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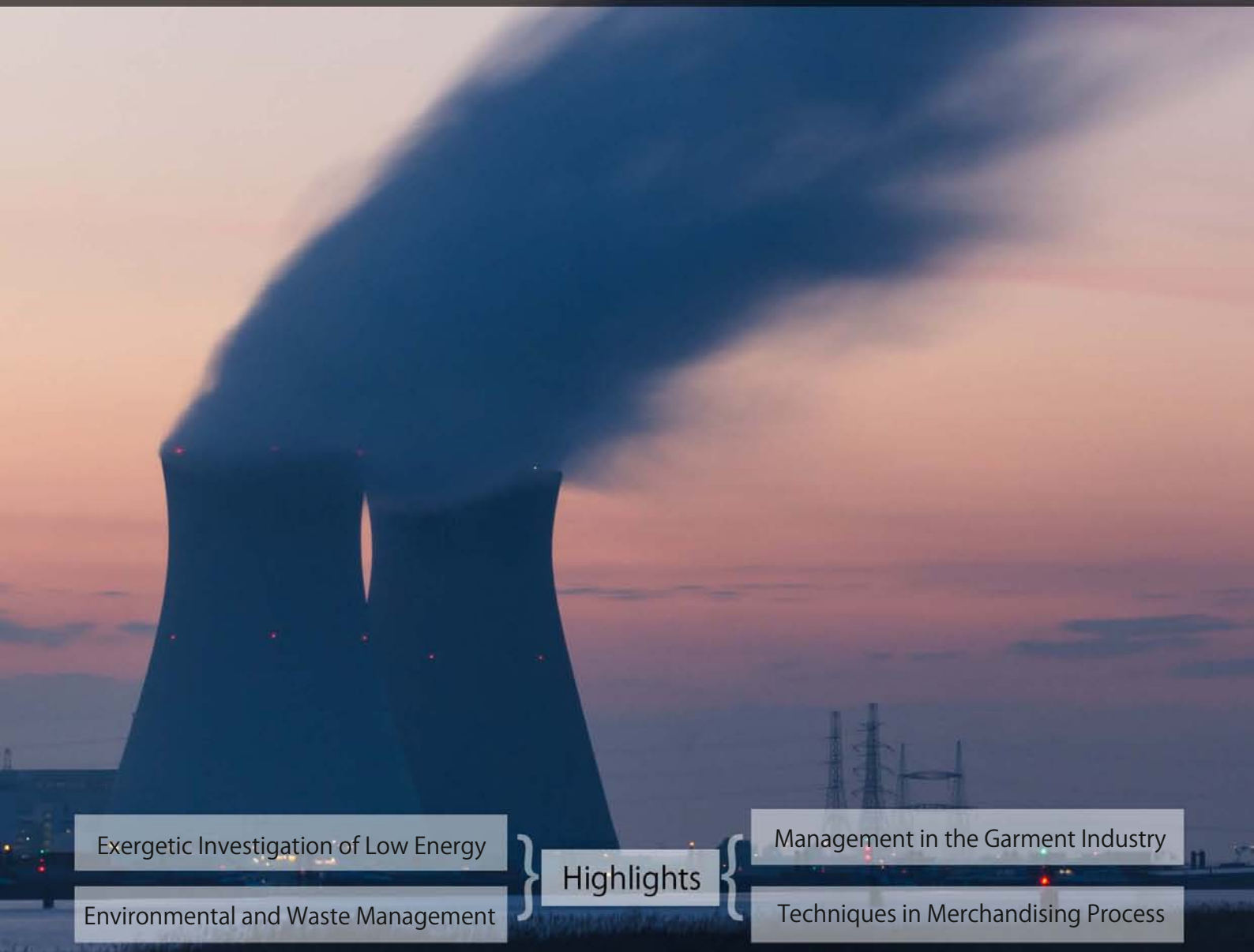

Highlights

Exergetic Investigation of Low Energy Environmental and Waste Management

Management in the Garment Industry Techniques in Merchandising Process

Discovering Thoughts, Inventing Future

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Environmental and Waste Management in the Garment Industry in the Republic of Moldova

By Gheorghita Maria
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Abstract- This paper reflects the situation in the Republic of Moldova regarding environmental management in the garment industry with focus on textile waste recycling and identification of possibilities for raising the industry sustainability and encouraging the transition to circularity principles. Moldova's Apparel is the largest and best-performing industry of the Moldovan economy. It is one of the largest exporters and an important employment generator. The COVID-19 pandemic has disrupted the Moldovan garment industry like never before, but even in these conditions the industry managed to remain in the top of the three Moldovan exporters. The bad part of the garment industry is that it is a big waste-generating industry at both stages: pre-consumption and postconsumption stage. Textile waste which are formed at preconsumption stage are not sorted, therefore they are not recycled. However, in Moldova there are some initiatives for recycling waste obtained in the garment industry. Practice shows there are certain initiatives for the collection and recycling of waste that appear at the post-consumption stage. In order to multiply the existing practices of collecting and recycling of the waste appeared in the garment industry, an information and training of both the enterprises and the population regarding the benefits of the circular economy is required.

Keywords: garment industry, impact on the environment, textile waste recycling, circular economy, sustainability.

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Keywords: garment industry, impact on the environment, textile waste recycling, circular economy, sustainability.

I. Introduction

In recent years, the effects and consequences of climate change have become more pronounced. These changes are greatly influenced both by the used technologies, but also by the waste that is formed in enormous quantities in different industries, including garment industry, which is a fundamental part of everyday life and an important sector in the global economy.

Clothing represents more than 60% of the total textiles used and in the last 15 years, clothing production has approximately doubled, driven by a growing middle-class population across the globe and increased per capita sales in mature economies. At the same time, clothing use has declined by almost 40%. Both developments are mainly due to the "fast fashion" phenomenon, with quicker turnaround of new styles, increased number of collections offered per year, and often, lower prices [1].

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The fashion industry has a massive impact on the environment, being responsible for 20% of the world's wastewater, 10% of carbon emissions and large amounts of waste. Every second, a garbage truck full of textiles is dumped in the landfill or incinerated. But an unseen impact is the pollution of the oceans with plastic fibers. About 60% of the materials used in clothing are made of plastic. According to the United Nations Environment Program the fashion industry has contributed to the pollution of the oceans with about 1.4 million trillion plastic fibers due to the use of synthetic fibers such as polyester, acrylic and nylon [2].

Globally, less than 1% of clothes are recycled as clothing, partly due to inadequate technology.

Regardless of the size of the country, environmental pollution is the same. The fashion industry in Moldova is a big generator of waste at the pre-consumption stage, but especially at the post-consumption stage. At the pre-consumption stage, the waste is generated by the growing number of garment companies and their production capacities, which do not sort and recycle the waste, so waste go directly to the landfill, with small exceptions.

The consumption of clothes in Moldova is quite high and is caused primarily by the traditions and culture of the country. It generates an enormous amount of waste at the post-consumption stage.

The problem of sorting, collecting, and recycling textile waste today became extremely important because it can generate savings on the one hand, and on the other hand it would protect the environment.

This paper aims to analyze the situation in the Republic of Moldova regarding environmental management in the garment industry with focus on textile waste recycling, and to present the existing potential for increasing the sustainability of the apparel industry by encouraging the transition to the principles of circularity.

II. Environmental Management and Waste Recycling in the Moldova's Garment Industry

a) *Overview of Moldova's Garment Industry and its trends*

Moldova's Apparel Industry is a key sector of the Moldovan economy (more than 5% in total Manufacturing Industry). Is the largest and best-

performing industry of the Moldovan economy and an important employment generator (16000 employees or approx. 20% of the total number of employees in the manufacturing industry), creates jobs and employs women, a big part of them being yang and provides key alternatives to migration for Moldovan women, allowing them to earn money while staying at home with their families.

Moldova's apparel industry is one of the largest exporters in the Moldovan economy (about 12 percent of the total exports). Over 70% of the total value of clothing production manufactured in the Republic of Moldova, are export oriented.

The COVID-19 pandemic has disrupted the Moldovan apparel industry like never before. In the pandemic period the number of employees within the Apparel Industry has decreased on average with 33%. Exports in the first half of 2020 fell by more than 38%. But since May 2020, the industry has experienced a recovery trend. In 2020, the export of the garment industry amounted to US $ 289,801.1 Thousand, or 89.1% compared to year 2019, and the share of this industry in the country's total exports was at the level of the previous year (more than 11%), which means that the industry remains one of the top exporters (Table 1).

Table 1: Export of the garment industry, mil US$

Indicators	2019	2020	2020/ 2019, %
Textile and Apparel Export	325,363.29	289,801.08	88.9
Total Exports	2 779 164.47	2 485 159.94	89.4
The share of Apparel industry in total exports, %	11.7	11.7	

Source: [3].

Most of Moldova's Apparel companies provide C&M (Cut & Make), CMT (Cut, Make Trimming) and FOB (Free on Board) services for European clients. Some companies produce and sell only under their own brand.

Regardless of the business model practiced by Moldovan garment companies, they must consider environmental and occupational safety standards if they want to retain and / or attract new European customers.

The consequences of the COVID-19 pandemic result not only in the economic decline of the garment industry, but also in the increase in the amount of waste, which will further influence environmental pollution.

b) Integration of international environmental, health and safety standards into current practices of Moldova's apparel companies

European Apparel and Textile Confederation EURATEX developed an ambitious program to improve the sustainable growth of the European textile and clothing industry. According to this program, the textile and fashion products of European Union producers must be exceptional in terms of environmental protection, consumer safety and labor rights, which means that special attention is paid to the existence of quality, environmental and occupational safety management systems at the garment manufacturers. Moldovan apparel companies should align with these conditions if they want to retain and / or attract new European customers. To meet these requirements Moldova's Apparel companies must implement Integrated Management Systems based on the provisions of the following international Standards ISO 9001 (Quality), ISO 45001 (Health and Safety), and ISO 14000 (Environment).

The Integrated Management System can be created using different combinations of the three international standards as follows:

1. Integrated Management System "*Quality - Occupational Health and Safety*" based on the requirements of ISO 9001 and ISO 45001 standards.
2. Integrated Management System "*Quality - Environment*" based on the requirements of ISO 9001 and ISO 14000 standards.
3. Integrated Management System "*Environment - Occupational Health and Safety*" based on the requirements of ISO 14000 and ISO 45001 standards.
4. Integrated Management System "*Quality - Environment - Occupational Health and Safety*" based on the requirements of ISO 9001, ISO 14000, and ISO 45001 standards.

The most complex version of the Integrated Management System is the fourth version, which combines quality assurance, vital safety, and environmental protection. The implementation of Integrated Management Systems that demonstrate business practices based on responsibility and sustainability, as a rule, requires investments that ensure the success of each factory, but also of the industry as a whole and become increasingly important for international customers, and in many cases even requested by them. With the support of the MCP Project (Moldovan Competitiveness Project) funded by USAID, the Government of Sweden, and the UK aid more than 20 apparel companies implemented Integrated Management Systems. This practice has shown visible results. Orders worth tens of millions of Euros have been

secured from existing customers, but new customers have also been attracted by Moldovan Apparel companies that have implemented Integrated Management Systems. This demonstrated that implementation of Integrated Management Systems needs to be extended, given that in the future there will be increasingly stringent requirements for the business activity of companies in the garment industry to meet the requirements of customers and consumers who have undergone essential changes such as due to the influence of the Covid-19 pandemic.

Foreign clients encourage their partners apparel manufacturers from the Republic of Moldova to make ongoing efforts to ensure optimizations for sustainability, and commitment to environmental protection and compliance with occupational health and safety requirements given that the industry uses a very high labor force. Moldovan apparel companies must comply with requirements regarding:

- having a valid environmental permit,
- holding and displaying the environmental policy to address the environmental
- impact,
- monitoring the impact of the apparel manufacturer's economic activity on the
- environment,
- setting and approving objectives on environmental issues related to reduction in
- water consumption and waste disposal, as well as energy consumption and GHG
- emissions - greenhouse gases,
- providing recycling waste opportunities and monitoring the amount of recycled
- waste.

c) *Moldovan Legal framework regarding environmental protection and waste management*

In the Republic of Moldova, the legal requirements in the field of environmental protection and waste management are provided by the Environment Agency which is responsible for implementing the state policy in this field. It ensures the implementation of the environmental legislation, harmonized with the European Union legislation established in the Association Agreement between the Republic of Moldova and the European Union, in the chapters "Environment", "Climate change" and "Trade and trade-related issues" (about 50 EU directives, regulations and decisions). The Agency is responsible for the implementation of new environmental tools such as: creation, maintenance and management of the environmental impact assessment system deriving from economic activities, the strategic environmental assessment system, the integrated environmental information system, the monitoring system of the quality of the environment, the monitoring system of natural resources, the integrated environmental authorization system, etc. [4].

The Moldovan legal and institutional frame work regarding environmental protection and waste management contains 49 documents. But the main documents related to environment and waste management are the following:

1. *Environmental Strategy for the period 2014-2023*, approved by Government Decision no. 301 of 24.04.2014, which sets out the priority directions of development in this field. The basic goal of the strategy is to guarantee the population of the Republic of Moldova the right to a sustainable unpolluted and healthy environment, in harmony with economic development and social welfare. The general objective is to create an efficient environmental management system, which will contribute to increasing the quality of environmental factors and ensure the population the right to a clean, healthy, and sustainable natural environment [5].
2. *The Waste Management Strategy in the Republic of Moldova for the years 2013-2027*, approved by Government Decision no. 248 of April 10, 2013. The main objective of the strategy is to establish the indicative direction of the activities for the development of the infrastructure and services necessary for the proper management of waste to protect the environment and the health of the population. Regarding the industrial waste (to which the apparel waste also refers) in a certain strategy it is indicated that the organization of the production waste management activity is the obligation of the generator, i. e. of the enterprise. In the strategy it is clearly indicated that the economic units carry out these activities with their own means or contract the sanitation services. Waste management followed by the apparel factories must be in line with these requirements [6].
3. *Law of the Republic of Moldova No. 209 of 29-07-2016 on waste,* which mentions the waste hierarchy, which includes prevention, preparation for reuse, recycling, other recovery operations, including energy recovery and disposal. According to Article 13, paragraph 2 of this law, to ensure a high degree of recovery, the initial waste generators and waste holders are required to collect at least the following categories of waste separately: paper, glass, metal, and plastic [7]. The garment factories in the Republic of Moldova comply with these provisions of the law and collect cardboard and film separately. As for the fabric and apparel cutting waste, which is formed in the cutting sections, the law does not require their separate collection. As there is no mandatory legal requirement, today, fabric waste, which appears in the cutting sections, is neither collected separately, nor recycled.

