, Deutsch et al (2017), predicted the remaining life of bearings using DBN with a particle filter. Zhang et al (2017) proposed a multi- objective evolutionary algorithm integrated with DBNs for bearing remaining life prediction, aiming to optimize the accuracy and generalization performance of the DBN

simultaneously. Ma et al (2017) used ant colony optimization to determine the structure of the DBN and then the DBN was used to predict the health status of a machine, specifically on bearing components. Some works used DBN as a feature learning tool embedded into a fault diagnosis structure. Xu et al (2019) applied three layers of RBMs to automatically extract features from raw signals and then used PCA to shrink features and implemented independent classification models for fault diagnosis. Zhang et al. (2020) presented an enhanced CNN model for bearing fault diagnosis that utilized time–frequency images as inputs. Seven datasets provided by CWRU and YSU were used to validate the proposed method's efficacy. As demonstrated by the diagnosis results, the proposed method extracts sensitive features much more rapidly and accurately than existing methods on small data sets with sample sizes of 200 and sample lengths of 512. Additionally, when the workload, such as dataset F, changes, the performance of time domain and frequency domain theory rapidly degrades. However, the proposed method is highly adaptable to changes in workload.

3.5.3 Auto-encoders

An auto-encoder is a three-layer neural network that is trained to minimize its input to its output (minimize reconstruction error between input and out- put). It consists of two parts: an encoder and a decoder. The encoding operation maps input to a hidden layer of neurons and the decoding operation reconstructs the input from the hidden layer. Auto-encoders are purely used for unsupervised feature extraction as they can be trained more easily and effectively. The structure of a standard auto-encoder includes an input layer, a hidden layer and an output layer. Several auto-encoders when stacked together to form a deep structure to learn representations by taking the output of each hidden layer (ith) as an input to train the next (i + 1) layer; this architecture is known as a deep auto-encoder (DAE). One of the earliest implementations of auto-encoders in the PHM of REBs can be found in it, where a five- layer auto-encoder-based deep neural network (DNN) was utilized to classify the health conditions of the machinery. It was observed that the classification performance of DNNs (99.6%) significantly outperformed that of backpropagation- based neural networks (70%). Thereafter, typical DAE-based approaches have generally focused on auto-feature representation (mapping to a higher dimension) and sensor fusion (mapping to a lower dimension). Adding a fully connected layer and soft max layer, it can both used for classification and regression. Jia et al (2016) validated the feasibility of implementation of DAE in REB fault diagnosis. Lu et al (2015) developed a health state identification model using a stacked denoising auto-encoder. Meng et al (2018) applied a denoising auto-encoder on raw signals and proposed an active regularization parameter tuning strategy. Regularization hyperparameters can be automatically tuned by increasing the number of layers. Jia et al (2018) designed a local connection network constructed by a normalized sparse auto-encoder to deal with fault signal shifting among different working conditions. Some other works which employ auto-encoder in bearing fault diagnosis using the CWRU dataset. Chen et al., (2020) examined three deep neural network models (Deep Boltzmann Machines, Deep Belief Networks, and Stacked Auto-Encoders) for identifying rolling bearing fault conditions. Four pre-processing schemes are discussed, including those in the time domain, frequency domain, and time-frequency domain. A single data set containing seven fault patterns is used to assess the performance of deep learning models for diagnosing rolling bearing faults based on the health state of a rotating mechanical system. The results demonstrate that the accuracy achieved by Deep Boltzmann Machines, Deep BeliefNetworks, and Stacked Auto-Encoders is extremely reliable and applicable to rolling bearing fault diagnosis.

3.5.4 *Recurrent Neural Network (RNN)*

RNN is a type of neural network that contains loops, enabling information to be stored within the system. Feature extraction step was carried out with the help of a discrete wavelet transform and for best classification accuracy orthogonal fuzzy neighbourhood discriminant analysis (OFNDA) was used by Wathiq et al (2015) as shown in Figure 4. After this step the features are passed onto RNN method for fault classification which would detect and classify faults under dynamic operating condition. Overall classification accuracy for the proposed method was found to be 97%. Honghu Pan et al. (2018) have proposed a method combining one dimensional convolutional and LSTM that are constructed into one framework.
The data were fed to CNN model which reduces the frequency variance and the result of the CNN were supplied to the input of the LSTM which has the advantage of the temporal model. Comparing with the traditional methods, proposed methods have the highest average accuracy rate prediction of 99%. Liang Guo

et al. (2017), have intended to study the RUL of a bearing using RNN– Health Indicators (RNN-HI) to increase the RUL Prognostic accuracy. The mapping of the time and frequency domain features for the extraction process were performed, obtained characteristics were chosen based on specific criteria metric. These characteristics were fed to the RNN and subsequently to RNN-HI so to build the proposed model. The proposed model was compared with self-organizing map (SOM) and this method performs better than HI-SOM. Hongkai Jiang et al. (2018), a "deep recurrent neural network" (DRNN) was obtained by stacking a number of recurrent neural network which captures the features automatically from the input data. In the next step adaptive learning method was implemented for training samples with the constructed DRNN and then finally the testing samples were checked for the proposed method. The average training and testing accuracy of 98.67% and 96.53% respectively. An et al., (2020) proposed a three-part model that is capable of ignoring the effect of varying rotational speeds. To begin, the sample is segmented, and each segment dimension is extended via an input network to ensure sufficient memory space for the information. Second, classification information is stored and transferred in a long short-term memory (LSTM) network before being output to the third section. Due to the gate units' function, the working condition information is ignored during this process. The proposed method is validated using bearing datasets with time-varying speeds and loads. The result indicates that our method is more accurate with a simpler structure and outperforms the traditional method in diagnosing bearing faults.

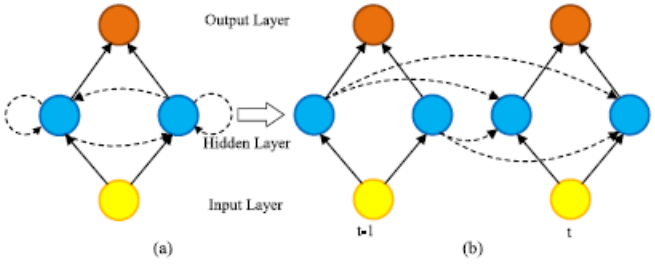

Figure 4. (a) Construction of RNN and (b) RNN over a time period (Wathiq et al 2015)

3.5.5 Generative Adversarial Network (GAN)

Generative adversarial networks are mathematical design that uses couple of neural networks, indenting one against the other (therefore the "adversarial" name) in order to generate new real data. Han Liu et al (2018) have studied a unique deep neural network called Categorical adversarial auto encoder (CatAAE) which enforces a previous allocation to latent coding space for unsupervised learning. The encoder compensated for producing examples to fool the classifier and later a classifier was trained to distinguish earlier division from the counterfeit division. In the course of adversarial training process, the identical faults have been allocated to the similar groups of classifiers. This proposed method was compared with conventional K-Means technique and the result showed better accuracy with the proposed method for Y. O. Lee et al. (2017) The discriminator classifies and differentiates the real and counterfeit data and later generator oversample the data generator which would be difficult to be classified by the discriminator. Authors have shown achievability of resolving the challenges associated with data imbalance using the proposed method. Yuan Xie et al. (2018) used a new technique to overcome the imbalanced dataset using deep convolutional generative adversarial network model for detection of faults in bearings. The original training data are fed to DCGAN, where it deals with the minority classes. Also "synthetic minority oversampling technique" (SMOTE) was used where it generates synthetic minority samples to balance the dataset. For classification of the fault, a SVM technique is used to verify better efficiency of the generative paradigm. The proposed paradigm showed in Figure 5 an accuracy for training and testing sample to be 95.64% and 86.33% respectively.

Bo Zhang et al. (2018) have generated a novel on adversarial adaptive 1-D CNN (A2CNN) based on DNN for the fault diagnosis of REB. Firstly, label classification error is minimized by labelling the source samples for source feature extractor. And then maximization of domain classification loss was attained by using target feature extractor to make sure that the source and target features have identical distribution following

mapping. Efficiency of the model was measured by the precision and recall parameters. S. Suh et al. (2019), have proposed a unique over sampling method to resolve the difficulties of data imbalance for the diagnosis of a bearing. This method was introduced because usually faulty data is lower compared to normal data. Firstly time-series data was converted into image domain using nested scalar plot (NSP) and then oversampling method Wasserstein GAN with gradient penalty on Deep convolution generative adversarial networks (DCWGAN-GP) used to overcome the data imbalance and then the CNN method was used classify the bearing faults. The proposed method showed better accuracy after implantation of the proposed model. The proposed classifier accuracy got improvised from 88% to 99%.

Viola et al., (2021) propose the FaultFace methodology for detecting failures in Ball-Bearing joints for rotational shafts by utilizing deep learning techniques to generate balanced datasets. The Fault Face methodology makes use of two-dimensional representations of vibration signals dubbed face portraits that are created using time-frequency transformation techniques. To achieve a balanced dataset, a Deep Convolutional Generative Adversarial Network is used to generate new face-portraits of the nominal and failure behaviours from the obtained face-portraits. A balanced dataset is used to train a Convolutional Neural Network for fault detection. The Fault Face methodology is compared to other deep learning techniques to determine its performance when used with unbalanced datasets for fault detection. The obtained results demonstrate that the Fault Face methodology is effective at detecting failures in unbalanced datasets.