The environmental issues, which are closely connected to the waste management, can no longer be addressed separately from the economic problems of the apparel enterprises from Moldova. Global competitiveness and the increasing use of limited resources are leading to considerable economic change. The policy of the European economy tends towards transformations in order to produce more with less resources. That is why the sustainable development of garment companies in the Republic of Moldova is closely linked to the responsible management of the environment, including waste. This requires regulations, incentives and public procurement policies that promote production and consumption patterns that are compatible with a country's sustainable ecological development. Of particular importance is the education of all kinds of producers and consumers in the field of waste sorting, to be recycled and processed.

d) Types of waste and their disposal in the garment industry in Moldova

The Moldovan garment industry is a large waste generator. The value chain of this apparel industry generates a wide range of waste. Among them two categories of waste can be listed:

i. *Pre-consumer waste*

Based on the interviews caried out with more than 25 Moldovan apparel companies we identified that at this stage, the following types of waste are generated (Table 2):

Table 2: The types of waste generated by the apparel value chain

#	Value chain stage	Type of waste
1	Supply	- The film in which the fabric and some accessories are packed. - Cardboard tubes from fabric, cardboard boxes in which some accessories are packed.
2	Cutting	- Fabric cuttings of different sizes, having different compositions as follows: o 100% natural fiber fabrics (linen, cotton, silk, modal, viscose) o Mixed fabrics: 92-97% natural fiber plus 3-8% elastane o 100% synthetic fiber fabrics (polyester, polyamide, nylon) o Mixed fabrics of two types of fibers (natural and synthetic in proportion of 40% -60%) o Mixed fabrics of three types of fibers (natural, synthetic and elastane). - Scrap paper (first and last layer to cut) - Non-compliant parts (either mistakes were made in cutting or non-conformities were detected in the fabric).
3	Manufacturing	- Thread spool tubes - Broken needles
4	Quality Control	- Fabrics, accessories, unfinished and finished goods with irrecoverable defects.

In the Republic of Moldova, preventive evaluations show that the pre-consumption stage generates an amount of approx. 8-10 thousand tons of fabric waste and approx. 3-5 thousand tons of other types of waste.

To clarify the situation regarding the waste management in the apparel industry, more than 25 garment enterprises small, medium, and large one, specialized in manufacturing of different assortments of finished products (clothes for men, women, children) from different fabrics (natural, synthetic, and mixed), which produce under their own brand and / or and provide services for foreign customers were interviewed. Following the interviews, it was found that practically no factory sorts the fabric waste that appeared at pre-consumption stage.

The practice of waste disposal in the garment industry of the Republic of Moldova is as follows:

- The film and the cardboard are collected separately, practically by all the enterprises, and they are handed over to the companies, specialized in the collection and processing of some types of waste.
- Apparel cutting waste is not sorted, and not recycled.
- A very small number of companies that process the raw material received from the international clients in C&M regime, collects the fabric waste and returns it to the client at the client's request, once the order is delivered.
- Most companies have concluded contracts with sanitation companies that pick-up waste from the company and transport it to existing landfills.
- A small amount of fabric waste is provided to farmers for tying the vine.
- Recently some apparel manufacturers started to offer the apparel cutting waste from Jersey fabrics to some organizations who produce handmade rugs.

ii. *Post-consumer waste*

This waste is generated by the last stage of the value chain and represents those garments that are no longer worn or used. In the Republic of Moldova, the waste record at the post-consumption stage is not performed.

At present, there is no single approach to the responsibility of producers for the collection of this waste. In the European Union, France has imposed specific legislation for extended producer responsibility in this field, with visible results. Also, some global companies have started to implement voluntary programs to recover used clothes from customers. In the Republic of Moldova this responsibility is not applied to enterprises. There is no well-developed process for collecting and using / processing this type of waste. Moreover, an impressive amount of second-hand clothes is imported into Moldova, which leads to an essential increase in the amount of waste at post-consumption stage. Only during 2019, second-hand garments worth 100.2 million MDL were sold, which was more than 2 times more than in 2018 (46.9 million MDL). All this amount of goods was imported. Second-hand clothes have a very short service life, which means that they reach the landfill very quickly.

e) *Overview of current recycling practices and recycling opportunities in the garment industry in the Republic of Moldova*

In the Republic of Moldova, the separate collection and recycling of textile including apparel cutting waste is a less promoted aspect in selective waste collection companies. That is why very often textile waste is dumped in landfills along with other types of waste.

Despite this fact, there is a practice of collecting and recycling certain waste in Moldova.

At present, the Ministry of Agriculture, Regional Development and Environment of Moldova, has issued 39 permits to enterprises that carry out waste management activities [8].

The information provided on waste collection and recycling companies shows that all these companies collect and recycle waste other than textile and apparel cutting waste. As mentioned, garment companies collect and hand over film and cardboard for recycling. As for the collection of apparel cutting waste generated during the manufacturing process, that is formed at garment companies at the pre-consumption stage, it is neither sorted, nor collected and nor recycled.

However, there are some initiatives in this area such as [9]:

1. *Collection and recycling of pre-consumption waste*. The organization Ra Planet transforms any type of fabric into beautiful and turbid carpets of all beauty. Ra Planet is a store with products for arts and crafts in Chisinau. But the amount of waste collected and recycled / used is still very small.

- *Collection of post-consumer textile waste*. Several organizations are active in this field. Some of them collect clothes that the owner no longer needs but are in good condition and sold them. The money collected is for charity. While clothes that are not in good condition are redistributed to animal shelters. Other organizations collect clothes and after they are sorted and redistributed to the socially vulnerable, the elderly, the homeless. Different NGOs collect clothes in street containers and in stores through the so-called "take back" programs. There are various advantages and disadvantages of these channels, but the main differentiation is that street collection methods can affect the quality of clothes and subsequently limit the possibilities for reuse and recycling.

Based on the existing practice of collection and recycling of apparel cutting waste, it can be concluded that at the current stage the main method of disposing of apparel waste in the Republic of Moldova is storage in existing landfills. This method has several drawbacks:

- It requires enormous landfill capacity for the storage of this type of waste,
- The landfills pose a threat to the water supply of the population. Every time it rains, the water drains through the garbage and picks up chemicals such as paints and bleaches from textile waste stored in the landfill. The water accumulates at the bottom of the landfill, often in large quantities and can often be more toxic than sewage water.
- The time required for the degradation of most textiles, when disposed of by storage, is long.
- Textiles, even from biodegradable natural fibres, do not degrade easily in landfills due to the lack of sunlight and oxygen.
- During degradation, textile waste emits greenhouse gases and pollutes the soil and water by contamination with chemicals and dyes,
- Wool fibres decompose relatively quickly, but during decomposition methane is produced, which is a strong greenhouse gas,
- Synthetic fibres generally do not decompose, which is a permanent source of soil and water pollution.

Discussions with garment manufacturing companies have shown that some companies use the method of incinerating the apparel cutting waste. However, it should be noted that incineration for energy recovery is a method of disposing of textile waste in industrial combustion plants. According to European legislation, incineration is not a form of recycling, but only a form of energy recovery or controlled waste disposal. Although it is preferable to use the method of waste disposing by storage, according to some studies, the amount of energy used for textile production is

significantly higher than that recovered. In addition, combustion processes in low-performance installations can lead to the release of hazardous chemicals into the atmosphere. Thus, after greenhouse gases have been removed into the atmosphere during the production process, it happens once again, this time by combustion.

As reported by the companies interviewed, virtually all of pre-consumption waste are disposed of in landfills, except for rather small quantities, waste arising from the production of clothing made of light, natural fabrics, or Jersey-type fabrics, some of which:

- Is sold to farmers for the tying of vines,
- Is sold to car repair centres, which are used as a material for hygienic purposes,
- Is sold to produce hand-made items.

III. Conclusions

Globally, textile waste accounts for 5% of total waste, being a huge source of pollution, second only to the oil industry, according to statistics. The impact of the fashion industry on the environment is huge. In the Republic of Moldova, the garment industry generates a large amount of waste, which rains down on the environment too, because the main method of disposing of apparel waste is storage in existing landfills, which requires enormous landfill capacity. The landfills pose a threat to the water supply of the population and produce during decomposition methane, which is a strong greenhouse gas.

Statistics show that in the Republic of Moldova as well as at the world level, during the last 10 years the quantity of purchased clothes has increased almost twice, which generated an increase in waste. Of the amount of waste generated by the fashion industry only a small quantity is reused.

However, there are some initiatives for recycling waste obtained in the garment industry. Practice shows that a small amount of waste was used to make handmade rugs that are sold quite well. There are certain initiatives for the collection and use of waste that appear at the post-consumption stage.

In order to multiply the existing practices of collection and recycling of the waste appeared in the garment industry, an information and training of both the enterprises and the population regarding the benefits of the circular economy is required.

The waste management in general, including waste management in the garment industry, as well as the training of skills in this field is closely linked to the legislation of the Republic of Moldova regarding waste. The main legislative instrument in this field is Law on waste. It presents a waste management hierarchy that includes: Extended producer responsibility, Waste recovery, Waste reuse and recycling, Waste disposal, Waste incineration and co-incineration. But the existing legislation does not reflect the particularities of the garment industry waste. The law in force does not reflect the collection and recycling of textile waste.

The need and demand for textile waste recycling is enormous as well as for efficient management of textile waste and recycling of garments, in order to ensure environmental protection.

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References Références Referencias

1. Fashion and the Circular Economy. [Online]. Available: https://www.ellenmacarthurfoundation.org/explore/fashion-and-the-circular-economy.
2. Ana Moca-Grama. Impactul nevăzut asupra mediului pe care industria modei nu vrea să îl știi. [Online]. Available: https://www.green-report.ro/industria-modei-poluare-microfibre/#
3. National Bureau of Statistics of the Republic of Moldova. [Online]. Available: www.statistica.md
4. Environmental agency. Fields of activity. [Online]. Available: http://www.mediu.gov.md/ro/content/acte-permisive-eliberate
5. Environmental Strategy for the period 2014-2023, approved by Government Decision no. 301 of 24.04.2014. [Online]. Available: https://www.legis.md/cautare/getResults?doc_id=48131&lang=ro
6. The waste management strategy in the Republic of Moldova for the years 2013-2027 approved by Government Decision no. 248 of April 10, 2013. [Online]. Available: https://www.legis.md/cautare/getResults?doc_id=67104&lang=ro
7. Law of the Republic of Moldova No. 209 of 29-07-2016 on waste. [Online]. Available: https://www.legis.md/cautare/getResults?doc_id=96742&lang=ro
8. List of authorizations issued to undertakings carrying out waste management activities. [Online]. Available: https://madrm.gov.md/ro/content/lista-autoriza%C8%9Biilor-eliberate-%C3%AEntreprinderilor-care-desf%C4%83%C8%99oar%C4%83-activit%C4%83%C8%9Bi-de-gestionare
9. 13 locations in Chisinau for waste collection and recycling. [Online]. Available: https://jurnalulverde.info/locatii-colectarea-reciclarea-deseurilor-chisinau/
10. From the heart shop. [Online]. Available: https://fth.md/catalog/artizanat.

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Contemporary Quality Management Approach

By Ibrahim Bedane & Mahmud Abdurahmen Mohammed
Madda Walabu University

Abstract- Quality is meeting or exceeding both customer and suppliers needs, requirements and expectations. This article present Core concepts of contemporary quality management approach using mathematical techniques to measure, analyze and monitor product quality and maintain processes to fixed targets by monitoring, controlling and managing quality with in allowable Percentage Defectives.

Keywords: quality, defectives, control chart, mathematical techniques, sampling, tolerance.

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Ibrahim Bedane [α] & Mahmud Abdurahmen Mohammed [σ]

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Keywords: quality, defectives, control chart, mathematical techniques, sampling, tolerance.

I. Introduction

In popular use of quality gurus and experts in the field, the word Quality is meeting customer requirements. However, this is too imprecise and limited idea of quality to be of any use. Quality is based upon supplier actual experience with the product or service, measured against requirements-stated or unstated, conscious or merely sensed, technically operational or entirely subjective in meeting requirements aimed at the needs, requirements and expectations of customer and supplier, present and future.

Quality is production of product or offering service which fulfills an aggregate needs and requirement of customers and suppliers, in all aspects. customers and suppliers quality priorities may be very different. suppliers quality priorities are producing non defectives profitable products which customer can buy satisfactorily and use effectively. Profitability is suppliers need where as customers ability and capability to use products for functions it produced appropriately is suppliers requirement. Because what is seen and added as important by the supplier in exceeding customers need, requirement and expectation may be very different from the priority concerns of the customer.

This article present the general concept of quality and quality management. Core concepts of process control using mathematical techniques to measure, analyze and monitor product quality and maintain processes to fixed targets by monitoring, controlling and managing quality to manufacture a product as designed with in allowable Percentage Defectives is aim of this article.

II. Analysis and Result

Quality control is essential activities and techniques employed at the point of operation or production to achieve and maintain the quality of a product, process, or service. It includes a monitoring activity, but is also concerned with finding and eliminating causes of quality problems so that the requirements are continually met.

Currently, many scholars and quality practitioners and controller are measuring if or weather process is in control for incapable process by measuring distribution of number of observed defectives data. They are measuring and monitoring processes on which control limit of data with sample size n and sample number m directly doubled if number of defectives of data doubled and both processes data are treated as in control as if both processes are producing products with in allowable Percentage Defectives. For instance, figure below shows control chart of sample data of two processes with doubled number of defectives for the same number of sample size (50) and Sample number (10) where both process are in control with doubled control limit value proportional to defectives.

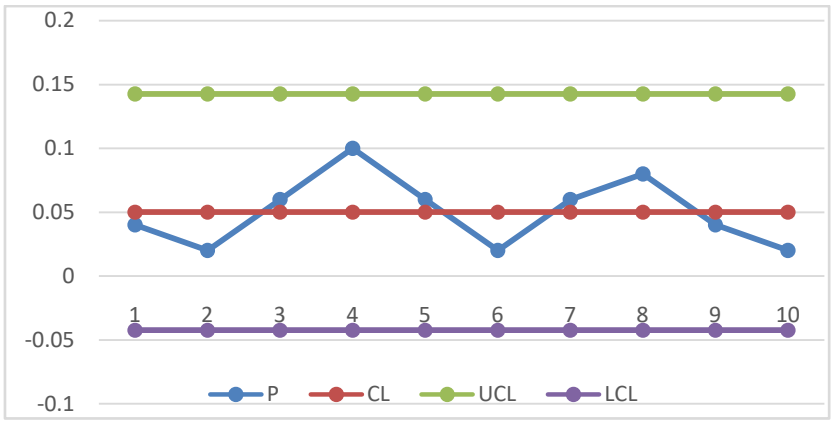

Figure 1: Control chart for number of defectives data I

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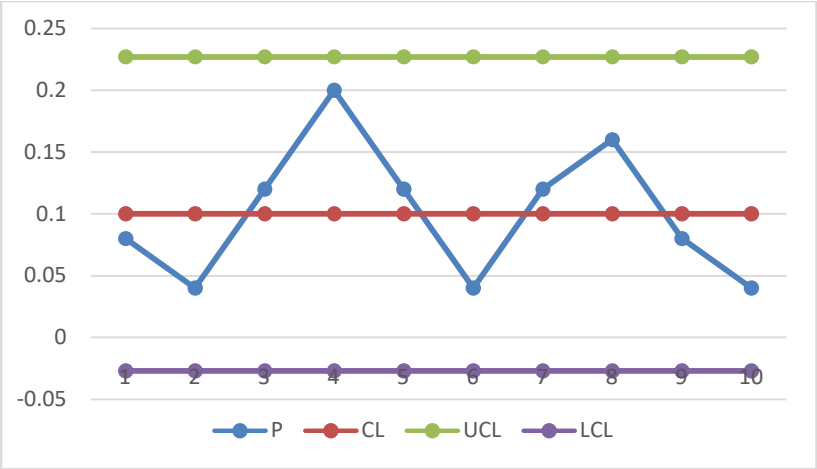

Figure 2: Control chart for number of defectives data II

Note: Percentage Defectives of both processes are 0.05 and 0.1 which doubled as number of defectives double. Since they are monitoring defectives distribution in relation to control limit doubled or tripled as number of defectives doubled or tripled, they forget to compare with allowable defectives that meets permissible Percentage Defectives for sample size n and sample number m of sampling.