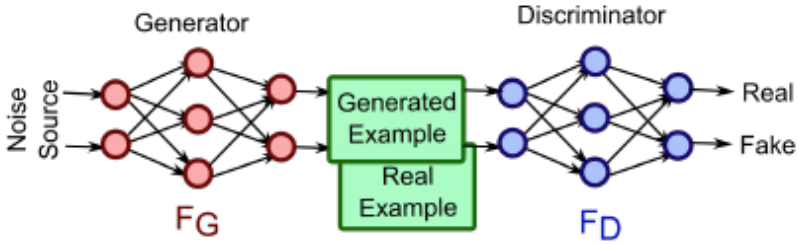

Figure 5. Construction of Generative Adversarial Network (GAN) (Xie et al., 2018)

4. Conclusion

The purpose of this article is to provide a general descriptive overview of the machine learning techniques for failure detection currently used in rolling element bearing diagnostics for rotating machinery. Machine learning techniques are discussed in along with its advantages and disadvantages. Numerous researchers have also demonstrated that using ANN Deep learning diagnosis Techniques can detect bearing faults at a high level. Although traditional techniques produce acceptable results, they require feature engineering and feature extraction prior to classification, and subject expertise is required to perform feature engineering and feature extraction for traditional techniques. Whereas deep learning requires a larger dataset to train the sample data and has numerous advantages since it automatically performs feature engineering and feature extraction without the need for subject field expertise. These techniques can detect bearing faults more quickly and with better accuracy.

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STEPPER MOTOR CONTROL SYSTEM FOR XY MODULE FOR IC PRODUCTION

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Abstract: The presented in the paper control system of the stepper motor of the two-coordinate printing module is developed on the basis of modern elements and allows you to control the stepper motor, providing the required shaft rotation speed and adjusting the number of rotation steps. This system realizes the processing of a moving object in several coordinates simultaneously without kinematic elements that convert rotary motion into linear, which makes it possible to speed up the time and accuracy of the processing tool. A forked optical sensor is used as workpiece position sensors. UART and USB bus are used for communication with the computer.

Keywords: stepper motor, simulation model, two-axis module.

1. Introduction

Stepper motors have taken a wide niche in industry and process control. Due to the simple principle of operation, which provides the necessary controllability without additional equipment. Stepper motors provide precise control of motor speed, angular position and direction of rotation of the motor. The stepper motor is best suited for the automation of individual units, modules and systems where high reliability and accuracy are required. Although stepper motors have been used for quite a long time, the popularity gained over the past several decades is due to the development of electronics. That in turn allows the creation of cheap and reliable control circuits meeting the complex requirements of motor speed, torque and angular displacement. In cases requiring positioning and precise speed control, as well as adjustable torque, a stepper motor is the most economical solution [1]

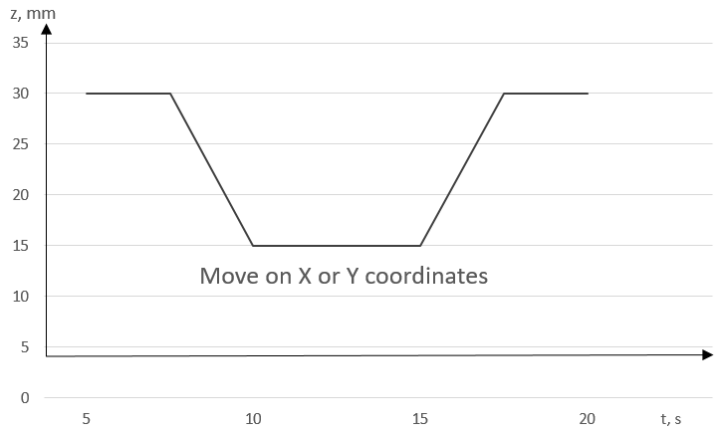

Figure 1. Diagram of the device operation.

The essence of the stepper motor is that the sequential activation of the motor windings generates discrete angular displacements (steps) of the rotor, and the angle of rotation of the rotor is determined by the number of pulses that are fed to the motor, which ensures the performance of the specified actions and their repeatability. Low rotational speeds for a load connected directly to the motor shaft can be obtained without an intermediate gear. Since the speed is proportional to the frequency of the input pulses, a fairly large speed range can be covered.

This paper presents a modular control system of stepper motor based microcontroller series ATMega 48 for a two-axis module for the production of integrated circuits.

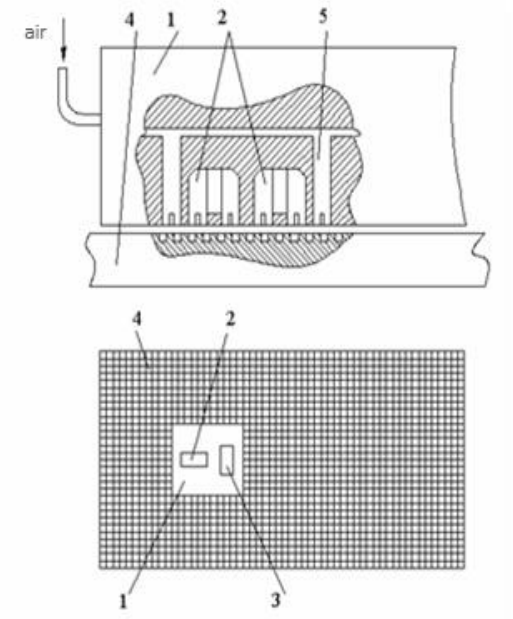

Figure 2. Coordinate table with a linear stepper motor: a) structural diagram; b) coordinate table with combined stator cutting: 1 - movable carriage, 2 - linear stepper motor of the X axis, 3 - linear stepper motor of the Y axis, 4 - stator, 5 – nozzles

2. Control Object and principle of operation

The control object (CO) is a two-coordinate transport module based on linear stepper motors (LSM), which is the main part of the probe installation used to manufacture microcircuits of a high integration degree.
The probe unit serves for marking the contact zones of the plate used for the manufacture of the microcircuit. The plate is divided into contact zones (80x80 microns), which are marked with a special paint in order to distinguish the defective contact zone from the working one.

The operating cycle of the installation is as follows. The coordinate table with the plate is raised until the position sensor (movement along the Z coordinate) is triggered, located 300 μm below the surface of the probes. After this sensor is triggered, the coordinate table moves along the Z coordinate at a lower speed to ensure smooth contact of the surface of the contact zone with the probes. The number of probes can be different: from 8 to 16. After marking the corresponding contact area, the XY table is lowered down to a height of 15 mm. After that, the coordinate table moves along the X or Y coordinate to move the next contact zone to the position directly below the probes. Then the XY table rises again and the next contact area is marked.

Coordinate systems that implement the movement of the processing object along several coordinates simultaneously without kinematic elements for converting rotary motion into translational motion are built on the basis of linear stepper motors.

Estimated system requirements

- simultaneous control of two stepper motors with a maximum phase current of up to 5.5 A;
- crushing 6400 microsteps per revolution;
- range of movement ±2147483648 discrete (step division);
- the maximum movement is up to ±8388608 discrete (step division).

The stepper motor control system is designed to generate signals on the stepper motor windings and control the rotation speed of its shaft and control the number of turning steps.

3. Control System and SIMULINK Model of the probe installation.

The stepper motor control system is designed to generate signals on the stepper motor windings and control the rotation speed of its shaft and control the number of turning steps.

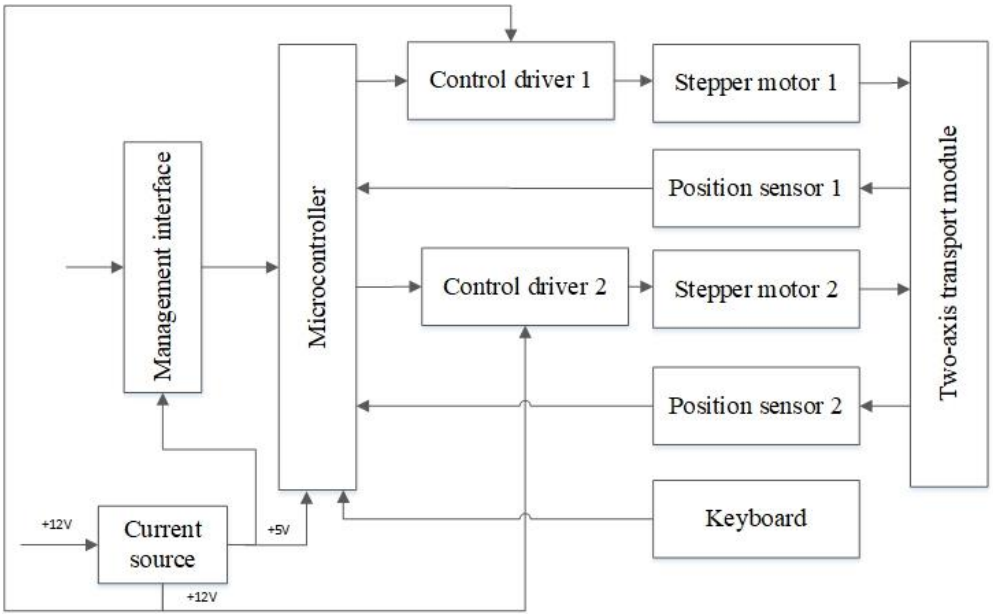

Figure 3. Block diagram of a stepper motor control system

Presented stepper control system (Figure3) has a separate controller and driver. This is due to the fact that a properly designed driver has a rather complex step crushing algorithm, which makes it possible to reduce the value of the minimum movement and avoid resonance phenomena. This separation makes it easy to use both specialized controllers made for a narrow range of tasks and the LPT port of a personal computer to control a stepper electric drive. The stepper motor driver for the user is a universal device, to the input of which only the power supply for the motor and the standard "direction" and "step" signals are supplied. On the driver, only the current value in the motor phases and the step division factor are set.