Sampling, Sample size and sample numbers, which shall be determine by Costs and time required are two basic for quality monitoring and process control to manage quality of products and services so that we can manage Quality let alone quantity of product is one factor which determine Sample numbers of Rational sub group. Rational sampling group sample size of sampling is basic factor to determine Rational permissible number of defects per sample where as Sample numbers of Rational sub group ascertain number of permissible defects of total sample.

Note: As number of product sampled increase number of defective products in relation to sample size increase. Thus, Sampling with lower number of Sample numbers of Rational sub group should produce lower number of defective products in relation to sample size where as Sampling with higher number of Sample numbers of Rational sub group can have higher number of defective products in relation to sample size. Moreover as quantity of sample size increase number of permissible defective products should decrease logarithmicly. Because variation in production of specified sample is low and expected quality level should be high and number of defective products in relation to sample size must be low to attain and assure quality level we must meet and exceed expectation. Hence process capability is more than one and increase as sample size increase.

There fore

$$D = Log\ n^{Ns}$$

Where

D- number of permissible defectives
Ns- total number of product sampled which is n*m
n- sample size
m - sample numbers

Note: sample size is base where as number of sampled is factor of quality control logarithm function. Mean or control limit of control chart of number of defectives should be number of permissible defectives of sampling.

We can say process is in control if number of defectives of sampling Rational sub group is less than or equal to number of permissible defectives of sampling. Based on mutual understanding tolerance can be added mainly to decade and set upper control limit which shall be based on Proportion of population covered with ɣ% Confidence of sample size n. Process must be in control and produce products at list with three ɣ% Confidence of sample size n from Mean or control limit. Thus upper and lower control limits of number of defectives control chart must be:

$$D \pm 3 * I$$

Where

D is number of permissible defectives
I is number of tolerable defectives with ɣ% Confidence of sample size n

$$UCL = D + 3 * I$$

Thus $$CL = D$$

$$LCL = D - 3 * I$$

Note: ɣ% Confidence of sample size n should be determined based on ratio of sample size to products from which it sampled.

With the help of GGOOCHAA let as see example

Example: table below show number of defectives (d) Samples data of 20 Sample number with 90% Confidence of 200 sample size to monitor process using

number of defectives control chart where Sn is sample numbers and d is number of defectives.

Table 1: Number of defectives data

Sn	d	Sn	d	Sn	d	Sn	d
1	1	6	2	11	2	16	4
2	3	7	1	12	4	17	2
3	4	8	3	13	3	18	1
4	2	9	5	14	1	19	3
5	1	10	3	15	3	20	2

Sample Number = 20
Sample size n=200
Total number of product sampled Ns is:

$$NS = m * n = 4,000$$

Number of permissible defectives D is:

$$D = Log^{4,000} 200 = \underline{1.56541201}$$

Note: with 1.56541201 number of permissible defective expected process capability Cp_E is approximately 1.3 with 0.00782706 percentage of defectives which is more than data process capability Cp_d of 1.2 with 0.0125 percentage of defectives. thus tolerance is required as per agreement and For 90% Confidence of 200 sample size I= 0.981

Thus, Control limits of control chart are:

CL= 1.56541201

UCL= 4.50841201

LCL= -1.37758799

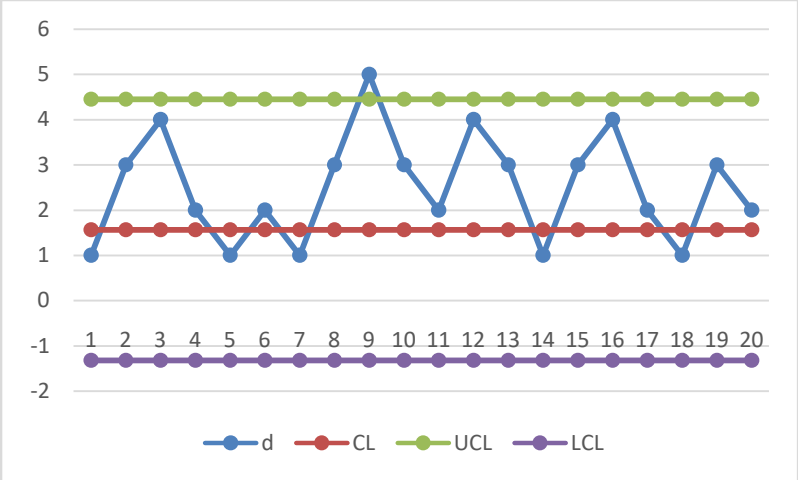

Figure 3: Control chart of number of defectives data and permissiblty

Note: with 90% Confidence of 200 sample size tolerated process capability Cp_t is less than 1.2 with 0.02254206 percentage of defectives which is less than data process capability Cp_d of 1.2 with 0.0125 percentage of defectives. Thus, we can say that the process is capable even though it is out of control with out of control data of number of defectives.

Moreover, with defectives tolerance of 90% Confidence of 200 sample size

1. Five samples of data produce defectives less than number of permissible defective, Hence process at that sample meet customer requirement satisfactorily and the product produced of that sample shall be fully accepted by customers.
2. Hence sample of sample number 9 produce defectives more than number of Tolerable defectives, process is out of control to meet customer tolerable requirement and the product produced of that sample shall be fully rejected by customers.
3. The rest 14 samples produce defectives more than number of permissible defective but less than number of Tolerable defectives, hence process is in control to meet customer tolerable requirement and the product produced of samples shall be tolerated and accepted by customers as per their agreement and level of data process capability Cp_d.

III. Discussion and Conclusion

Quality is based upon supplier actual experience with the product or service, measured against requirements-stated or unstated, conscious or merely sensed, technically operational or entirely subjective in meeting customer requirements aimed at the needs, requirements and expectations of customer and supplier, present and future. Quality management mean improving the quality of everything, i.e. creating a high quality company; high quality man, machine, material, methods and information in satisfying or exceeding customers and suppliers present and future

need, requirement and expectation by operating with in lower Percentage Defectives.

Scholars are saying Percentage Defectives for Different Values of Cp and Cpk for Smaller-the-Better and process with less than one Cp is in capable. Where as currently many scholars and quality practitioners and controller are measuring if or weather process is in control for incapable process with high Percentage Defectives. For instance to say process is capable with at list Cp=1 Percentage Defectives must be less than 0.135. moreover, they are only monitoring process if or weather in control based on observed defectives data rather than permissible number of defectives in relation to sample size n and sample number m. As per their analysis number of defectives control chart measure uniformity of ratio of number of defectives per sample size across sample numbers. Hence for process producing products far from allowable number of defectives having uniformly distributed banch of defectives are treated as in control.

Sampling, Sample size and sample numbers, are two basic for quality monitoring and process control mathematically to manage quality of products and services within tolerable number and/or Percentage Defectives as per customers and suppliers agreement so that they manage and meet Quality by satisfying or exceeding customers and suppliers need, requirement and expectation. Mutual agreement of customers and suppliers on sampling, Sample size and sample numbers, and on γ% Confidence of sample size n determine factors of control chart control limits and hence permitable and Tolerable number of defectives of Rational sampling group quality level so that product can be accepted or rejected and process can be monitored if or weather capable and in control to produce product as designed with in allowable Percentage Defectives.

Acknowledgement

A lot of thanks to GGOOCHAA

References Références Referencias

1. Jeya Chandra, 2001, Statistical Quality Control; CRC Press LLC
2. Thomas Pyzdek 2003; Quality Engineering Handbook, Second Edition; Marcel Dekker, Inc. NEWYORK•BASEL
3. DOUGLAS C. MONTGOMERY; Introduction to Statistical Quality Control, Sixth Edition; John Wiley & Sons, Inc.; Arizona State University.

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Environmental and Exergetic Investigation of Low Energy Sources Organic Hybrid Heat Pumps

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Abstract- Today the protection of the environment is becoming a topic of primary importance given the intensity of industrial activity around the world and its negative consequences on the environment. There are many examples in industry that has shown that reducing pollutant emissions is directly related to efficient use of energy in the processes in question. This work is part of the valuation and development of systems leading to energy savings in the field of air conditioning and cold production. The main objective is the optimization of energy performance in order to minimize the environmental impact through a sustainable energy system. The use of exergy throughout labor actually identified the benefits of sustainable technologies. It is used to assess and improve energy systems, on the one hand, and to better understand the benefits of using clean energy.

Keywords: hybrid heat pump, environmental analysis, low energy source.

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Environmental and Exergetic Investigation of Low Energy Sources Organic Hybrid Heat Pumps

RabebToujani[α] & Nahla Bouaziz[σ]

Abstract- **Today the protection of the environment is becoming a topic of primary importance given the intensity of industrial activity around the world and its negative consequences on the environment. There are many examples in industry that has shown that reducing pollutant emissions is directly related to efficient use of energy in the processes in question. This work is part of the valuation and development of systems leading to energy savings in the field of air conditioning and cold production. The main objective is the optimization of energy performance in order to minimize the environmental impact through a sustainable energy system. The use of exergy throughout labor actually identified the benefits of sustainable technologies. It is used to assess and improve energy systems, on the one hand, and to better understand the benefits of using clean energy.**

Keywords: hybrid heat pump, environmental analysis, low energy source.

I. Introduction

Faced with the degradation of ecosystems and the quality of life, social and political concern for the environment has continued to grow. Economic life can no longer ignore this aspect thanks to laws, imposed standards and political initiatives.

Whatever their intentions, actors need environmental management tools to assess changes in the environment. Thus, the decisions taken in a sustainable development policy need to be designed and evaluated according to a suitable frame of reference. By going through all the environmental impacts that an activity can generate, we observe a variety of indicators to study.

Unlike the economic point of view where a single indicator, the financial cost, characterizes the impact of an activity, the environmental assessment must be based on a multi-criteria analysis. It is a combination of several impacts; it also takes into account the particular importance of each of them with regard to environmental aspects. Thus, a multicriteria analysis allows decision-makers to argue their decision by reducing the risk of a conflict situation and also seeking solutions that correspond to the best compromise for all stakeholders.

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The analysis of the performances of the various technologies leads in a traditional way to calculate their energy balances. In addition, especially when one seeks to optimize a system, the development of its exergy balance is of great interest, because this balance makes it possible to quantify irreversibilities. Drawing up an exergy balance does not pose any particular difficulty but requires to be done with great care.

The exergy provides thermodynamics with very relevant tools to be coupled with other approaches: economic, ecological, environmental, technological, etc.

As an indication, exergy analysis and economic analysis form the thermo-economic basis, which is also called exergo-economic analysis [1, 2]. Thus, an exergy loss directly implies economic losses [3, 4]. The consideration of exergy efficiency as an additional criterion for comparison with environmental criteria, through ELCA, will provide LCA with more relevant tools for accounting for the consumption of abiotic resources. Thus, the increase in the exergy efficiency of the processes was considered as a solution to reduce the environmental impacts through the reduction of the degradation of natural resources. The most important contribution of ELCA in the framework of the implementation of a sustainable development undoubtedly remains the perspective of life cycle which makes it possible to save resources and to solve the pollution problems in a definitive way, avoiding thus moving them from one point in the production chain to another.

The choice of the field of refrigeration may seem reductive, in fact, a proven technology exists: absorption. These performances can also be considered as resulting from a natural optimization, resulting from know-how acquired over several decades of research, and responding to current technical and economic constraints. This technology can therefore serve as a test for the various thermodynamic criteria which will be defined below.

Absorption machines have several advantages such as environmental protection. In addition, this type of refrigeration machinery does not use CFCs (chlorofluorocarbons) which deplete the ozone layer, Kang et al. [5], Boer et al. [6], Göktun [7], Laouir et al. [8]. They are possibly silent compared to vapor compression machines, Riffat and Guoquan [9].

A recent study [10], combines a conventional vapor compression refrigeration system with an absorption refrigeration machine. Indeed, this system has the advantages of both processes, which results in a more profitable system. Electricity / thermal consumption is considerably reduced.

The results obtained show that the value of the coefficient of performance is greater than that of a system operating in stand-alone mode. From another perspective, R. Haghbakhsh [11] investigated the feasibility of using DES absorbents (Reline, Ethaline or Glyceline) as an operating fluid in absorption refrigeration cycles further analysis was performed to assess thermodynamic properties and determine optimal operating conditions.

The results indicate that these ESD / water working fluids can be adapted to absorption refrigeration cycles although their energy efficiency appears to be relatively low.

Based on an exergetic approach, a study of a new combined cycle power plant assisted by high temperature solar energy was proposed by F.Calise [12].

It is a high temperature solar cooling system coupled with a conventional combined cycle; the aim being to improve the efficiency of the system and the electrical capacity.

The system is analyzed from an exergy point of view, on the basis of an energy-economic model for which the efficiency is higher compared to that of a conventional model.

The results showed that the components of the Joule cycle (combustion chamber, turbine and compressor) are the main sources of irreversibility.

The optimization of the double and triple effect cycles, resulting from research carried out in the laboratory, has enabled the design of high-performance installations, which are now on the market. Note that the cycles implemented today result from a thermodynamic analysis including the second principle.

The analysis of absorption cycles has been developed from an energetic as well as an exergetic point of view. The latter is based on the notion of exergy destruction and therefore the degradation of the quality of energy transformations taking place within the components of an installation.

Two types of absorption / compression cycles have been selected. [13, 14] The first is single-acting, the results of the latter are compared to the conventional absorption machine. The results of the second double-acting configuration were also compared with those of the conventional double-acting absorption machine. In terms of performance, the single-stage hybrid machine offers relatively greater results when compared to the double-stage one [15].

In another approach, the integration of other organic absorbent / refrigerant pairs is envisaged, in order to further optimize the exergy and energy performance of the machine [16].

The most common refrigerant mixtures are water and lithium bromide mixtures, water being the refrigerant and lithium bromide the solvent and the mixture of ammonia and water in which ammonia is the fluid. refrigerant and water the solvent. A certain number of characteristics required of the fluids used in compression machines can be transposed to absorption machines. In particular: high enthalpy of vaporization, Non-toxicity, Low viscosity, High thermal conductivity, A moderate cost.