Motor control commands can be received via one of two communication interfaces either via USB or via UART, while the choice between one of these interfaces is carried out by switching the corresponding four microswitches, also installed on the board.

The control module is implemented on the AVR ATMega48 microcontroller, combined with the L6205 driver, which allows to control the drive based on both a stepper motor and a DC motor. The controller operates with a clock frequency of 10 MHz, with a supply voltage of + 5V. The USB interface is implemented on the basis of the FTDI FT232R converter, which allows quick pairing of standard UART and USB interfaces. To track the initial (zero) position of the motor shaft, an optical slot zero-mark sensor manufactured by Honeywell HOA08 is installed on the board. This sensor allows to unambiguously determine the initial position of the motor shaft when the supply voltage is reapplied or the microcontroller program is reset. The microcontroller's stable supply voltage is supported by the LM2594M pulsed buck DC-DC converter.

The module is connected to a standard USB port of a personal computer, via a cable with a mating miniUSB connector, or via a UART serial interface to another microprocessor system, while the signal level is + 5V. For programming the microcontroller, an ISP interface is provided, with contact pads for connecting a standard AVR programmer. It should also be noted that an LED connected directly to the controller is installed on the module to display the current operating mode or indicate an error. The typical supply voltage of the control system is + 12V, while its minimum level is slightly more than 8V and is limited to 20V.

3.1 Algorithm of the stepper motor control system

The algorithm of the main program (Figure 4) controls the speed of rotation of the stepper motor shaft and controls the number of steps of rotation. This algorithm is identical for engine 1 and engine 2.

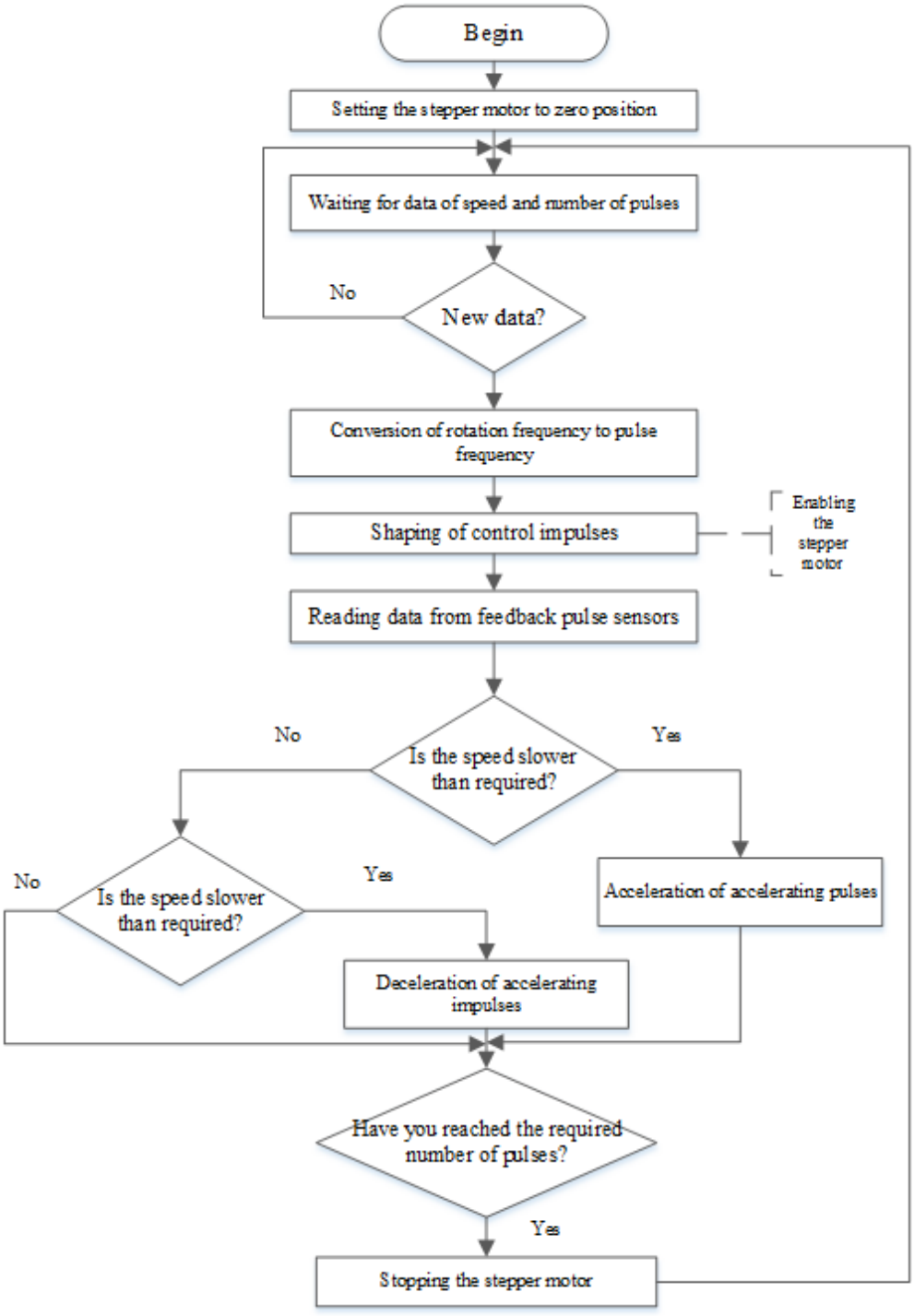

Figure 3. Algorithm of the stepper motor control system

3.2 The mathematical model of a stepper motor

The automated electric drive of the designed installation includes two two-phase linear stepper motors. Each phase is controlled by a control device that includes a current regulator and an inverter. The mathematical model of a stepper motor is described by the following equations:

$$u_A = R \times i_A + L \times \frac{di_A}{dt} + \Psi_m \times \frac{d\theta}{dt} \times \sin\theta$$
$$u_B = R \times i_A + L \times \frac{di_B}{dt} + \Psi_m \times \frac{d\theta}{dt} \times \cos\theta \quad (1)$$
$$\frac{d^2\theta}{dt^2} - k \times i_A \times \sin\theta - k \times i_B \times \cos\theta = f_l$$

Where A and B are the phases of the linear stepper motor; u_A and u_B - instantaneous values of voltages applied to phases; B - active resistance of the phase winding, Ω; A - phase winding inductance, H; i_A and i_B - instantaneous values of phase currents; Ψm - maximum flux linkage, Wb; θ - moving; m - moment constant, N / m; l - load force, N.

When simulating a stepper motor, it is necessary to take into account the holding torque (force) of the motor and the effect of the viscosity overcome by the rotor. In an inductor stepper motor with permanent magnets, the influence of the fourth harmonic of the torque (force), which is called the holding torque (force), is significant. This harmonic component should be taken into account by introducing an additional component at the load moment. The viscosity is also taken into account by the introduction of an additional component at the loading moment.