Recently, research has focused on the study of new refrigerant / absorbent pairs that can be an excellent alternative to conventional pairs. Wang et al [17], in 2011, presented a study of a diffusion absorption refrigeration (DAR) system operating with the R23 / R134a couple as refrigerants and DMF (N, N-dimethylmethanamide) as absorbent, it These torques have been proven to be a solution for the use of low energy sources.

A study, carried out by Ben Ezzine et al in 2010 [18] shows that the R124 / DAMC couple provides a higher COP than that of ammonia / water and that it presents an intercurrence for solar refrigeration. An experimental study prior to the latter two, in 2008 carried out by Muthu et al [19], shows that the COP of a refrigeration system using the R134a / DMAC couple reaches 45% under the test conditions and that this couple can be also used for low energy sources.

It is customary to evaluate the efficiency of energy transformations by calculating the energy yield, in fact, according to the first principle of thermodynamics, for each process, energy is conserved. It can neither be destroyed nor produced. In contrast, the exergy approach, as determined as the energy method, results from the second principle of thermodynamics, and focuses on the degradation of energy during a process. Exergy potentially presents a powerful tool that is used to carefully assess the quality of the flows involved in a well-defined process. The resulting analysis can be used as a benchmark in optimizing energy systems [20]. This analysis also makes it possible to identify areas of failure in a process in order to design new systems contributing to sustainable development [21]. Different indicators resulting from exergy analysis have been supported by [22] to assess the sustainability of an energy process within the framework of industrial ecology. These parameters take into account exergy efficiency and environmental efficiency.

Indeed, different methods have been proposed for the energy evaluation of the performance of anthropogenic systems. The motivation for these studies was mainly rooted in the economic industry, but there were implicit and explicit environmental concerns permeating.

The inability of standard exergy analysis to determine the best configurations when monetary costs have been approached, in the field of process analysis, by: a theory of common economics and thermodynamics, correctly termed thermo-economics, developed to industry standards over the past ten years or so on the basis of formulations. In this approach, the yields are calculated via an exergy analysis, and the non-energy costs (capital, interest, overheads, labor, maintenance, insurance, etc.) are linked to the technical and thermodynamic parameters of the process considered.

One of the objectives of EEA (Extended exergy accounting) is to go beyond thermo-economics and to develop a formally complete theory of costs based either on an exergy or monetary metric, that is to say a general pricing method in which kJ / kg or kJ / kW are perfectly and systematically equivalent to € / kg and € / kW, respectively).

The first extrapolations of exergy in the context of sustainable development focused on the valuation of natural resources and process waste (Belhani, 2008) [23]. The basic idea is to minimize the irreversibilities related to non-renewable resources. The exergy also brings a good clarification which identifies two primordial criteria, the quality and the degradation of the energy;

Life Cycle Analysis is concerned with the environmental impacts generated throughout the product life cycle. However, the objective is to go beyond taking the environment into account and provide practical recommendations on the integration of social and economic dimensions in decision-making, from a life cycle perspective [24]. Consequently, the life cycle analysis becomes a step in a more comprehensive approach to sustainable development and not an objective in itself. According to Grisel and Osset [25], life cycle management aims to improve the environmental performance of an industrial sector through eco-design. The eco-design or control of the environmental impacts of a product is based, at best, on its Life Cycle Analysis (LCA) [26]. Eco-design appears as a process of integrating environmental aspects into the design and development of products, the objective of which is to reduce the environmental impacts of products throughout their life cycle. Thus, eco-design appears as a solution so that companies can integrate the priorities of individuals with regard to sustainable development into commercial interrelationships [27]. Breset and Van Hemel defined eco-design as a sustainable solution which consists in finding the perfect balance between ecological and economic requirements in product development.

Eco-design integrates environmental considerations into product life cycle reasoning. To be more precise, this concept means reducing from design the impacts in economic, social and environmental terms, and maximizing the concept of sustainable development over all stages of a product's life cycle. By adopting an eco-design approach, companies can develop products that are more respectful of the environment while maintaining the objectives of competitiveness, quality and time to market. Therefore, LCA aims to enable companies that use it to improve their performance from an eco-efficiency perspective. This is a concept that was revealed at the Rio conference in 1992. According to the WBCSD (World Business Council for Sustainable Development), it is about providing goods and services at competitive prices that meet the needs. human beings and improve the quality of life while gradually reducing ecological impacts and resource consumption throughout their life cycle.

Cornelissen redefined the concept of sustainable development, incorporating the notion of exergy, as follows: “for sustainable development, the destruction of the exergy reservoirs of natural resources must be minimized to a level at which there is no no damage to the environment and to which the supply of exergy to future generations is secured”.

Indeed, exergy and LCA can be used for sustainable development. The methodology which brings together these two tools in a single composition called Exergy Life Cycle Analysis. Indeed, it will take advantage of the strong bridges separated from each approach for the establishment of sustainable development on the one hand.

Exergy is reputed to be an effective means in the political decision-making of energy strategies as it is the only function which harmonizes energy, environment, economy and sustainable development [28]. The classic definition of "nothing is created, nothing is lost, everything is transformed", with the exception of nuclear reactions, makes the concept of the depletion of materials and non-renewable energies subjective.

On the other hand, the consumption of resources is also a form of damage to the environment; a resource is a substance, an ordered state, out of balance with the environment, therefore having a high exergy value; the consumption of a resource therefore reflects a loss of exergy value.

Lombardi [29] rethinks that exergy efficiency is an additional element of review to the environmental criteria used in the methodological framework of LCA, because exergy cannot replace the impact assessment methods of the methodological framework of LCA.

Exergy can be utilized by combining with ACV at three levels:

- Simultaneously with LCA for inventory accounting and as a criterion for the depletion of natural resources, thus constituting an additional criterion judging the effectiveness of the scenarios studied;

- A pre-selection criterion, judging the effectiveness of the scenarios studied before being analyzed by a full LCA;
- A post-selection criterion, judging the effectiveness of the scenarios studied beforehand by a complete LCA.

However, improving the exergy efficiency of processes is revered as a way to reduce environmental impacts through reducing degradation of natural resources. The objective of this study is to carry out a comprehensive analysis of the life cycle of a cooling system from renewable energy sources, presenting its consequences on the environment.

II. System Presentation

In this paper, we propose to study a hybrid compression/absorption heat pump for which we have introduced new refrigerants chosen for their environmental characteristics and which allow the system to be adapted to a source with low enthalpy value.

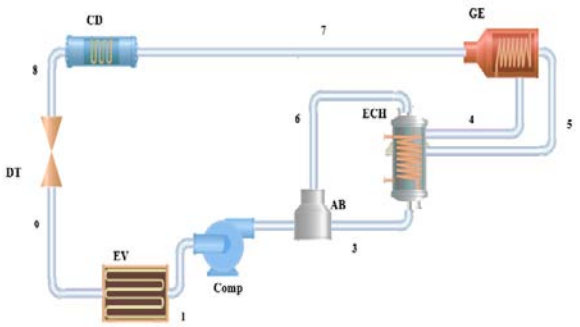

Fig. 1: Hybrid heat pump

The heat pump (figure 2), subject of this study, is a combination of the conventional absorption pump and the compression pump. A compressor is injected into the cycle, upstream of the absorption part, in order to improve the absorption process. The system operates at three pressure levels: the refrigerant vapor leaving the evaporator (1) is at the lowest pressure (PEV). It is compressed by an isentropic transformation (2) into an intermediate pressure (P2) and finally injected into the absorber. The rich solution from the absorber (3) is heated by the lean solution from the bottom of the generator (5) by a solution heat exchanger. The condenser and the generator operate at the third pressure level (PCD) which is the condensing pressure.

Numerical analysis was performed using Aspen plus software. The thermodynamic properties of binary mixtures were determined using the NRTL model based on experimental results. When it is necessary to choose a working fluid for an application, it is generally desired that it lead to high energy performance and that it be suited to the operating conditions of the cycle.

A certain number of characteristics required of the fluids used in compression machines can be transposed to absorption machines. The criterion of non-toxicity is essential, the fluid must be non-flammable, non-explosive, non-corrosive, and has no dangerous physiological action.

Some researchers have focused on new refrigerant / organic absorbent pairs that can be a good alternative to classic pairs.

The configuration proposed represents an improved cold production system for which a new organic pair R245fa / DMAC (1,1,1,3,3-Pentafluoropropane / N, N-dimethylacetamide) has been integrated. This family of refrigerants is characterized by a low global warming potential (GWP).

The results showed that the new configuration has the same energy performance as that of the conventional system. The optimum COP is around 45% for R245fa / DMAC, however, the same value is obtained for a conventional system where the operating pressure is in the order of 600kPa. In addition, the added value lies in the adaptation of the machine to organic mixtures which have a relatively low temperature and between 60 ° C and 80 ° C, which allows the use of energy sources with low energy value. The exergy analysis also revealed a decrease in the irreversibility of the system.

In reality, the use of such refrigerants allows the installation to be adapted to a low energy source.

III. Exergetic Analysis

The exergy balance is based on the exergy destruction method, it is calculated for each component as follows [30]:

$$ExDi = \sum [(m)\,Ex)]_{in} - \sum [(m)\,Ex)]_{out} \pm \left([Ex]_{\dot{Q}} \right) \pm \sum \dot{W} \quad (1)$$

The first two terms represent the exergy of the flows entering and leaving the control volume.

The third and fourth terms are the exergy associated with the heat transfer $\dot{Q}$ of the source maintained at a constant temperature T and equal to the work obtained by the Carnot engine operating between T and T0, and is therefore equal to the maximum reversible work that can be obtained from thermal energy Q. The last term is the mechanical work transferred to or from the control volume.

$Ex_{\dot{Q}}$ is the thermal exergy and is expressed as follows [31, 32]:

$$Ex_{\dot{Q}} = \dot{Q}(1 - {}^{T_0}/_{T}) \quad (2)$$

We can also express the loss of exergy in terms of exergy efficiency; it is the rate between the exergy of entry and that of exit [33]:

$$\eta_{ex} = \frac{outlet\ system\ exergy}{intletsystèmeexergy} \quad (3)$$

Several hypotheses were taken into account in the exergy study:

- Kinetic and potential exergy is neglected.
- All transformations are in a stable state.
- Pressure and heat losses in the system component are neglected.
- The exchange temperature is the logarithmic mean temperature of the inlet and outlet.
- The reference temperature and pressure P0 and T0 are respectively 1atm and 25 ° C.

IV. Environmental Analysis

The sum of the exergy destruction gives the irreversibility of the life cycle of the system and therefore the impact indicator of the depletion of natural resources.

Exergy analysis is a focused approach and it does not take into account the exergy developed throughout the production chain.

It is in this sense that the Analysis of cumulative exergy consumption (CExC).

Indeed, this method is used to assess the exergy of all-natural resources consumed in a process.

It takes stock of the quality of the resources and it is expressed as follows:

$$CExC = \sum_{i}^{N} Ex_{r,i} \quad (4)$$

With: $Ex_{r,i}$ the exergy of natural resource i which is part of the process and N is the number of natural resources.

This approach has been applied for different industrial processes [34].

CExC analysis is based on the same principle of LCA where all the elements involved in the process are taken into account.

In fact, the notion of exergy has been exploited in the context of life cycle analysis as an alternative to methods of measuring the depletion of natural resources [35].

Likewise, the added value in relation to sustainable development is to reduce irreversibilities due to the use of non-renewable resources.

Improving exergy efficiency imperatively leads to a reduction in environmental impacts.

In the same context, efforts have been made to oust the multicriteria side of the LCA environmental study by a single quantity which is exergy.

Indeed, it was introduced in the LCA methodology to be used as a uniform indicator of the total environmental impact [36].

It is approved as a unit of measure for the potential of a pollutant to cause environmental degradation [37].This will allow us to minimize the amount of data with a single magnitude that clarifies vision without resorting to parameters used in conventional LCA and which are deemed to be subjective;

a) Solar source

From the perspective of producing energy more economically, the ability to limit wastage rates is a major issue. The proposed new model uses the principle of cogeneration, already applied in some thermal power plants, and which consists in producing both electricity and heat from the same primary source.

In the case of solar cogeneration, this involves combining, in a single module, conventional photovoltaic solar cells and a waste heat recovery system. The main objective is to improve the performance of the machine while preserving the environment. The originality of the project is based on the addition of a photovoltaic system to serve the compressor.

In addition, the use of the heat released by the photovoltaic cells will heat the coolant in order to improve the operation of the generator. This concept offers a relatively high production of electricity and heat on the same surface and improves the efficiency of these panels, which decreases with increasing temperature. For the modeling of the improved heat pump, the work was carried out for a condensing temperature equal to 40 ° C, the temperature of the generator in fact varies according to the daily solar radiation.

He basic function of the photovoltaic installations analyzed in the context of this work is the production of electricity.

The functional unit of the LCA should be determined in correspondence with the function of the observed system and serves as a basis of comparison for the analysis of the results of different photovoltaic power generation systems.

The environmental impact assessment stage translates elementary flows into environmental impacts. It includes classification of emissions by impact category, intermediate characterization and damage characterization. The indicators selected in this work include environmental impact indicators and energy flow indicators, namely:

- Global warming potential at 100 years (GWP100) in kg CO2 equivalent.
- Consumption of renewable primary energy in MJ.
- Consumption of non-renewable primary energy in MJ.
- The environmental assessment of the PV system is based on three different stages:
- Generation of impact factors on PV systems to estimate the environmental impacts of the PV system.

- Evaluation of the productive life cycle of the photovoltaic installation on the prospective site and on the reference site (reference sunshine).
- -Voluntary environmental effects of the PV system reported to the UF functional unit.

Two types of results are expected for the environmental impacts: the environmental impacts linked to the producible estimated on the anticipated site of the installation and the so-called reference environment.

To calculate these impact factors, two steps are necessary:

The first step is to calculate the impact factors per process such as:

$$Imp_n = FI_n . QR \quad (5)$$

The impacts of each of the processes are calculated according to equation (5) and then added to obtain the impacts corresponding to each PV subsystem (PV infrastructure, additional infrastructure, site, maintenance). The impacts of the PV system are finally obtained by summing the impacts of each PV subsystem.

At the end of the first step, the impacts of the PV system on its life cycle are defined to calculate the environmental impacts by the power of the PV system:

$$Imp_{sysPV\ (KWc)} = \frac{Imp_{system\ \ pv}}{Puiss_{nom}} \quad (6)$$

The PV impact factor (kWp) corresponds to the environmental impacts of the photovoltaic installation per nominal power.

To assess the producible, we opt for a simplified method allowing component manufacturers to have a reference calculation to estimate production and thus serve as a basis for comparison for different products.

To estimate the production potential over the life cycle of the PV system, Equation (7) is used:

$$E_{total} = \sum_{n=0}^{lifetime\ \ of\ \ the\ modules} \left(\frac{P_c . Ir_{plan} . Pr_{instal}}{\phi_{irrSTC}}\right)^{\sum \frac{100-\partial . n}{100}} \quad (7)$$

The degradation of the modules reduces the efficiency of the photovoltaic system during the lifetime. A linear degradation of 0.7% per year must be considered, which corresponds to a total degradation of 20% at the end of the life of the modules.

A 30-year module life should be considered.