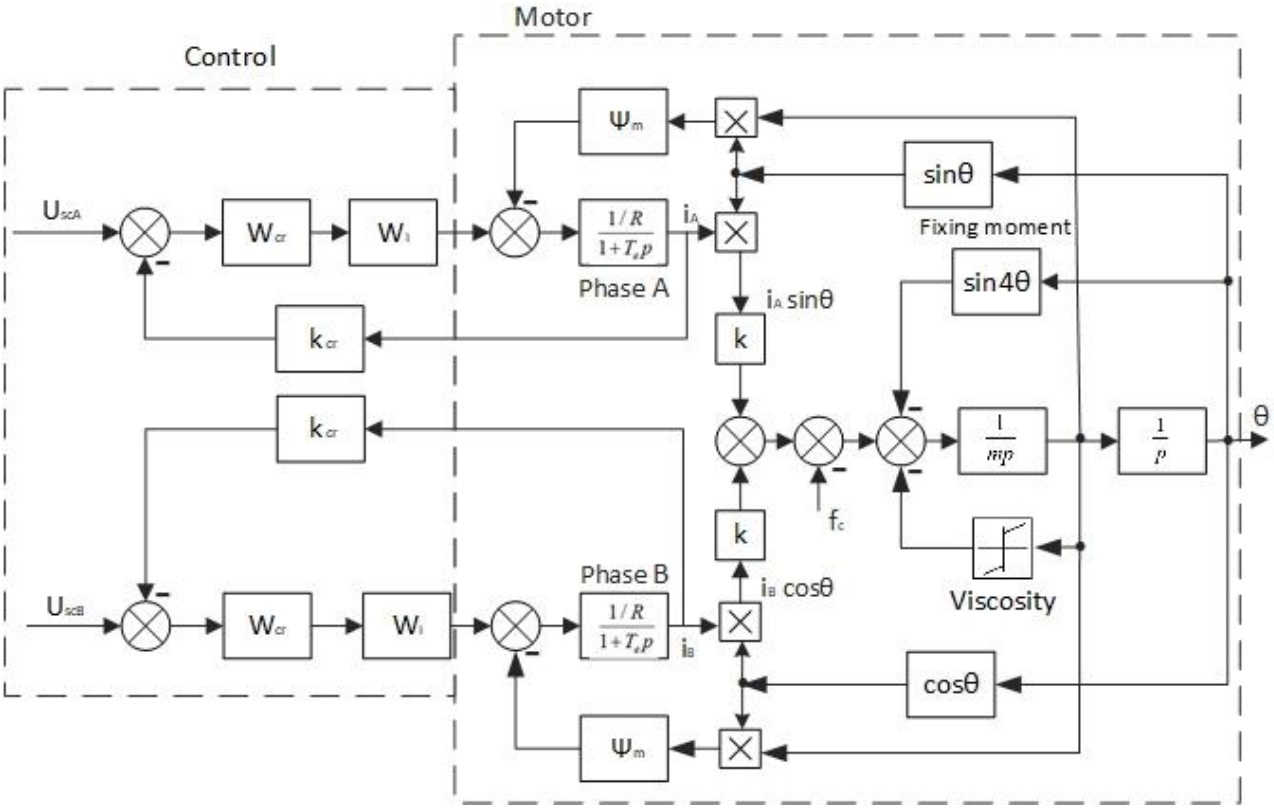

Figure 6. Diagram of an automated electric drive with a linear stepper motor

W_{cr} - is the transfer function of the current regulator;
W_i - transfer function of the inverter;
e - is the time constant of the winding of the motor phase;
U_{scA}, U_{scB} - signals for setting the currents of phases A and B, respectively.
The control object is a two-phase linear stepper motor.

3.3 Calculation of the parameters of the control object.

Motor phase winding time constant:

$$T_e = \frac{L}{R} = \frac{0.3\times10^{-3}}{5} = 0.06\text{ms} \quad (2)$$

Since the engine is running without load, the load force is l = 0.
Maximum flux linkage:

$$\Psi_m = L \times I_m \quad (3)$$

Where I_m is the maximum current in the motor phase.
Then, the maximum flux linkage:

$$\Psi_m = 0.3\times10^{-3}\times5.5 = 1.65\mu Wb \quad (4)$$

Technical characteristics of the Controlled Object:

Parameters	Values
Phase winding resistance, Ohm	5
Phase winding inductance, mH	0,3
Rotor weight, kg	3
Maximum flux linkage, Wb	0,00165
Fixing torque component, N / A	0,01
Viscous friction coefficient, Nm*s	10-4
Dry friction coefficient	10-8
Time constant of the winding of the motor phase, ms	0,06

The designed system requires a control system with a structure that has low sensitivity to parametric disturbances. To design such a structure, it is necessary to use the stability property with infinite gain in the loop.

To determine the stability conditions for a closed-loop system with an infinite gain β, we represent its characteristic polynomial in the form:

$$N(p) = a_n p^n + a_{n-1}p^{n-1} + ... + a_1 p + a_0 + \beta(b_m p^m + b_{m-1}p^{m-1} + ... + b_0) \quad (5)$$

In formula (5), the following designations are adopted: b_i are the coefficients expressed in terms of the parameters of the system.

In accordance with the conditions of M. V. Meerov [2] for

n - m = 1 the system remains stable at $\beta \to \infty$ always, at

n - m = 2 subject to inequality $a_{n-1}/a_n > b_{m-1}/b_m$ and in case n - m $\geq$ 3 at $\beta \to \infty$ the system does not remain stable.

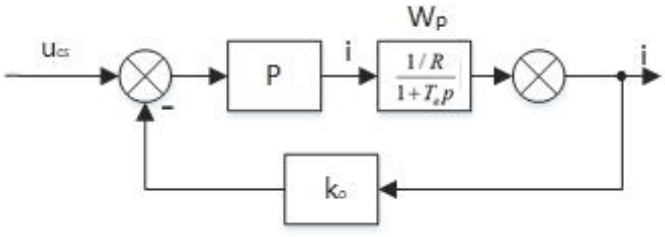

Figure 7. Current regulation loop

Figure 7 shows a current control loop, in the forward channel of which there is a link P. Its input-output characteristic has a vertical section equivalent to infinite gain, and the output signal u is limited in magnitude by the value um. If we denote by β the gain of the link P, then the transfer function of the circuit can be represented as:

$$\Phi = x(p)/u(p) = \beta W/(1+k_0\beta W) \tag{6}$$

Obviously

$$\lim_{\beta\to\infty}\Phi = 1/k_0 \tag{7}$$

and the contour properties do not depend on the link parameters W(p). So, for

$$W(p) = \frac{k}{T_e p+1} \tag{8}$$

we get:

$$\Phi = \beta k(1+T_e p+k_0 k\beta) \tag{9}$$

n = 1, m = 0, n - m = 1, and the system is stable at $\beta \to \infty$.

Since all the conditions for using the relay regulator are met, we implement the current regulator with a relay element with the maximum permissible deviation of the actual phase current from the reference current equal to 0,05A (1% from rated current 5,5 A).

3.4 Simulation model

Computer modelling of the projected installation performed in the MATLAB 6.0 mathematical modelling environment using the Simulink library. The model is based on Equations 1.

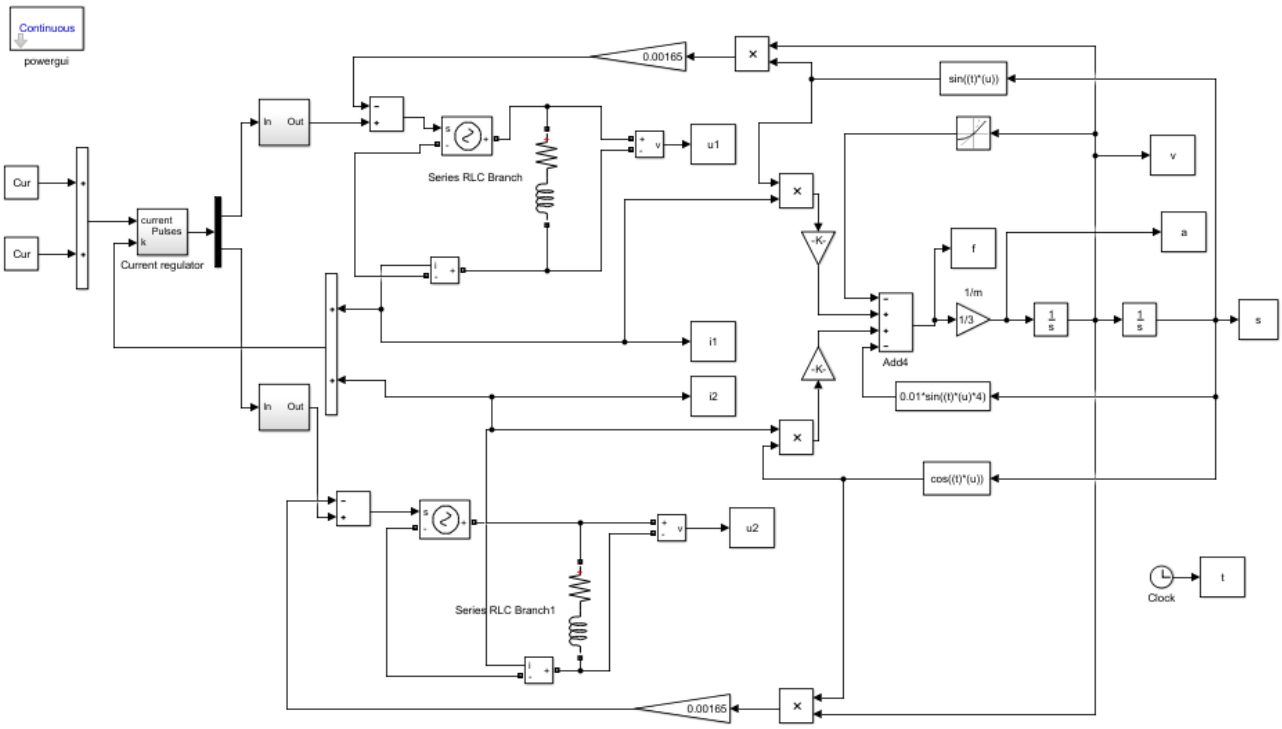

Figure 8. Simulation model of the electric drive of the designed installation.

Where

a and La - resistance and inductance of the winding of phase A;

в and Lв - resistance and inductance of the winding of phase B;

Blocks "u1" and "u2" return the time dependences of voltages applied to phases A and B; blocks "i1" and "i2" return the currents of phases A and B as a function of time; block "f" returns the linear stepper motor traction as a function of time; block "a" returns the acceleration as a function of time; block "v" - returns the speed as a function of time; the "s" block returns the movement as a function of time. The block "1 / m" takes into account the mass of the moving part, equal to 3 kg.

4. Simulation Results

The graphs obtained as a result of modeling in the MATLAB environment are presented in Figures 9-17.