The value of the coefficient of performance of a PV system, which is a correction factor for the overall efficiency of the photovoltaic installation, depends on:

- DC / AC conversion system
- Actual operating temperature of the modules
- Type of module integration

The following equation is used to assess the environmental impacts of the PV system based on the functional unit:

$$Imp_{UF} = \frac{Imp_{system\ \ pv}}{E_{total}} \quad (8)$$

Impacts by functional unit must be calculated for each impact category chosen.

b) Wind source

The life cycle stage responsible for the majority of the impact for the two wind energy sectors is the manufacture of components, using mainly fossil energy.

In order to carry out the LCA of a product, it is essential to define its function. In our case, the functional unit chosen for this LCA is as follows:"1 kilowatt-hour, from wind power production capacity, delivered to the electricity grid, for a lifespan of 20 years" State-of-the-art environmental assessments report that the majority of studies consider a system life of 20 years (Arvesen, 2012).

An average load factor is used in order to be as representative as possible over the lifetime of the installation. The environmental impact assessment step translates elementary flows into environmental impacts. It includes the classification of emissions according to impact categories.

It makes it possible to detect the main contributors to the impact on each indicator. The phases of the life cycle are first studied in order to understand their responsibilities as a whole and then to specify which processes and substances are responsible for the impact.

c) Biomass source

This part is devoted to the LCA of a biomass recovery system, namely forest residues.

The UF chosen for this study is a ton of biomass that feeds our system. This UF is generally chosen by studies aiming to recover agricultural and forestry waste [38].

The structure of the project consists of subdividing the system into a set of elementary modules [39].

The application of life cycle analysis in the bio-resources sector reveals specific issues.

Until now, the questions asked to the specific problems of LCA applied to products of biomass origin have not all been answered and the answers that have been provided have not been the subject of a consensus. Real at the level of the LCA community.

From the extraction of their raw material to their end of life, biomass products are the source of various carbon-biomass flows.

V. Results and Discussions

The objective of this investigation is to analyze the different models, so management and life cycle thinking are very important.

The best solution must have the lowest environmental impacts; this exergetic methodology makes it possible to evaluate the scenarios considered and to achieve this objective.

a) Solar heat pump

In figure 2, we can see the contribution of each stage of the life cycle on the indicator of global warming for solar configuration. The stage mainly responsible for the impact is the construction phase with a contribution of 88%

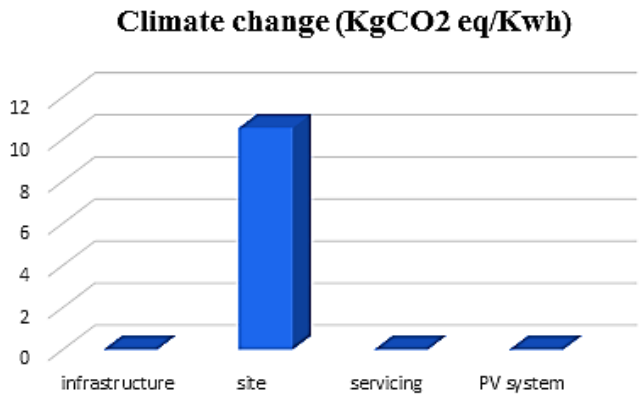

Fig. 2: Climate change (KgCO2eq/Kwh).

In the following Figure 3, we can see the contribution of each stage of the life cycle on the indicator of Ozone Layer Depletion. Mainly, the element responsible for the impact is the PV system with a contribution of 90%.

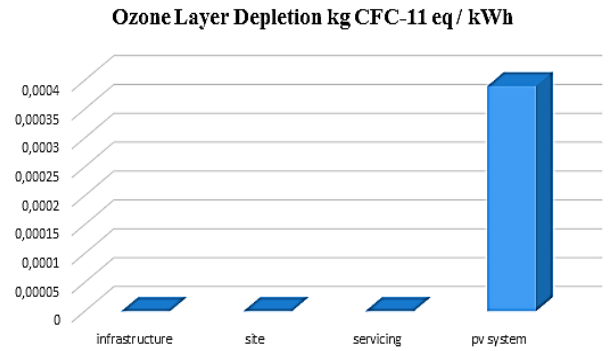

Fig. 3: Ozone Layer Depletion kg CFC-11 eq / kWh

For renewable primary energy consumption (figure 4), the contribution of each stage of the life cycle is also assessed. Essentially, the element responsible for the impact is the site.

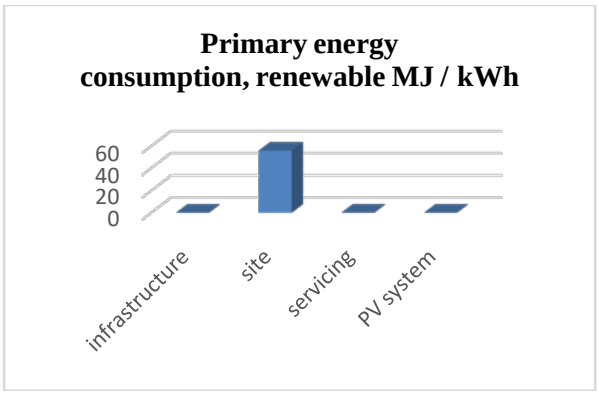

Fig.4: Primary energy consumption, renewable MJ / kWh

The following figure 5 shows the contribution of each indicator to the system life cycle.

Obviously, that of non-renewable primary energy consumption has the most important contribution.

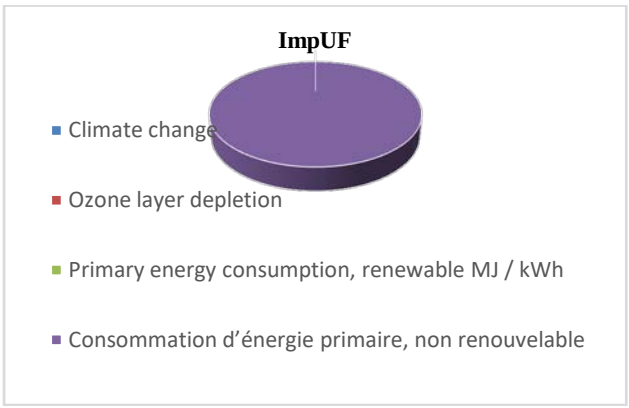

Fig. 5: ImpUF

The indicators that result from the exergy methodology are irreversibility and CexC. They have been evaluated in the installation and shown in the following figure 6.

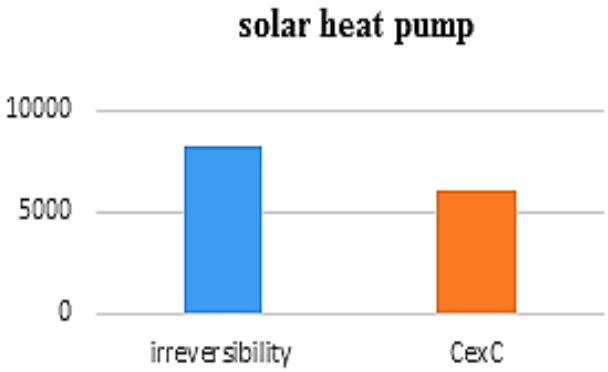

Fig. 6: Exergy impact of the solar heat pump

In the following figure 7, we can see the contribution of each stage of the life cycle on the acidification indicator. Primarily, the stage responsible

for the impact is the manufacturing phase with a 60% contribution including an avoided impact of 22% through end of life.

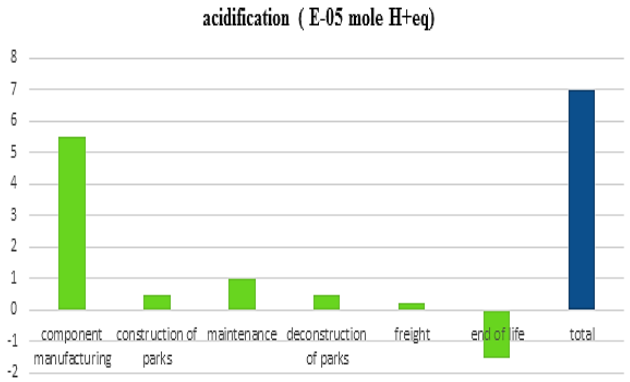

Fig. 7: Environmental impacts of 1 kWh on the acidification indicator

b) Improved cycle using wind energy

Global warming is dominated by the construction of the various components with a larger share of the nacelles.

The main sources of impact related to the manufacture are for the rotors the composition of the blades, the amount of steel in the nacelles and in the masts, and finally the manufacture of clinker in the concrete of the foundations. These materials emit CO2 primarily because of the energy they consume to be produced.

In figure 8, we can see the contribution of each stage of the life cycle on the indicator of global warming. The step primarily responsible for the impact is the manufacturing phase with a 66% contribution including an avoided impact of 23% through end of life.

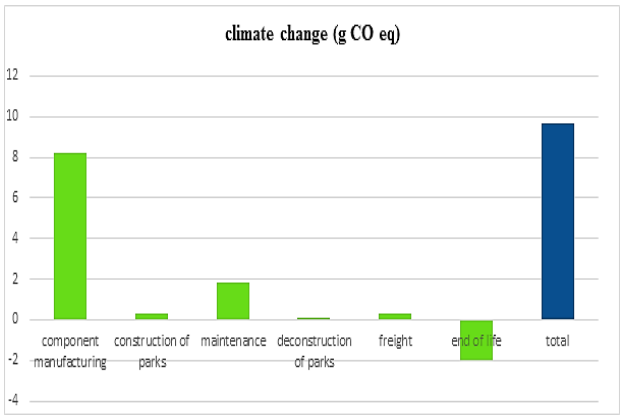

Fig. 8: Environmental impacts of 1 kWh on the global warming indicator

The steel industry is considered to be a major emitter of greenhouse gases, with up to two tonnes of CO2 emitted for one tonne of steel produced. These emissions are mainly linked to the energy used in the various transformation processes.

The impact of the rotors is entirely related to the use of epoxy reinforced fiberglass, the production process of which requires a great deal of energy.

The impact of the operation and maintenance phase is linked to the transport of maintenance workers because of the CO2 emitted directly by the technicians' vans.

The total contribution of the construction and deconstruction parts of the fleets is linked to the quantity of fuel used in construction machinery. Freight has little impact on this indicator despite a type of truck transport.

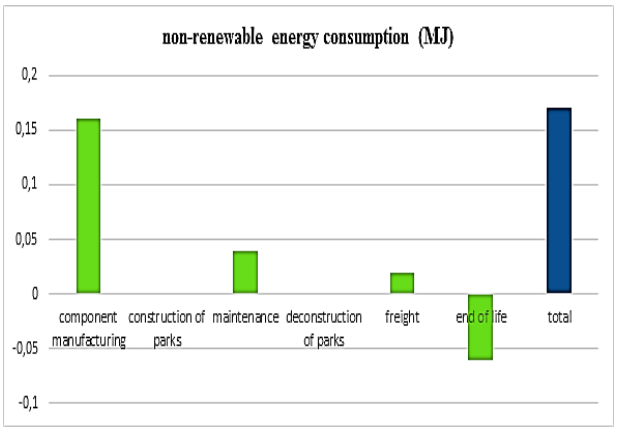

Fig. 9: Environmental impacts of 1 kWh on the CED indicator (non-renewable)

In Figure 9, we can see the contribution of each stage of the life cycle on the indicator of CED NR. The step primarily responsible for the impact is the manufacturing phase with a 64% contribution including an avoided impact of 29% through end of life.

In general terms, the substances responsible for the impact are the main types of non-renewable resources used for energy production: oil, gas, coal and uranium. These impacts are mainly related to the production of steel for masts and nacelles as well as plastic / epoxy fibers for blades and nacelles.

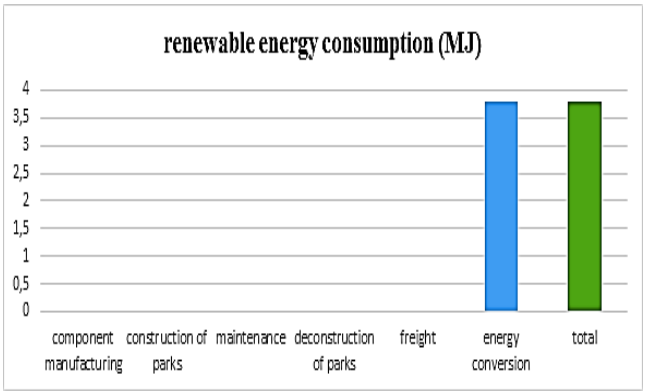

Fig. 10: Environmental impacts of 1 kWh on the CED indicator (renewable)

In Figure 10, we can see the contribution of each life cycle stage on the indicator of CED R. The

stage mainly responsible for the impact is the conversion of kinetic energy using wind power. In fact, we are studying the impact of 1 kWh from the wind power sector, it is logical to find this kilowatt hour in the demand for non-renewable energy.

In addition to the environmental impacts presented above, the figure 11 shown below shows the two ecological indicators that result from the exergy analysis, namely, the irreversibility and the CexC assessed in the installation.

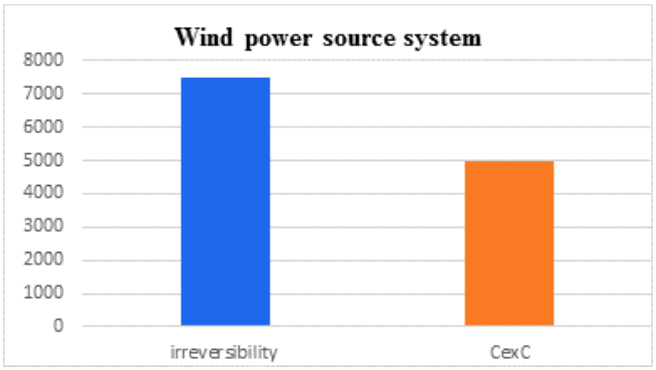

Fig. 11: Exergy impact of the wind heat pump

c) *Improved hybrid heat pump coupled to a biomass power plant*

The biomass carbon balance is not always zero. In the case of the landfill scenario, the degradation being slow and incomplete, at the end of its life, all the biomass carbon is not enlarged. One of the simplifying methodological choices adopted with regard to the consideration of flows linked to biomass carbon is to make the hypothesis of neutrality, on the basis that the fixed carbon is enlarged during the product's life cycle.

The methodological choice of not taking into account the flows linked to biomass carbon does not make it possible to assess the negative or positive impact of these flows. For example, it puts a cut and burnt forest and a sustainably managed forest at the same level. On the contrary, taking into account biomass carbon will make it possible to differentiate an exotic wood product from sustainably managed forests from a product resulting from deforestation which cannot claim CO_2 removal. Likewise, this methodological choice does not make it possible to account for the improvement in the energy efficiency of biomass boilers.

Thus, the climate change indicator may turn out to be negative, reflecting a beneficial effect in the fight against climate change, if the biomass carbon is not fully expanded during its life cycle and if it offsets the GHG emissions of 'fossil origin. This will be all the more true as biomass carbon will be permanently stored, that is to say beyond 100 years.