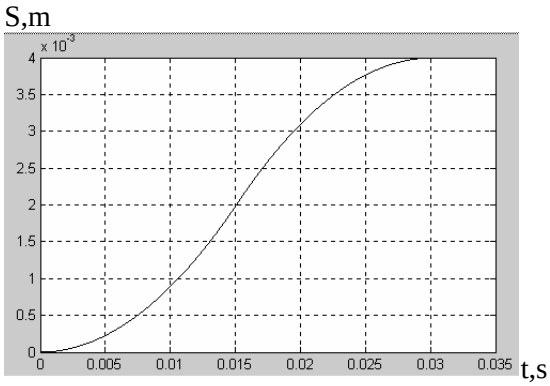

Figure 9. Displacement as a function of time

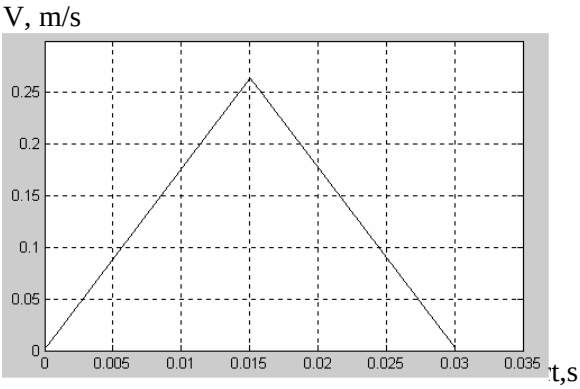

Figure 10. Speed as a function of time

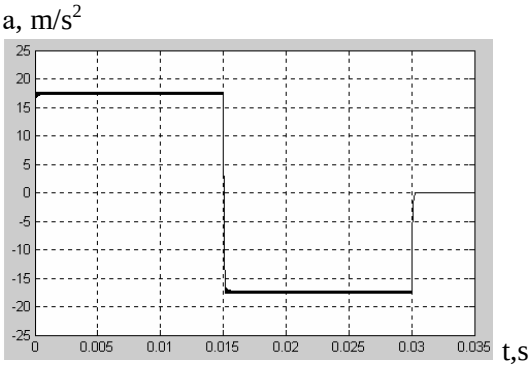

Figure 11. Acceleration as a function of time

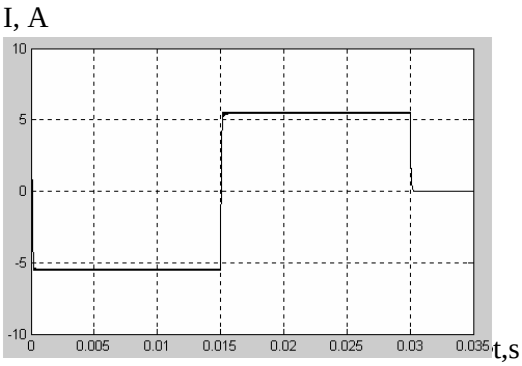

Figure 12. Phase A current as a function of time

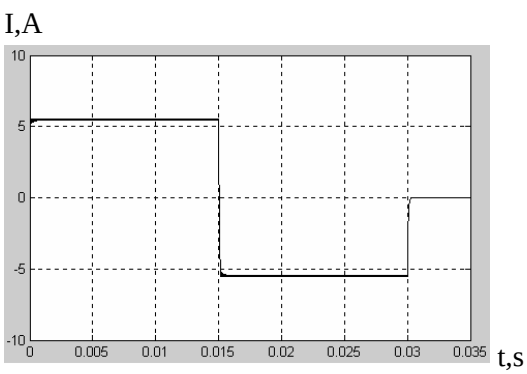

Figure 13. Phase B current as a function of time

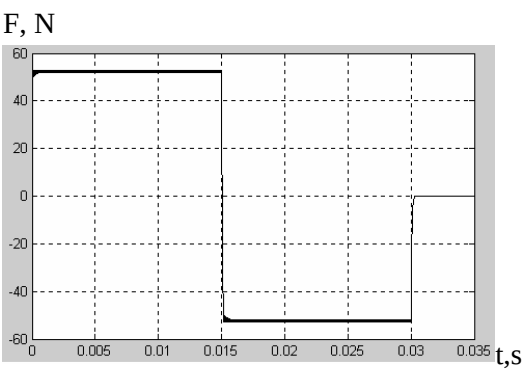

Figure 14. Tractive effort as a function of time

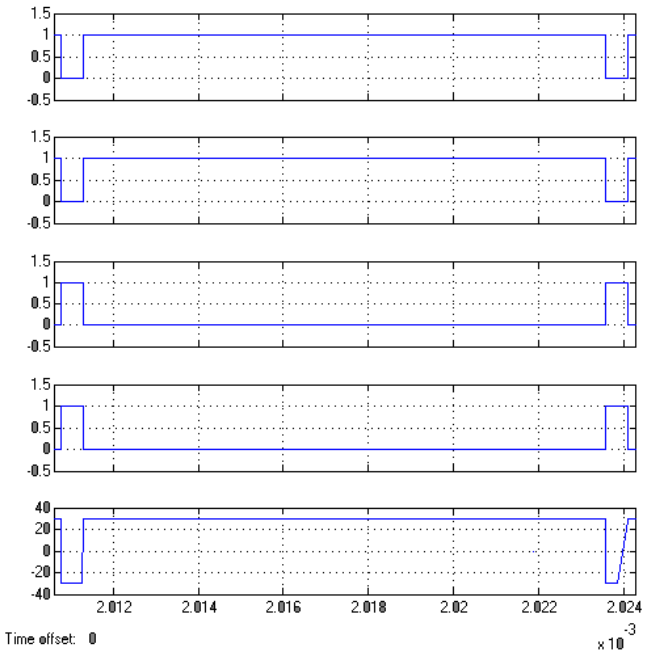

Figure 15. Algorithm of operation of the switches of the phase A inverter

Figure 15 shows the algorithm of operation of the switches of the phase A inverter for a time from 2.01*10-3 s to 2.025*10-3 s. This is the time period in the acceleration section of the electric motor. Since the frequency of the pulse-width modulation of the voltage is very high, due to the fact that the permissible deviation of the phase current from the given one is 1%, it is impossible to reliably reflect the change in voltage on the phase of the electric motor throughout the entire time of a typical movement. The algorithm of operation of the switches of the phase B inverter is shown in Figure 16.

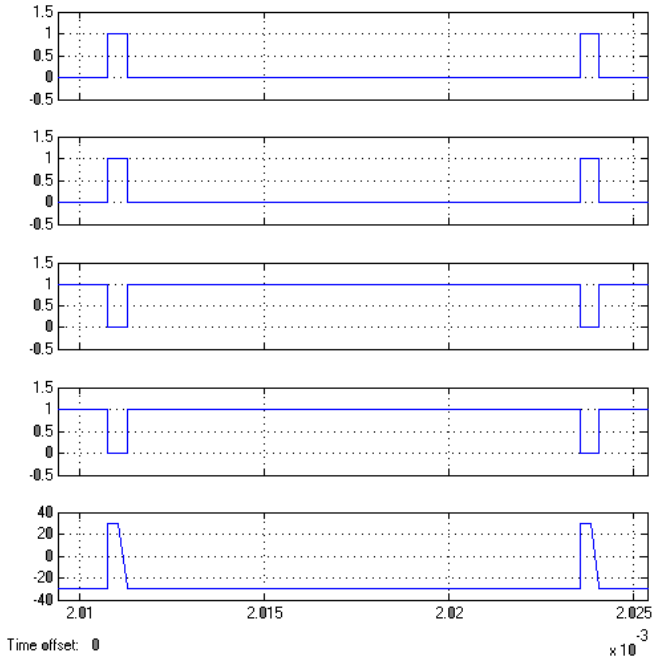

Figure 16. Algorithm of operation of the switches of the phase B inverter

The phase B current command signal is out of phase with respect to the phase A current command signal by 90 electrical degrees.

4.1. Calculation overshoot

The quality of regulation is usually assessed by the following main indicators [8]:
- the amount of overshoot;
- speed or time of regulation;
- the number of fluctuations of the controlled value during the transient process.

The overshoot is calculated by the formula:

$$\Delta\% = \frac{h_{\max} - h_{set}}{h_{set}} \times 100\% \tag{10}$$

Positional overshoot is especially important for the plant being designed.

Diagram on Figure 17 shows that $h_{max} = h_{set} = 4$ mm, therefore, overshoot Δ % = 0%. When working out a single step $h_{max} = h_{set} = 10$ μm .The response speed, or regulation time, is the time during which the deviation of the controlled value from the steady-state value exceeds a certain permissible value. In most cases, this value is assumed to be 5%. From Figures 9 and 17 it is obvious that the controlled variable (displacement) after reaching the steady-state value no longer deviates from it, and, therefore, the regulation time is zero.

The number of fluctuations of the controlled value during the transient process does not exceed the permissible value, since there are no fluctuations.

Figure 17 shows that the unit step size is 10 μm, therefore, the system meets the requirements for positioning accuracy. Figure 10 shows that the maximum speed in the designed installation is 0.27 m /s, which doesn't exceed the required maximum speed of 0.28 m /s and is equal to the value of the calculated maximum speed.

Figure 11 shows that the maximum acceleration is 17.7 m /s^2, which does not exceed the required value of 18 m /s^2.

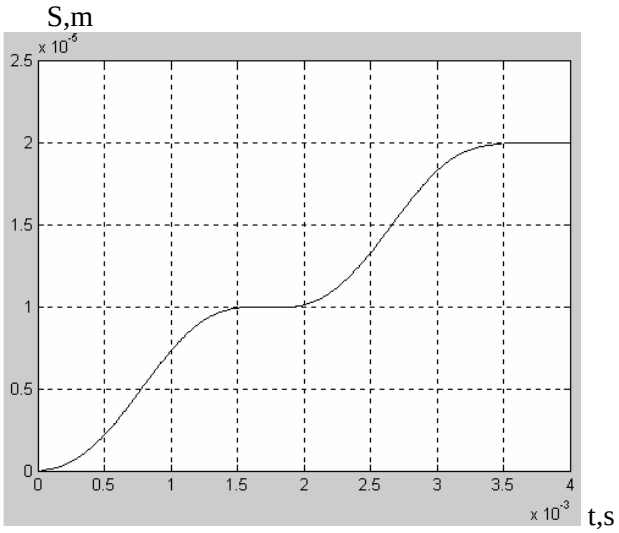

Figure 17. Diagram of the stepper motor working out two steps forward.

4. Conclusion

Currently, a good alternative to micro-drives, consisting of a high-speed feedback motor and a manual transmission, is the stepper drive, which has already become a traditional actuator for many electronic devices and systems.

In particular, the system is attractive in that it is small in size, provides engine protection when operating in critical modes, and is easy to configure.

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EUROPEAN GREEN DEAL POLICY FOR THE CIRCULAR ECONOMY: OPPORTUNITIES AND CHALLENGES

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Abstract: In December 2019, a European Green Deal was introduced to the EU and its community as a new development strategy by the European Commission (EC). The key goal of the European Green Deal is to reshape the EU into an ethical society with efficient use of resources and a modern-competitive economy. The European Commission targets an absolute reduction of greenhouse gases net emissions by 2050 in all EU. Thus, one of the most important actions in implementing this new growth strategy "EGD" is to coordinate the industry for a circular and clean economy. To reach this goal, EC introduced the most advanced legislation follow-up package that EU's society and businesses can benefit from. This legislation package includes actions and steps with a connecting guideline of principal policies, starting from a very determined goal in eliminating emissions, as well as investments in related innovation and research in order to protect the natural environment of Europe. However, reaching the goal of being the first among other continents to be climate- neutral by 2050 is so far the biggest challenge, as well as the greatest opportunity for Europe. In reality, in order to implement such advanced goals, obstacles need to be addressed as well, in national and international level. Thus, this paper analysis the European Green Deal (EGD) policy, the opportunities provided by EGD, and in particular the challenges faced for reaching the targets of EGD.

Keywords: New Growth Strategy**,** European Green Deal, Sustainability, European Commission, Circular Economy

1. Introduction

The European Union (EU) for decades has played a crucial role in formulating strategies to address climate change. It supported a climate change policy from 1992, and in 1996 approved the mission of reducing global warming by 2 degrees Celsius (Siddi, 2020). Later, in 2001, EU empowered its qualifications as a global ruler in tackling climate change after achieving sufficient supporters for adopting the Kyoto Protocol, although the United States had detached from it (Parker et al, 2017). Strong and determined internal policies supported the EU's international role and goal (Siddi, 2020). In this way, the EU established the ETS - Emission Trading Scheme, which is the most fundamental trading scheme regarding greenhouse gas emissions and the supreme of EU's climate strategy (Kulovesi, 2017). After two years of the ETS establishment, EU approved broad and extensive climate legislation that contained the 20-20-20 aims (Siddi, 2020). However, although the global community failed in achieving an international understanding and agreement on reducing greenhouse emissions, EU still followed with working on its internal climate goals, as well as preparing and designing new targets for 2030 (Szulecki,2016). In 2015 the EU diplomacy achieved the Paris Climate Agreement, which furthermore inspired the Union to reconsider the energy efficiency, greenhouse emission reeducation, and renewable energy goals (Oberthür, 2019). However, in 2016, many major leaders, like as Jair Bolsonaro of Brazi, and Donald Trump in the United States have questioned and confronted EU and its global climate policies (Vihma, 2019). Yet, considering the climate crises around the world, the EU has followed to address climate policy as a prime issue (Siddi, 2020). In the same time, Ursula

von der Leyen, as the head of the European Commission, on December 2019 has put the energy transition as one of EU's priority and declared that it will follow with a GREEN DEAL (European Commission, 2019).

Thus, in December 2019, a European Green Deal was introduced to the EU and its community as a new development strategy by the European Commission (EC). Great Deals are free-will and self-imposed consensus among different actors working jointly to expand sustainability and innovation. The European Green Deal can be view as an outline of crucial strategies for EU's climate policy, from which the EC will follow to establish legislative schemes and policies from 2020 and forth (Siddi, 2020). The main goal of the Green Deal outlook is to encourage movements in society through green projects and eliminate the obstacles for implementing them (Ganzevles et al, 2017). However, reaching the goal of being the first among other continents to be climate-neutral by 2050 is so far the biggest challenge as well as the greatest opportunity for Europe (Montanarella and Panagos, 2021). Thus, this paper analysis not only the opportunities provided by the European Green Deal but also the challenges faced for reaching the targets of EGD.

2. Literature Review

Assessing the European Green Deal Policy

For a while now, the society has been concerned with ecological and environmental matters in daily life, not only for the availability of water, sanitation and food, but also for the waste and green energy policies (Sikora, 2021). Hence, the European Commission presented the EGD proposal, an expanded legislation wrap with the goal of approaching climate change (Pianta and o Lucchese, 2020).The key goal of the European Green Deal is to reshape the EU into an ethical society with an efficient use of resources and a modern- competitive economy (Smol et al, 2020). Moreover, the European Commission through the European Green Deal aims to achieve a climate- neutral economy by eliminating carbon emission by minimum of fifty percent until 2030 and to reach a low-carbon future by the mid-century (Sikora, 2021). In particular, the mineral resources control has gained particular attention considering that EGD aims for economic growth which is limited due to inefficient resources management (EU, 2019). Thus, one of the most important actions in implementing this new growth strategy (EGD) is to coordinate the industry for a circular and clean economy (Toth, 2019). The circular economy and decarburization have captured a special attention as well, in particular in European Union which has been determined to be the prime of international energy transformation (European Council, 2019). The call for reducing greenhouse gas emissions and to reach carbon neutrality by 2050 has become a serious and urgent matter for lawmakers in Europe. Considering the special apprehensions regarding global warming, climate change and circular economy in particular, the EU has indicated its significant political engagement towards these issues by presenting various goals on renewable resources, energy efficiency, and GHG elimination (Hafner and Raimondi, 2020). According to Montanarella and Panagos (2021), these goals underline the principal concerns of EU. Nevertheless, some goals are easier to achieve than others. In reality, in order to implement such advanced goals, obstacles need to be addressed as well, in national and international level.

The European Unions has been actively giving attention and priority to actions against climate change. Various policies have been supported and adopted from EU in adopting sustainable energy, decreasing greenhouse gas emissions, as well as actively initiating global climate negotiation (Claeys et al, 2019). The European Green Deal is the latest policy for economic growth approved on late 2019 by the European Commission (Smol, et al, 2020). In this line, the EU president, Ursula von der Leyen, has assured to expand and reinforce the European climate policy (EU, 2019). In this context, the European Green Deal was proposed, which calls for climate neutral from EU by 2050- making Europe the first continent adopting this law (Claeys et al, 2019). According to Von der Leyen (2019) and Claeys et al, (2019), the European Green Deal outlines about 20 different schemes. These schemes aim to strengthen EU's 2030 goal on reducing emission up to 55 from 40 percent, presenting a carbon border tariff, developing a sustainable Europe Investment Plan, reshaping the EU Investment Bank from unsustainable banks, as well as creating a new industrial European strategy (EU 2019). However, achieving these targets requires the industry's mobilization for a circular and clean economy (Smol, et al, 2020).

According to Siddi (2020), the significance of climate policy by the new EU commission has been provided due to various factors: the climate crisis has become increasingly evident both in Europe and globally, as highlighted by repeated record high summer and winter temperatures, the melting of polar ice and glaciers, and highly mediatized events such as the catastrophic forest fires in Sweden, Siberia and Australia in 2018-

2019. Ursula von der Leyen announced climate policy a main priority in the new EU commission on December 2019. This priority differs from the others in previous commissions as it positions the security of supply on a stronger significance and priority as a result of the tensions in Russia and the crisis in Ukraine in 2014 (Siddi,2020). Moreover, this policy related to the EU energy and climate regulation is built on three principal headline goals, a) enhancement in energy efficiency, (b) reduction on greenhouse emission, and (c) the production of final energy consumption from renewable energy (Directive 2018; Siddi, 2020).