Evaluating the environmental impact of a product, essential for decision support in the context of progress initiatives, is a difficult and complex subject to deal with, encompassing many parameters and affecting multiple criteria.

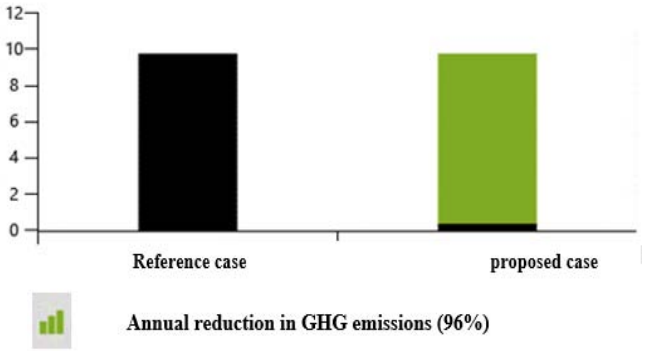

Fig. 12: Annual reduction in GHG emissions

In addition to the environmental impacts presented above, the figure 13 illustrated below represents the two ecological indicators that result from the exergy analysis, namely, the irreversibility and the CexC assessed in the installation.

VI. General Conclusions

At a time of awareness of the finitude of resources and the growing need for energy, the concept of sustainable development must take a central place in the evolution of society. To achieve this goal, it is now recognized that a profound change in consumption is needed; whether it is energy consumption or finished products. We believe that this paradigm shift is only possible if all actors move forward in concert on the various issues we are facing. Everyone at their own level must therefore be able to make the decisions that are binding on everyone. This is the logic that motivated the study of this thesis, we are studying the possibility of a sustainable cold production solution.

Reducing energy needs and CO_2 emissions is of major interest in the general context of rising energy prices and ecological demands.

Traditional approaches to energy optimization often focus on improving the efficiency of individual equipment, or that of energy infrastructure. This is where the energy integration of processes comes into play, with the objective of optimizing processes from a global perspective.

Exergy Analysis itself is a valuable tool in energy integration. Within the imposed framework of minimizing total annual costs, entropy analysis helps determine the optimal plant concept, optimize energy conversion and use, and improve profitability.

It is an original contribution concerning the impact on the environment of all anthropogenic activities and showing that exegetical efficiency constitutes a fundamental criterion for the preservation of the environment.

The objective of this work is to study cold production scenarios in order to determine which is the most eco-efficient.

This study was eventually expanded. The results obtained confirmed the possibility of adapting the heat pump to a renewable energy source. In our case, we opted for three types of sources: solar, wind and biomass.

The results can be seen as tools to help define new energy and environmental policies.

The consideration of exergy efficiency as an additional comparison criterion to environmental criteria, through the Exergy Life Cycle Analysis, will endow Life Cycle Analysis with more relevant tools for accounting for the consumption of abiotic resources. Thus, the increase in the exergy efficiency of the processes was considered as a solution to reduce the environmental impacts through the reduction of the degradation of natural resources. As a result, ELCA was retained in this work as a tool for comparing cold production scenarios. It has provided us with relevant tools for comparison between the different stages of the models proposed by identifying areas of potential for environmental improvement.

Nomenclature

P = Pressure (bar, Pa)
T = Temperature (K, ° C)
x = Mass fraction
ExD = Destruction of exergy.
$\dot{m}$ = mass flow (kg.s-1)
W = Power (W)
Q = heat exchanged flow (W)
Ex = Specific exergy of a flow (kJ.kg-1)
ηex = Exergy efficiency
Impn: Impact of process n
FIn: conservative impact factor
QR: reference quantity
ETotal: value of the producible
Pc: maximum power of the photovoltaic installation (expressed in kWp)
Ir: average annual irradiation in terms of installation
Main: Performance ratio or coefficient of performance of the photovoltaic system: illumination under STC conditions (equivalent to 1 kWp / m²)
δ: Annual degradation of modules
n: Service life of the modules (expressed in years)
ImpUF: Impact of the PV system per functional unit
ImpSystem PV: Impact of PV system
ETotal: value of the producible

Subscribed

i = Component or stage i
T = Total
0 = Reference
EV = Evaporator
COMP = Compressor
GE = Generator
ECH = Solution exchanger
AB = Absorber.
V = Steam

References Références Referencias

1. Bejan A. Entropy generation minimization. Boca Raton, FL: CRC Press; 1996.
2. Yantovskii, Eugene I. & Wall, Göran& Lindquist, Lars & Tryggstad, Joakim, 1994
3. Beijing, China. Thermodynamic Analysis and Improvement of Energy Systems ON EXERGETICS, ECONOMICS AND OPTIMIZATION OF TECHNICAL PROCESSES TO MEET ENVIRONMENTAL CONDITIONS, Mei Gong and Göran Wall, TAIES'97, June 10-13, 1997,
4. Dincer, I., Technical, Environmental and Exergetic Aspects of Hydrogen Energy Systems. International Journal of Hydrogen Energy, 2002, 27, 265-285
5. Kang Y.T., Kunugi Y., Kashiwagi T., Review of advanced absorption cycles: Performance improvement and temperature lift enhancement. Int. J. Refrig., 2000, 23, 388–401.
6. Boer D., Valles M., Coronas A.: Performance of double effect absorption compression cycles for air–conditioning using methanol–TEGDME and TFE–TEGDME
7. Göktun S., Performance analysis of a heat engine driven combined vapor compression-absorption-ejector refrigerator. En. Con. Mgmt., 2000, 41, 1885–1895.
8. Laouir A., Legoff P., Hornt J.M., Cycle de frigopompes ŕ absorption en cascades matérielles–détermination du nombre d'étages optimal pour le mélange ammoniac–eau. Int J. Refrig., 2002, 25, 136–148.
9. Riffat S.B., Qiu G., Comparative investigation of thermoelectric air-conditioners versus vapour compression and absorption air-conditioners. App. Th. Eng., 2004, 24, 1979–1993.
10. Mussati, S.F.; Morosuk, T.; Mussati, M.C. Superstructure-Based Optimization of Vapor Compression-Absorption Cascade Refrigeration Systems, Entropy, 2020, 22, 428.
11. Haghbakhsh, R.; Peyrovedin, H.; Raeissi, S.; Duarte, A.R.C.; Shariati, A. Energy Conservation in Absorption Refrigeration Cycles Using DES as a New Generation of Green Absorbents, Entropy, 2020, 22, 409
12. Calise, F.; Libertini, L.; Vicidomini, M. Exergetic Analysis of a Novel Solar Cooling System for Combined Cycle Power Plants. Entropy, 2016, 18,356.
13. Bouaziz N, Ben Iffa R, Kairouani L. ,Performance of a water_ammonia absorption system operating at

three pressure levels, Mechanics & Industry, 2011, 3(4), 120-127
14. Nahla Bouaziz, D. Lounissi, Energy and exergy investigation of a novel double effect hybrid absorption refrigeration system for solar cooling, International journal of hydrogen energy, 2005, 40, 13849-13856
15. R. Toujania, R. Bayindir, N. Bouaziz and I. Colak, "Exergetic Comparison of Two Configurations for an Upgraded Absorption/Compression Heat Pump Integrated Organic Mixtures," 2018 7th International Conference on Renewable Energy Research and Applications (ICRERA), Paris, 2018, 1-5.
16. Rabeb Toujani, Dorra Lounissi and Nahla Bouaziz, Exergetic comparison of two novel mixtures for an upgrated absorption/compression heat pump: R245fa/DMAC and R236fa/DMAC, 4ème Conférence Internationale des Energies Renouvelables (CIER-2016) Proceedings of Engineering and Technology – PET Pol.16, 120 – 125.
17. N. Ben Ezzine , R. Garma, A. Bellagi, A numerical investigation of a diffusion-absorption refrigeration cycle based on R124-DMAC mixture for solar cooling, Energy, 2010, 35, 1874–1883
18. V. Muthu, R. Saravanan, S. Renganarayanan, Experimental studies on R134a-DMAC hot water based vapor absorption refrigeration systems, International Journal of Thermal Sciences, 2008, 47, pp. 175–181
19. Bertrand Fankam Tchanche, George Papadakis, Gregory Lambrinos, Antonios Frangoudakis, Fluid selection for a low-temperature solar organic Rankine cycle. Applied Thermal Engineering, 2009, 29, 2468–2476.
20. Computers & Chemical Engineering, Volume 22, Supplement 1, 15 March 1998, Pages S545-S552, Exergy analysis: An efficient tool for process optimization and understanding. Demonstrated on the vinyl-chloride plant of Akzo Nobel, A.J.G.G. Gravelandab E. Gisolfab
21. Silvia Bargigli, Marco Raugei, Sergio Ulgiati, Comparison of thermodynamic and environmental indexes of natural gas, syngas and hydrogen production processes, Energy, Volume, 2004, 29, 2145-2159,
22. Anita Zvolinschi Signe Kjelstrup Olav Bolland Hedzer J. van der Kooi, Exergy Sustainability Indicators as a Tool in Industrial Ecology, 2007, 11, 85-98
23. Mehdi BELHANI, Analyse de cycle de vie exergétique de systèmes de traitement des eaux résiduaires, THESIS , l'Institut National Polytechnique de Lorraine (spécialité Génie des Procédés et des Produits) , 10 December 2008
24. Reyes T.C., L'éco-conception dans les PME: Les mécanismes du cheval de troiméthodologique et du choix de trajectoirescommevecteursd' intégration de l'environnementen conception, Thesis, Université du Sud Toulon-Var, 2007.
25. Grisel L., Osset P., L'analyse du cycle de vie d'un produit ou d'un service – applications et mise en pratique, AFNOR, 2004.
26. Brezet J.C, Van Hemel C., Ecodesign- A promising approach to sustainable production and consumption, 1997, UNEP, United Nations Pubication.
27. Karlsson R., Luttropp C., EcoDesign: What's happening? An overview of the subject area of EcoDesign and the papers in this special issue, Journal of Cleaner Production, 2006, 14, 1291-1298.
28. Dincer I., The role of exergy in energy policy making, Energy Policy, 2002, 30(2), 137-149
29. Lombardi L., LCA comparison of technical solutions for CO_2 emission reduction in power generation, Energy Conversion and Management, 2003, 44, 93-108.
30. N. Bouaziz, D. Lounissi, L. Kairouani and M. El Ganaoui, Exergetic Analyses of a Particular Absorption Cooling System, Defect and Diffusion Forum, 2012, 326-328, 641-646
31. .Q. Chen, Z.H. Qi, Systems account of societal exergy utilization: China 2003, ecological modeling, 2007, 208, 102–118.
32. B. Chen, G.Q. Chen, (2006), Exergy analysis for resource conversion of the Chinese Society under the material product system, Energy, 1993, 31, 1115–1150.
33. Nahla Bouaziz, D. Lounissi, Energy and exergy investigation of a novel double effect hybrid absorption refrigeration system for solar cooling. International journal of hydrogen energy, 2015, 40, 13849-13856.
34. Morris D. R., Exergy analysis and cumulative exergy consumption of complex chemical processes, the industrial chloralkali processes, Chem. Eng. Sci. 1991, 46, 459-465
35. Cornelissen R. L., Hirs G. G., The value of the exergetic life cycle assessment besides the LCA, Energy Conversion and Management, 2002, 43, 1417-1424
36. Gong M., et Wall G., On exergy and sustainable development- Part 2: Indicators and methods, Exergy an International Journal, 2001, 1(4), 217-233.
37. Seager T. P., et Theis T. L., Exergetic pollution potential: Estimating the revocability of chemical pollution, Exergy an International Journal, 2002b, 2,273-282.
38. Subramaniam V., May C.Y., Muhammad H., Hashim Z., Tan Y.A., Wei P.C. Life cycle assessment of the production of crude palm kernel

oil (part 3). Journal of Oil Palm Research, 2010, 22, 904-912.
39. herubini F. Strømman A.H. Life cycle assessment of bioenergy systems, State of the art and future challenges. Bioresource Technology, 2011, 102, 437–451.

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Avoiding Non- Value Added Activities by Applying Lean Techniques in Merchandising Process

By Nandhini N. & Thenmozhi R.

Abstract- Clothing industry focus is for achieving effective productivity and improving capacity and also to satisfying the customer needs. Lean tool is used to improve the productivity in the production industry. This study is about analyzing and removing the non value added activities and improving the flow process of an order.

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I. Introduction

Merchandising process involves its hard role from examine order till shipment, and thus they plays a very dangerous role in completing an order. The single mistake of each stage will be reflected only in the end process of shipment, so appropriate destinations that cause problem should be encircled priory to avoid issues. Every organization in today's condition, seeking for some proficient method to improve, in that way lean techniques utilization could be troublesome in implementing though it has its ideal improvement of all asserts like labour, cash and strategies. To accomplish these, the lean creation theory I utilized here is Kaizen and six sigma. The authors discussed about the lean role in the industries that is discussed by various authors.

The idea of 'Lean creation' was at first acquainted with the more extensive open in the book "The machine that changed the world" composed by Womack et al. (1990). The term is likewise perceived as 'Lean assembling' or simply 'Lean', to a business methodology with the target of ceaselessly limit squander and augment the progression of data and items (Liker, 2004; Ohno, 1988)(1).

Lean has subsequently expanded to business practice generally. Lean administration is turning into the norm for deliberate profitability improvement. Inefficient activity wiped out the unwanted exertion, space, and capital required and lead time is diminished while quality increments and the expense of value diminishes. Lean implementation faced various obstacles related to human aspects such as the lack of knowledge of daily kaizen practices for process improvement(5).

The Time Study observing framework, a yield of the examination, is a compelling and effective device to improve profitability in the whole sewing segment, whose advantages stretch out to the entire association. Wasteful action is eliminated the result is that less effort, space, and capital are required and lead time is reduced whilst quality increases and the cost of quality decreases(6).The fundamental standards of lean and its goal is that the idea is based upon the worth creation forms, which implies that every movement, inside or outer, that doesn't support the end client, is recognized as waste, and will be killed from the procedure (Liker 2004; Hodge et al. 2011; Shah and Ward, 2007).

Here, certain changes in process were implemented to avoid non value added activities and getting gradual improvements in bottleneck areas.

II. Methodology

Garment Export Company is one of the important components in an export industry of India. The garment exporting is the second largest export from India after gems and jewellery export according to the year 2002 survey. The garment export is being in important contributor for the foreign exchange earnings of the country (Deshpande 2009). The Indian exports had a decline by one percent in 2017 when compared to 2016. This is highly possible only because of applying certain lean techniques and developing the standard process to make a prominent work flow.

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Process flow of an order

Hereby, above mentioned was the process flow happening in the merchandising process and highlighted stages are the bottle neck operations where efficient development is needed.

Lean Techniques were implemented to overcome the problem were occurred in production department is discussed here.

a) Changing of order sheets

According to Stern, Susan vi et al 1984 The textile exporting is the next largest source after agriculture in India. The textile has provide the jobs over 10 million employees. India has been the one of the large exporters due to its skilled workforce of the employee, low wages, trained technicians etc. This made India to be the strong economy which gives the improvement of 7 per cent in 1983. Eliminating the waste of time and effort gradually increased them to next stage.