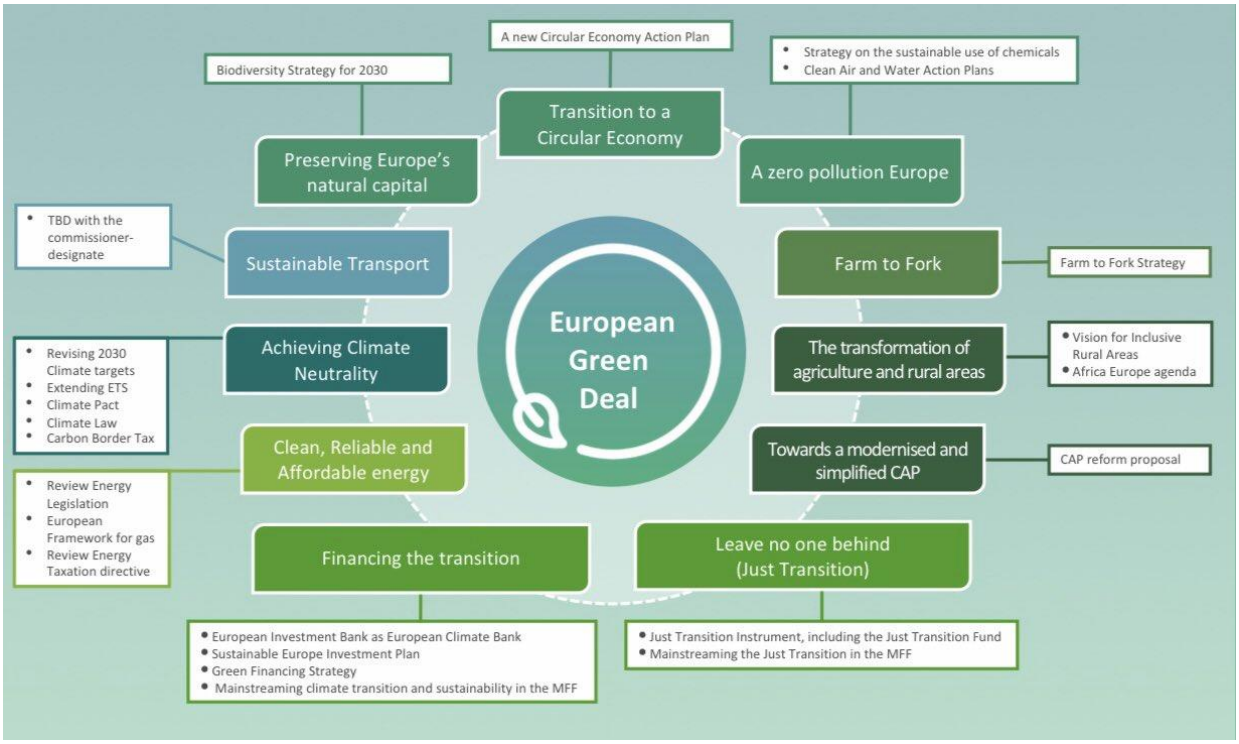

Figure 1. European Green Deal, Source: EUROCOOP (2020)

However, EU has failed to convincingly decrease greenhouse emissions, and not managed to fully address emission in some areas. Moreover, in Europe, growing concern about climate change was reflected in stronger electoral support for Green parties in the 2019 European elections, especially in some larger Western member states, as well as in the emergence of grassroots movements such as 'Fridays for Future' or 'Youth Strike for Climate (Siddi, 2020). The rise of climate change deniers such as Donald Trump in the US risked fatally undermining global cooperation on tackling climate change, as enshrined in the Paris Climate Agreement. All of these factors encouraged the Von der Leyen Commission to take the initiative and strengthen the Union's profile in global climate action (Siddi, 2020) In this line, the EU Commission expects to decrease the unwillingness of countries of Eastern and Central Europe, which have been resistant in environmental regulations considering that their business mainly rely on carbon (Lucchese and Nascia, 2016; Pianta and Lucche, 2020). Still, the most principal, aspiring and challenging target presented by the Commission is to reach zero net greenhouse gas (GHG) emissions by 2050 (Hafner and Raimondi, 2020). According to Block et al, (2020); Pianta and Lucche, (2020) there are crucial weakness that make EGD inadequate to convincingly approach Europe's climate change. Firstly, financing EDG could reach one trillion euro as a total amount over the ten next years, including Member States co-funding, EU and individual private funds (Piata and Lucche, 2020). Yet, regardless of succeeding in collecting such finances, this just amounts to a third of EU green investment gap to get to the climate goals until 2030 (Storm 2020, Clays et al, 2019). Second, EGD has poor strategy tools for increasing business's and government's willingness to comply with EDG's priorities (Figure 1.):

(i) they do not have a clear group of stimulators for investing in green manufacture;
(ii) Members States lack of executive restrictions that can make governments apply the EDG policies; and
(iii) there are no clear statement as to how could environmentally harmful public subsidies be removed (Pianta, Lucchese and Nascia 2020).

Last, according to European Commission (2020), the Member States should provide 7.5 billion of fund to the "Just Transition Mechanism", so they could leverage 100 billion of private and public fund during the period 2021-2027. The total of this fund does not contemplate the resources required to guarantee the social transformation related to the climate change (Storm 2020; Pianta and Lucchese, 2020) Accordingly, the European Green Deal will be followed by a fund named "Just Transition Mechanism", whose task is to support regions and areas that rely mainly on carbon-concentrated operations (European Commission 2020; Pianta and Lucche, 2020), However, the success of the EU Green Deal relies on the stakeholder's effective and continuous commitment to accomplish the strategy (Yau, 2012, Camilleri 2020, Shawtari, Shamsudin, & Hussain, 2018).

Opportunities and Challenges implementing EGD

EGD Opportunities

The overall goal of EU's Green Deal was to make the 27 EU members achieve a low-carbon economy, with more health benefits, low air and water pollution, improved socio-economic aspects, and in general improved society's welfare. The EGD defined an aspiring framework of realizing 50-55% reduction in GHG by 2030 and net-zero carbon emission by 2050 (European Commission, 2020a). Hence, the environment and economy do not necessarily dispute each other's functions. According to the green growth theory there can be a collaborating relationship between the economy and ecology by replacing and removing the parasitism of an environment-damaging industrial economy (Ossewaarde and Lowtoo, 2020). Thus, based on a green growth discourse, ecology preservation is a chance that yields high return investment, instead of pricey constrains (Bowen and Frankhauser, 2011; Loiseau et al., 2016; MacArthur, 2020). Increase in production, latest technologies, new materials, higher job possibilities and consumption increase are just few of the effects that the reconciled relationship between ecology and economy might provide to the economy (Ossewaarde and Lowtoo, 2020). However, regardless the fact that there is still some space for improvement regarding the Green Deal's proposal, yet it can greatly impact health improvement, as well as it could eliminate and minimize the growing health issues arising from globalization (Haines and Eb, 2019). In order to achieve these health benefits it is required the application of adequate policy in sectors like, food industry, transport, health and energy sectors, which cause CO2 gas emissions and other climate pollutants (Haines, et al., 2009). The implementation of adequate policies can decrease air pollution, green gas emissions and O3, with great positive impacts in health. Moreover,, producing renewable energy instead of nonrenewable fuel source in these sectors would avoid around 4 million annually early deaths that are caused from heart and pulmonary chronic debases, stroke and other causes (Haines and Scheelbeek, 2020).

In this regard, the rise of green sectors would not only provide ecological benefits but also health and economic ones , such as increasing green job possibilities and in general improving the standard and welfare of living (Sabato and Fronteddu ,2020) The international Labor Organization has also given attention to such benefits of green economy by stating that the green growth in economy could have impact on social advancement as well, considering its impact on green job creation (ILO, 2015). Moreover the energy efficiency is highly impacted from different environmental policies and regulations on local and international energy market (SIDDI, 2020); and the economic development and the society's welfare will be greatly improved through the cheap energy provided. In this regard, the negative effects resulted from poverty will be reduced (Cameron ET AL., 2020; Clayes and Tagliapietra, 2020; Deisenrieder et al., 2020) Moreover, the fast economic global development will increase the energy production for all areas of the economy. Considering that nowadays the advancement of the energy sector is created to boost the economic growth, it will support the competitiveness of all countries in the economic sector as well (European Conservatives and Reformists, 2020; Euractiv, 2020a; Euractiv, 2020b).

However, while the European Green Deal designs a general policy for sustainability, critical weaknesses affect the implementation of such strategy for global warming (Pianta and Lucchese, 2020).

EGD Challenges

The European Green Deal has anticipated around one trillion euros for financing as a general amount for the next 10 years, among which funds from the private sector are joint financed by the Member States and the EU funds. Considering that this amount might be reached by the EU, it still consists of just 1/3 of the EU

"environmental investment gap" in achieving climate goals for the next decade as appraised by the EU Commission (Claeys, Tagliapietra and Zachmann 2019; Storm 2020). The biggest part of this amount plays a role as an assurance from which bigger financial capital could be used in coordinating private funds in green production and technologies (Pianta and Lucchese, 2020). However, usually organizations hesitate in investing in processes that are of high risks and technologies are still in progress. In this regard, governments should step in and support such organizations with the "risk-reward nexus" concept - where government institutions should manage the allotment of high risk resources and socially required – environmental investments (Pianta and Lucchese, 2020) (Figure 2.)

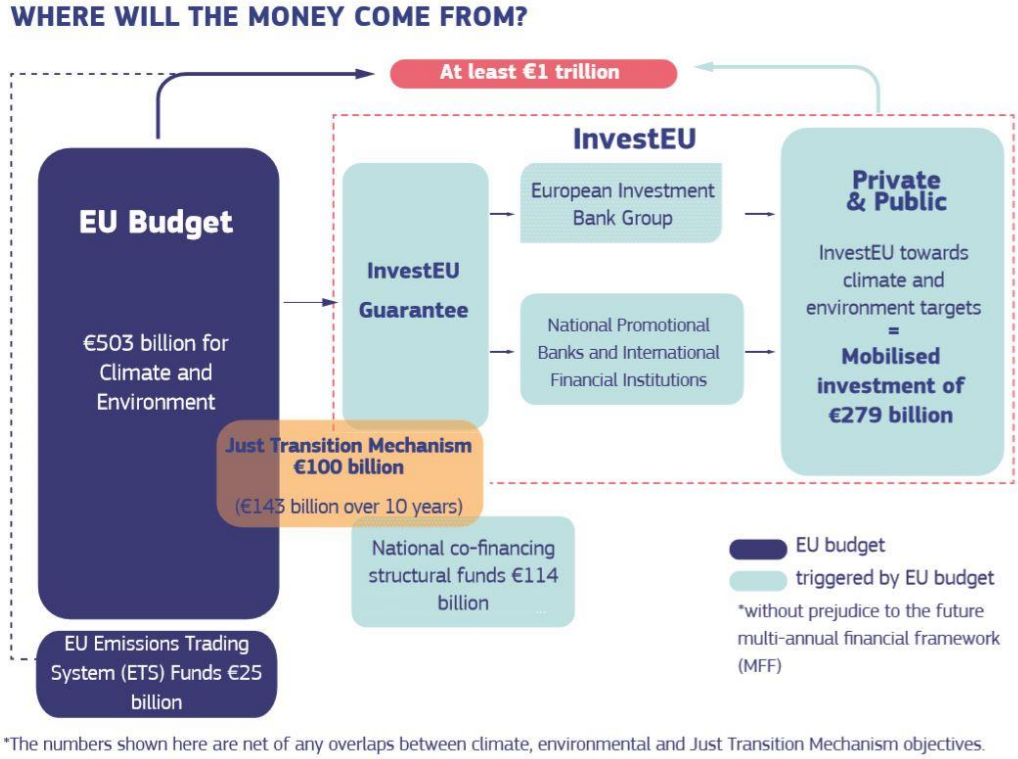

Figure 2. EGD Budget, Source: European Commission (2020)

From the 1 trillion euro aimed for green investment, 100 billion Euro are required to be mobilized by the Just Transition Mechanism (JTM) by the period 2021- 2027, in order to reduce the economic and social effect of the climate transition in regions whose activities and processes depend on fuel and coal chain (Parker, 2017). However, some experts argue that this amount will be mobilized by EU in order to rescue the banking industry from the economic crises occurred from 2008. They are also reluctant as to whether this amount declared by the EU is current and will it indeed be realized (Ringel and Knodt, 2018). Moreover they criticize that the JTM will transfer EU taxes to powerful upper-class locals whose business rely on decarburization, instead of allocating them to the main actors that were damaged from the fossil fuel processes (Schreurs, M., 2016). The EGD has poor strategy methods for stimulating governments and businesses to apply its agenda: companies have no transparent or clear stimulus for funding sustainable manufacturing (Pianta and Lucchese, 2020). Furthermore, Member States lack legal political restrictions that would stimulate state institutions to follow Green Deal's priorities (Karl and Schratzenstaller, 2016).In particular, the Green Deal agenda lacks clear proposal on how the price network will be adjusted, consisting of the price of C02 -which has made businesses to follow up with unfriendly environmental actions (Pianta and Lucchese, 2020). Third, the EU Commission on itself admits that a wide EU industrial policy is needed for the European Green Deal Agenda (Karl and Schratzenstaller, 2016). However, the actual actions for industrial strategy continue to be limited in application and it is not clear as to if the EU regulations will be considered regarding the non – support state institutions towards companies which include green activities in their business (Clayes, 2019).

Key challenges for a Green Industrial Policy

The evolution towards a green economy demands for structural modifications in production and technology processes. Thus, modern technologies have to be established entirely and the previous ones have to be restored (Altenburg and Rodrik 2017). Moreover the development and progress of economic structures requires investment in new technologies, establishing new manufacturing capacities, larger use of know-how and development of new socio-economic activities. To make this progress, the high economic and revenue disparities that have appeared in South-Eastern Europe countries should be taken into consideration (Pianta, Lucchese and Nascia, 2016). As a further challenge, there lacks a clear explanation as to how will the disparity, deindustrialization and climate change be approached, and with no clear vision of how an undivergenced and environmental friendly economy will arise in Europe. Thus, the evolution of this challenging climate direction delivers a huge part to public policies to address the green technology and developing new market possibilities (Lamperti et al., 2018).

Moreover, the Member States are required to provide 7.5 billion fund to the Just Transition Mechanism, while targeting a total of 100 billion private and public funds to be used from 2021-2027(European Commission, 2020). Yet, this total of fund does not manifest the capital that is required to guarantee society engagement in following with climate evolution (Storm 2020). Moreover there is no link whether and how the EGD may impact on repealing the socio-economic disparity among the" center" and "periphery" that have been spread in Europe in the last ten years (Pianta, Lucchese and Nascia, 2016). Nowadays, there is high inequality of capacities to increase resources for green investment and green technologies among EU countries and this new generator of disparity may continue to expand fragmentation and inequalities across Europe (Cleantech Group, 2017). In this matter, this progress towards industrial policy puts Europe before far-reaching challenges. Firstly, replacing the old technologies with new-modern ones can impact largely the workers, companies and markets among regions (Siddi, 2020).

Thus, the allocation of the costs and capital should be properly managed and successful adaptation policies should be implemented. Fuel, coal and other environmental damaging industries will require a considerable time of replacing the old technologies, which put state institutions in charge of addressing the transfer process (Euractiv, 2020c). Second, costs and prices will likely be affected and changed due to major modifications in energy sources; which will call for adequate methods to guarantee running competitiveness in regions with diverse energy mixes (Siddi, 2020). Such evolutions might expand divergences among companies that have it easier to shift into environmental friendly production due to their higher technological capacities - and companies that attain old technologies and fewer resources (Siddi, 2020). Polices have to aim expanding the system's production capacities simultaneously and motivate businesses to reach the higher environmental and technological standards (Altenburg and Assmann, 2017). Finally, modifications in productions, service and technology system could highly affect the number and quality of employment, salaries and capacities. Thus, policies should guarantee that employers receive the benefits of sustainability relating to higher salaries, employment and capacities, and ensuring that industrial divergences are reduced (Siddi, 2020). Moreover, the relation among EU national and local policies is another concern, which can play a huge role in approaching climate change. The concern is related in terms of how to develop strategies that consider the disparities between the capital, production and capacities among different countries and regions in EU (Bailey, Glasmeier and Tomlinson, 2019). Thus, public institutions could establish universal objectives for the green economy evolution; arrange an unanimity supporter between socio-economic performers and leaders; create the necessary knowledge jointly with universities and companies through establishing research technological divisions and establishing or reinforcing funding projects (Euractiv, 2020b). Finally, in order to acquire the positive impacts of an environmental friendly and unbiased economy, modifications in production structure should comply with relevant changes in social motilities and institutional environments (Perez, 2016). Broad- environmentally awareness progress in social relations, political actions, administration settings and private-public jointly practices are the strategies the goal of a green-environmental friendly Europe could be realized (Siddi, 2020).

Based on the literature review, the following correlations can be detected between the individual economic and policy program elements. The details of the SWOT analysis based on the processed literature are as follows. (SWOT stands for Strengths, Weaknesses, Opportunities, and Threats, and so a SWOT Analysis is a technique for assessing these four aspects of the analysed policy. We can use SWOT Analysis to make the most of what we've got, to our systems' best advantage.) (Table 1.)

Table 1. Evaluation SWOT table about the Greed Deal program

Strengths: ▪ achieving climate policy goals ▪ start green, waste-free conversion ▪ maintaining economic growth ▪ increasing security of supply in material and energy use	**Weaknesses:** ▪ low level of innovation potential ▪ technical background and the unsuitability of basic systems for green development in underdeveloped parts of the EU ▪ various impediments to global economic dependence
Opportunities: ▪ rapid opportunity for economic growth ▪ green transformation of lending and investment programs ▪ a green insurance system can reduce business risk ▪ implementation of a closed material cycle instead of open waste streams	**Threats:** ▪ growing regional disparities in development ▪ energy price increase ▪ the sharpening of conflicts between energy and climate policy interests

3. Conclusion and Recommendations

Various policies have been supported by EU in adopting sustainable energy, decreasing greenhouse gas emissions, as well as actively initiating global climate negotiation. The European Green Deal (GD) is the latest policy for economic growth approved in late 2019 by the European Commission, which calls for climate-neutral from EU by 2050- making Europe the first continent to adopt this law. However, achieving these targets requires the industry's mobilization for a circular and clean economy. To reach this goal, EC introduced the most advanced legislation follow-up package that EU's society and businesses can benefit from this green evolution.

Thus, the European Commission needs to assure the following:

(i) The supplementary allotment of funds for the GD is in fact added to the former budget, rather than a reorganization of funds realized previously;
(ii) The amount required for GD will not be mobilized by EU in order to rescue the banking industry from the economic crises that occurred from 2008;
(iii) EGD should follow up with a proposal on establishing legal political restrictions that would stimulate state institutions to follow Green Deal's priorities and a clear proposal on how the price system will be adjusted;
(iv) Policies should guarantee that employers receive the benefits of sustainability in regards of higher salaries, employment, and capacities, and ensuring that industrial divergences are reduced;
(v) Public institutions should be encouraged to establish universal objectives for the green economy evolution; arrange a unanimity supporter between socio-economic performers and leaders; create the necessary knowledge jointly with universities and companies through establishing research technological divisions and establishing or reinforcing funding projects ;
(vi) A clear proposal and vision as to how will the disparities, deindustrialization, and climate change be addressed;

The legislation package includes actions and steps with a connecting guideline of principal policies, starting from a very determined goal in eliminating emissions, as well as investments in related innovation and research in order to protect the natural environment of Europe. However, reaching the goal of being the first among other continents to be climate-neutral by 2050 is so far the biggest challenge, as well as the greatest opportunity for Europe. In reality, in order to implement such advanced goals, obstacles need to be addressed as well, in national and international level.

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