Here, some sheets of order sheets are not considered and used by the production unit. So order sheets was converted from six sheets into three sheets in which only required information are described short and clearly. This type of changes avoids paper waste, unwanted process, avoiding confusion and also minimizes the time to get it completely done.

Specification sheet: Pattern details, shade number, fabric width, parts of merchandise and accessories trims as shown in Fig. 1

Embellishment sheet: About the embellishment and its placements as shown in Fig. 2

Quantity sheet: About quantity, sizes and their comments as shown in Fig. 3

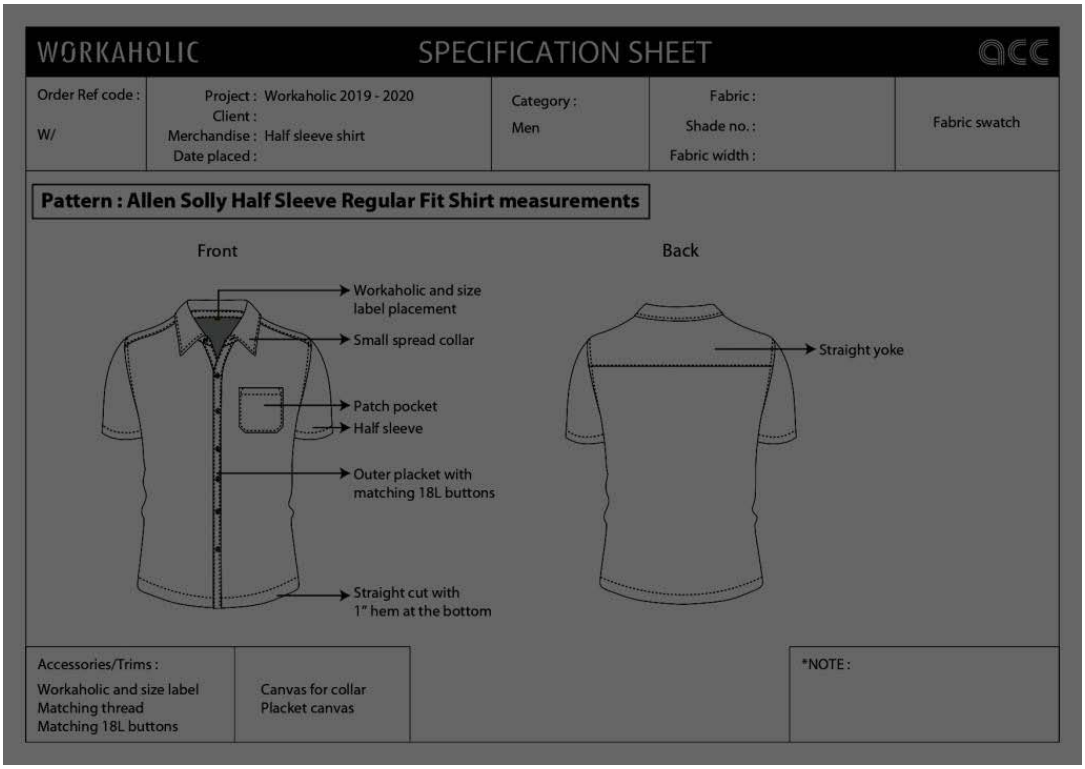


Fig. 1: Specification sheet

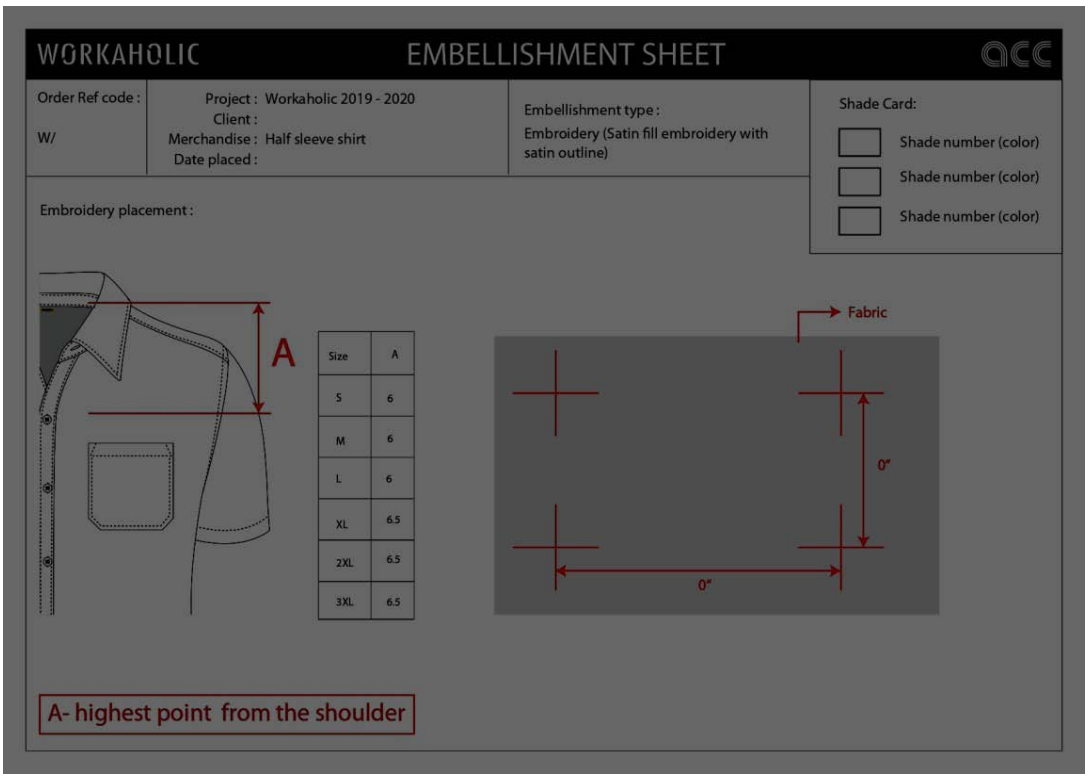
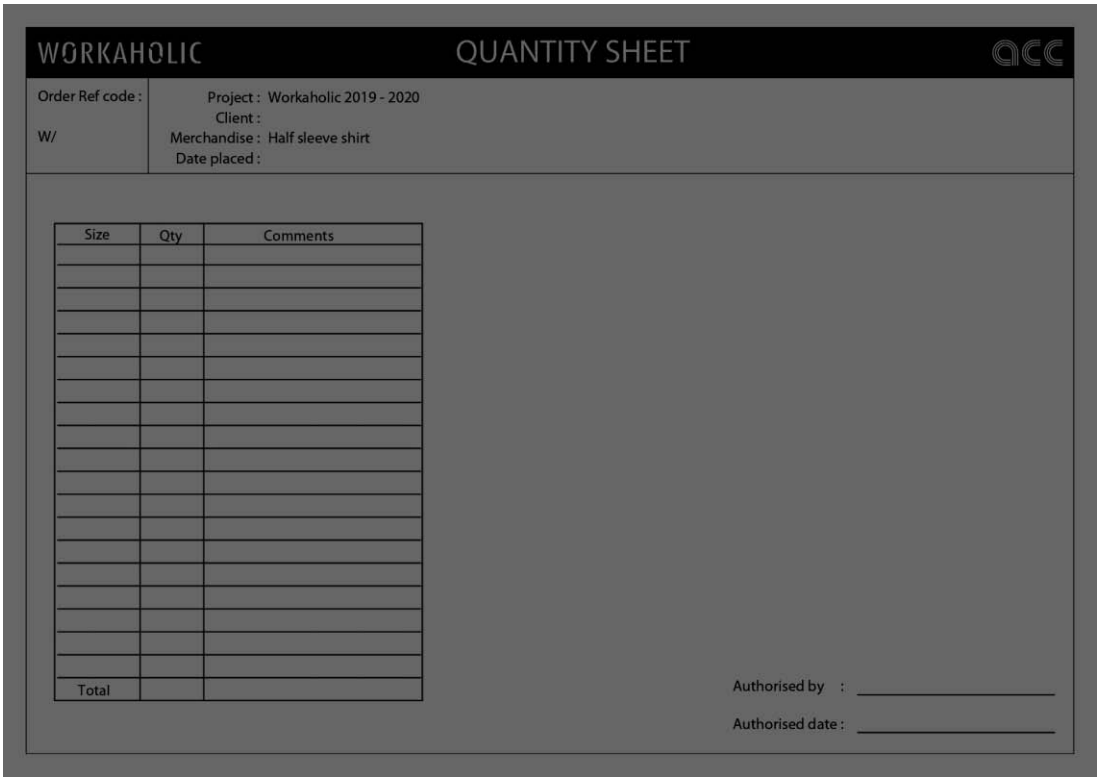


Fig. 2: Embellishment sheet


WORKAHOLIC QUANTITY SHEET acc

Order Ref code :
W/

Project : Workaholic 2019 - 2020
Client :
Merchandise : Half sleeve shirt
Date placed :

Size	Qty	Comments
Total		

Authorised by :
Authorised date :

Fig. 3: Quantity sheet

b) Adding additional form to clientle

According to Jung Ha-Brookshire (2015) One of the key goals of the vending function is to plot garb merchandise within the styles that focus on clients would like to have, at the price they are willing to pay, inside the sizes they want, and at the time they want to shop for. Precise forecasting is one of the most vital secrets and techniques to fulfillment in any clothing agency in these days's market surroundings.

When sales managers meet clients to get their needs, there happens a lag of communication in conveying the right features needed in that particular merchandise. So there is a common clientele form for sales manager where some necessary details (like name of client, fabric, merchandise, quantity) was supposed to be filled by sales manager and get confirmation signature from clients to start the process further.

To bring lean techniques, had added an extra form called client approval form to get additional confirmation from clients (Fig 4) which contains the visual diagrams of different collar, cuff, embroidery positioning etc. that is more easier for clients to visually understand and finalize the design they want. This gradually decrease the confusion between client, sales manager, enquiry team and designers to follow up the process effectively.

Fig. 4: Client approval form

c) *Minimizing the timeline for each process*

According to Pankaj Sharma 2005, Indian exporting is typically lower than China in which China has 6 time more revenue in garment than India. The cycle time of a product is an important aspect in which it affects both price and delivery schedule.

Involving too much of time and no committed time leads to delay in process and delivery, to minimize the problem, deadline line for each process was allotted with confirmation of all team workers including production unit.

These are the proposal deadlines for each department

Sales manager confirming the enquiry- 5 days

Enquiry team working for their quotation – 2 days

Working for sample – 3 Days

Sales manger should get PO from client after confirming the sample – Minimum 2 days

Fabric should reach production at maximum – 30 Days

Production Process – Maximum 15 days (Depends On Quantity)

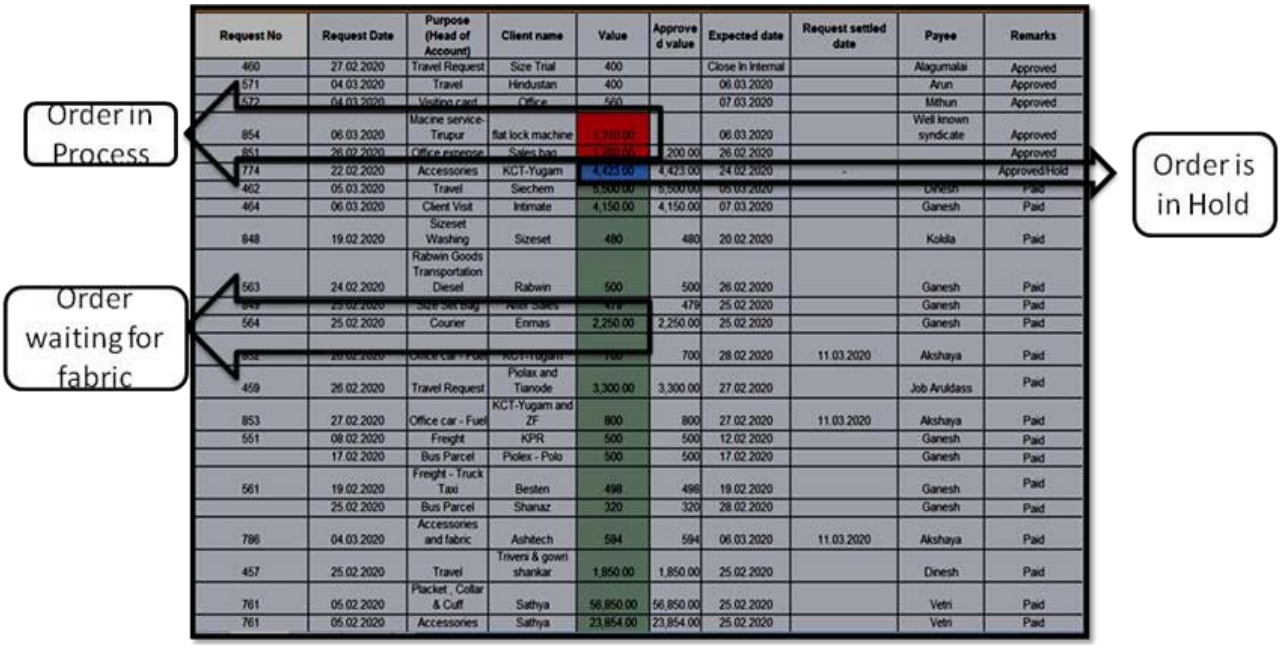
Client reachable - 60 days from PO (Compulsory)

Payment Clearance- 15 days from receiving goods.

d) *Catogirizing the datas according to priorwise*

According to Arashdeep Singh (2015) The 2d S, Seiton, manner 'neatness' and targets to have matters in the proper location or proper layout in order that humans can acquire or use something they want quick. To do that, one need to prioritise the need and importance of products/gadget to maximise ease of place. The key questions who, what, why, in which, while and the way (Imai, 1986) have to be requested of oneself in respect of each object. This pastime involves ensuring distinctive places for all items within the place of business, thereby facilitating employees to have green manipulate over the operations and allows employees to meticulously plan substances, supplies, or tools requirements.

There numerous datas in drive like internal request, purchase request, fabric booking, sample request, order sheet request etc. There will be more orders to look simultaneously but some have prior attention due to high value order or orders that received advanced payment etc.. In that case all these orders in a sheet will be highlighted in different way to indicates the importance and status of each orders shown in Fig 5 This reduces the confusion of getting jammed of finishing certain works. This goes by a flow and every order gets good time management and most probably the delay in each process will be eliminated.



Request No	Request Date	Purpose (Head of Account)	Client name	Value	Approved value	Expected date	Request settled date	Payee	Remarks
460	27.02.2020	Travel Request	Size Trial	400		Close In Internal		Alagumalai	Approved
571	04.03.2020	Travel	Hindustan	400		06.03.2020		Arun	Approved
572	04.03.2020	Visiting card	Office	560		07.03.2020		Mithun	Approved
854	06.03.2020	Macine service-Tirupur	flat lock machine	3,300.00		06.03.2020		Well known syndicate	Approved
851	26.02.2020	Office expense	Sales han	200.00	200.00	26.02.2020			Approved
774	22.02.2020	Accessories	KCT-Yugam	4,423.00	4,423.00	24.02.2020	-		Approved Hold
462	05.03.2020	Travel	Siechem	6,500.00	6,500.00	06.03.2020		Dinesh	Paid
464	06.03.2020	Client Visit	Intimate	4,150.00	4,150.00	07.03.2020		Ganesh	Paid
848	19.02.2020	Sizeset Washing	Sizeset	480	480	20.02.2020		Kokila	Paid
563	24.02.2020	Rabwin Goods Transportation Diesel	Rabwin	500	500	26.02.2020		Ganesh	Paid
849	25.02.2020	Size set bag	Anu Sales	479	479	25.02.2020		Ganesh	Paid
564	25.02.2020	Courier	Enmas	2,250.00	2,250.00	25.02.2020		Ganesh	Paid
852	28.02.2020	Office car - Fuel	KCT-Yugam	700	700	28.02.2020	11.03.2020	Akshaya	Paid
459	26.02.2020	Travel Request	Piolax and Tianode	3,300.00	3,300.00	27.02.2020		Job Aruldass	Paid
853	27.02.2020	Office car - Fuel	KCT-Yugam and ZF	800	800	27.02.2020	11.03.2020	Akshaya	Paid
551	08.02.2020	Freight	KPR	500	500	12.02.2020		Ganesh	Paid
	17.02.2020	Bus Parcel	Piolex - Polo	500	500	17.02.2020		Ganesh	Paid
561	19.02.2020	Freight - Truck Taxi	Besten	498	498	19.02.2020		Ganesh	Paid
	25.02.2020	Bus Parcel	Shanaz	320	320	28.02.2020		Ganesh	Paid
786	04.03.2020	Accessories and fabric	Ashitech	594	594	06.03.2020	11.03.2020	Akshaya	Paid
457	25.02.2020	Travel	Triveni & gown shankar	1,850.00	1,850.00	25.02.2020		Dinesh	Paid
761	05.02.2020	Placket , Collar & Cuff	Sathya	56,850.00	56,850.00	25.02.2020		Vetri	Paid
761	05.02.2020	Accessories	Sathya	23,854.00	23,854.00	25.02.2020		Vetri	Paid

Fig. 5: Status of orders in different colors

e) Minimizing the Sample pieces

According Fabrizio, Tapping (2006) The movement which does not add any value to the work is waste of motion. If the company is not having a efficient job process and office design leads to more walking, reaching or bending than necessary. The seiso is to clean the work place and setting things in order.

Giving more sample pieces to a specific client without getting purchase order is giving a way for client to involve in illegal process like implementing our designs with other vendor with minimum cost where that vendor does not have overheads and it is so easy for them to quote for less amount.

f) Created CRM Profile

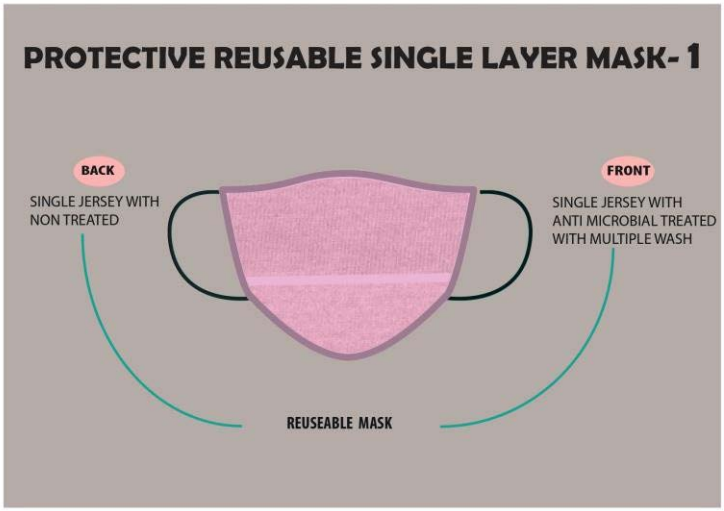
According to Takhar (2004) has mentioned the benefits associated with 5S, such as fewer mistakes, high speed work management, better inventory management, improved employee discipline, and a more impressive environment to handle potential customers.

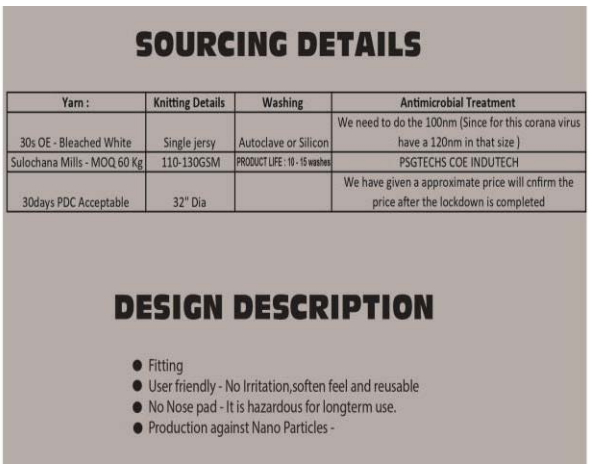
To get more effective relationships with client, created CRM profile, this is a platform in which all recurring clients can be added and started to have a relationship management with industry. In CRM all new output designs and quotations will be uploaded, so client get a chance to look details about all the merchandises and this helps to get more promoted about the ideas of design and create awareness about the industry works.

g) Proposal idea for new technique effective woven mask

Unfortunately, whole world was supposed to face a pandemic situation "Covid-19" which made everyone of us to protect ourselves with mask. When comes to surgical, using of onetime usable mask is not most appreciable for day to day life.

So used technology in potential way and made an effective reusable woven single layer innovative cheap mask with best possible price that can be easily affordable and also highly effective. Here it is explained it in detail with design, pattern details, sourcing details and effectice costing.





COSTING DETAILS

Yarn Price /KG	214
Knitting Charge /KG	18
Washing /KG	16
Antimicobial finsih /KG	180
Total'	428
5% Processing waste	21.4
Fabric Price	449.4
Consumption per Mask	7grams
Cost Per Mask	3.1458
Elastic Price per meter	5
Elastic Per Mask(12" including both side)	1.5
Sewwing thead (2 Meter)	0.016
Cutting	0.8
Stitching	2
Total	7.4618
Production & Management Over Heads	1
Margine 20%	1.49236
Grand Total	9.95416
Selling Price	10

Thus the above mentioned 7 methods are implemented in a way of lean approach to avoid non value added activities and to make a standardised flow in merchandise process.

III. Results and Discussion

The proposal ideas had directed a standardized, effective and efficient flow of the process to make the flow easier. To find the ranking of each changes, conducted a survey with 25 sample of merchandisers and designers. Their points for each changes was noted, consolidated and given below as Fig 7.

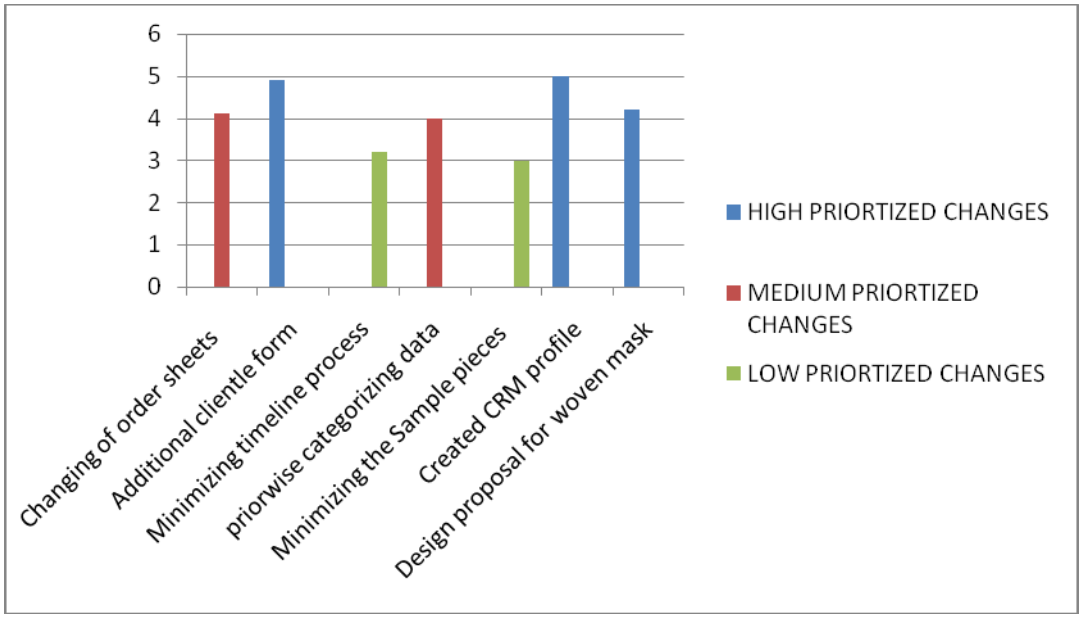


Fig. 7: Ratings of each methods

High Priortized Effective Changes	Medium Priortized Changes	Low Priortized Changes
Additional form to clientle- This gradually decrease the confusion between client and sales manager, sales manager and enquiry team and enquiry team with designers to follow up with correct flow.	Changing of order sheets - This changes avoids paper waste, unwanted process, avoiding confusion and also minimizes the time to get it completely done.	Minimizing Timeline for each process- It may not be suitable for all type of orders, it depends on clients, merchandise, fabric availability and quantity.
Created CRM profile- Chances of attracting clients and maintaining their relationship for a long time. Design Proposal for effective woven mask – This is cheap effective method that can be used for a month with expected filtration	Priorwise Data - This reduces the confusion of getting jammed of finishing many requests. This goes by a flow and every order gets good time management and most probably in delay in each process will be eliminated.	Minimizing the Sample pieces- Not all clients get satisfied with this point, as we are a startup company, we cannot demand for samples with clients.

IV. Conclusion

Thus from the above study it was understood that the merchandising is an important job and lot of non value added activities are involved in it and making the task more risk. Therefore in this study, by considering the risks involved, the lean techniques has been selected and implememnted for reducing the non value added activities and making easy job for merchandisers.

Thomas A. Fabrizio (2006) Reduction of waste in the office helps to increase the cost or time of doing the work This can be applied to the most of the problems in industry by doing the 5s the seven waste can be eliminated such as correction and rework, waiting, unnecessary motion, over processing ,equipment downtime, Inventory and storage and inspection. Most of the companies feel that 5 per cent of work is only value added and others are non value added or wasted activity.

As per the discussion, applying principles of lean techniques had a major role in developing the order process in a most possible way. It helps to reduce time, to reduce overlapping work and confusion and it also helps to maintain a standard way to move in a flow.

References Références Referencias

1. Implementing Lean Practices: Managing the Transformation Risks- Antony Pearce and Dirk Pons in 2013
2. 12th Global congress on manufacturing and management, gcmm 2014.
3. Berna Dengiz, Kunter S. Akbay Computer simulation of a PCB production line: meta modeling Approach
4. Int. J. Production Economics, 63 (2000), pp. 195-205
5. M. Rother, J. Shook Learning to See: Value Stream Mapping to Add Value and Eliminate Muda
6. The Lean Enterprise Institute, Inc., Brookline, MA. (1999)
7. J.K. Liker The Toyota Way
8. McGraw-Hill, New York (2004)
9. Rajesh Kumar Mehta, Dharmendra Mehta, K. Naveen, Mehta An Exploratory study n employee's perception towards lean manufacturing systems Management & marketing, X (1) (2012)
10. Fawaz, Abdulmalek, Jayant Rajgopal Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A process sector case study
11. Int. J. Production Economics, 107 (2007), pp. 223-236.
12. Applying lean techniques in delivery of transportation infrastructure projects Awad S. Hanna1, Michael Wodalski2, and Gary Whited.
13. Alavi S. (2003) "Leaning the right way", IEE Manufacturing Engineer, Vol. 82, No.3, pp. 32–35.
14. Bhasin S. & Burcher P. (2006) "Lean viewed as a philosophy", Journal of Manufacturing Technology and Management. Vol. 17, No. 1, pp. 56 – 72
15. Ciarniene R. & Vienazindiene M. (2012) —Lean manufacturing: theory and practiceǁ Economics and Management, Vol. 17, No.2, pp. 726-732.
16. Dixit Abhishek, Patel Sanjay, Dixit Anupam (2011) —Lean Manufacturing to lean enterprisesǁ proceedings of the International Conference on Industrial Engineering held at SVNIT, Surat, November 17-19, 2011, pp-431-435.
17. Esfondyari Alireza & Osman M.R. (2011) —Success and failure issues to lead lean manufacturing implementation.ǁ proceedings of the International Management Conference, Malaysia, April 16-17, 2011.
18. Hines P. & Taylor D. (2000) "Going Leanǁ, Lean Enterprise Research Centre, Cardiff Business School, pp. 3 – 43, assessed from www.text matters.com on 12.12.2013.
19. Hines P., Holweg M. & Rich N. (2004) "Learning to evolve: A review of contemporary lean thinking", International Journal of Operations & Production Management, Vol. 24 No.10, pp.994-1011.
20. Kaizen Desk Reference standard by Raphael I. Viralo, Frank Butz, Joseph P. Vitalo.
21. Lean Manufacturing Implementation by Dennis P. Hobbs.
22. Lean Thinking James P. Womack and Daniel T. Jones.
23. Mekong"s Capital Review (2004) —Introduction to lean Manufacturing ǁ Accessed from http://www. lean6sigma.vn/Download-document/2-Lean-Manufacturing.html on 12/12/2013; pp. 1-20.
24. Pedram Mirzaei (2011) —Lean Production: Introduction and Implementation barriers with SME"s in Swedenǁ, School of Engineering in Jonkoping, Sweden.
25. Pingyu A.Yang & Yu B. Yu (2010) —The barriers to SME"s implementation of Lean production & countermeasures. ǁ International journal of innovation, management & technology. Vol.1, No.2 pp. 220-225
26. Pramod V. R. & Banwet D.K. (2010) —ISM for understanding the inhibitors of a telecom service supply chainǁ proceedings of the International conference of Industrial Engg. & operation Management, Dhaka, Bangladesh, Jan. 9-10, 2010.
27. Rose A.M.N., Deros B.Md & Rahman, M.N. Ab. (2010) —Development of framework for lean manufacturing implementation in SME"sǁ Asia pacific Industrial Engineering and Management Systems Conference, Melaka, Dec. 7-10, 2010.
28. Singh Binod kumar, Bhar Chandan & Pandurangan Visvesvaran (2011) —Competitive advantage of lean manufacturing over traditional manufacturingǁ proceedings of the International Conference on

Industrial Engineering held at SVNIT, Surat. November 17- 19, 2011, pp. 442-446.
29. Teleghani Mohammad (2010) —Key factor for implementing the lean manufacturing system‖ Journal of American science. Vol.6, No. 7, pp. 287-291.
30. Womack J. P. and Jones D. (2003), —Leam Thinking‖, FREE PRESS, NY.

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4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

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Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Engineering Research Paper

Techniques for writing a good quality engineering research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of research engineering then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.

- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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