

# Green Manufacturing and Environmental Sustainability Manufacturing in Kosovo's Small and Middle Enterprises, Barriers to Implementation

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**Abstract:** This paper investigates the state of Green Manufacturing and Environmental Sustainability Manufacturing in Kosovo's SMEs and identifies barriers to implementation within the Small and Medium Enterprises of Kosovo's Manufacturing Industry. The study uses the Delphi survey method, semi-structured questionnaires and interviews as research instruments. The aim of this study is to identify factors that affect green manufacturing and the main barriers to its implementation. The analysis revealed that Energy, Pollution, Emissions, Waste, and Water are the most significant factors affecting Green Production in Kosovo's SMEs. The study finds that lack of training and expertise in Green Manufacturing Principles, weak organizational structures, and management hesitation towards adopting new practices are the main barriers to the implementation of Green Manufacturing Principles in Kosovo's SMEs. The paper concludes that technical support and training are essential for overcoming these barriers and promoting the implementation of Green Manufacturing Principles in Kosovo's SMEs.

**Keywords:** barriers; emissions; environmental sustainability; Kosovo's small and middle enterprises; global warming; green manufacturing

## 1 INTRODUCTION

As it is known Small and Middle Enterprises (SMEs) have a crucial role in the growth of Kosovo's economy. SMEs can be considered the base of economic development in all countries, particularly in developing countries. According to the World Bank, SMEs are important contributors to global economic development and job creation. About 90% of businesses belong to SMEs worldwide and more than 50% of employees are included in the SMEs. Formal SMEs contribute up to 40% of national income (GDP - Gross Domestic Product) in emerging economies [1]. According to European Commission, 2019 [2], "Kosovo's SMEs play a particularly important role in Kosovo's "non-financial business economy", accounting for 99,9% of all firms in 2016. SMEs in Kosovo generated 81,0% of the total value-added. This is significantly higher than the average contribution of SMEs to total value added of the "non-financial business economy" in the EU, which amounts to 56,2%" [2]. Since SMEs have a very important role in the economic growth of Kosovo, SMEs have been chosen for the investigation of green manufacturing and environmental sustainability. Based on the literature review there is a lack of data and investigation about Green Manufacturing and Sustainability Manufacturing in the Kosovo Manufacturing Industry. Green Manufacturing globally has taken considerable attention. All around the world today in different forums, conferences, social media, journals, magazines, governance, and so on, people are discussing global warming and it is important to find the best solutions to upkeep the world green. Most studies regarding environmental manufacturing management in SMEs focus on SMEs' experience when it comes to greening their production facilities. Therefore, the main purpose of this paper is to investigate Kosovo's SMEs about how much their product is green and what is the implementation of SMEs' greening policies as well as barriers to implementation.

The terminology "Green Manufacturing" was made up to represent a new manufacturing model. It is considered that in its production process it encourages sustainable production, uses energy (renewable energy systems), raw

materials and resources efficiency, low waste, low carbon, without pollution (clean technology equipment), and produces products in conformity with the environment [3-6].

Based on the literature review, it has been noticed that there is a gap in studies on the identification of barriers in the implementation of Green Manufacturing in SMEs, and in the identification of main factors that have an impact on it, particularly in Kosovo. This investigation tries to fill this gap in Kosovo's SMEs.

The following main research questions, but not limited to addressing our objectives are:

1. RQ1: Have the enterprises installed or implemented equipment to reduce energy, waste, and water consumption and have they taken any action to recycle waste?
2. RQ2: Which are the most important factors that affect Green Manufacturing?
3. RQ3: Which are the main barriers to the implementation of Green Manufacturing Principles?

This study tries to address approaches to adaptation of Green Manufacturing and Environmental Sustainability Manufacturing, particularly barriers to their implementation and factors that affect Green Manufacturing.

## 2 LITERATURE REVIEW

Greening Manufacturing deals with adopting strategies that aim to minimize wastage and pollution created during the manufacturing process. It gives opportunities for cost reduction, fulfilling environmental principles, minimizing the health risks, and improving the company image. Green Manufacturing's focus is to reduce the side effects of the manufacturing process and products. It is significant for future manufacturing sustainability and to continue implementing the system of lean manufacturing [7]. The purpose of green manufacturing is to reduce wastage, avoid, control, and prevent it during the process of production. According to Dornfeld [8], Green Manufacturing principles could be divided into five areas: changes in raw materials, product and production process changes [9], internal re-use of wastes, and better

housekeeping [8]. Sharma et al. [10], mentioned processes such as reusing, recycling, and refilling as a green manufacturing approach.

According to the Balkan Green Foundation report, published in October 2018 [11], the main identified problems in sustainable development in Kosovo are air pollution, illegal landfills, destructive forests, lack of sewage systems, erosion, and industrial leftovers. Lack of government support is another issue that has not been addressed in the context of green manufacturing [12]. All of these has a negative impact on the life of the local communities and the Environmental Sustainability of Manufacturing in Kosovo. For sustainable development, clean energy remains too important and has to be fulfilled by both developing and developed countries. Most of Kosovo's electricity generation comes from the thermal power station; due to coal power plants 5,8 million tons per year of carbon dioxide are released into the atmosphere [13]. Alternative solutions should be adopted in Green Manufacturing [14]: solar, thermal, photovoltaics and wind power can be considered as a solution because Kosovo has potential for solar energy [15]. The use of hybrid power systems, which integrate renewable energy sources, can offer numerous benefits such as high system availability, lower costs, improved load matching, and higher fuel efficiency [16]. Such systems can play a critical role in achieving sustainability goals by reducing reliance on fossil fuels and minimizing greenhouse gas emissions. Investments and financing can be a good option for companies if they have future projects that improve their sustainability (like "green" projects) and if they have a business model that integrates sustainability into their regular activities [17]. Biomass and hydrogen power as well can be considered. This leads to sustainable production, use of renewable energy, raw materials and resources efficiency, results in low waste, low carbon, without pollution, and produces products in conformity with the environment.

According to OECD (OECD - Organisation for Economic Co-operation and Development), European Training Foundation, European Union and European Bank for Reconstruction and Development [18], in Kosovo there are none of the national strategic documents explicitly focusing on environmental policies for SMEs. The draft PSDS - Private Sector Development Strategy (2018-2022) [Ministry of Trade and Industry], does not contain objectives or any activity items regarding SME greening. Elements that are important for SMEs and have environmental policies according to the government are included in the three strategies and the related action plans as follows: the Strategy for the Development of Energy Sector by 2030; the Strategy for Environmental Protection (2013-2022), which is a central national environmental policy document; and the Waste Management Strategy 2.0 (2017-2021) [18].

### 3 RESEARCH METHODOLOGY

As we mentioned in the literature review section, there is a gap in studies about the identification of barriers in the implementation of Green Manufacturing in SMEs, and in

the identification of main factors that have an impact on it, particularly in Kosovo. Therefore, this paper aims to investigate the state of the art in Green Manufacturing and Environmental Sustainability Manufacturing in Kosovo's SMEs and determine the barriers to implementation within the Small and Medium Enterprises of Kosovo's Manufacturing Industry.

The companies for the survey were selected based on their size and industry sector. Specifically, we targeted small and medium-sized enterprises (SMEs) in the manufacturing industry in Kosovo, which have been operating for more than 10 years and have a track record of success in their activities. The SMEs were selected from a list of registered companies obtained from the Kosovo Business Registration Agency (KBRA). The criteria for selection were based on the number of employees, turnover, and industry sector. The surveyed SMEs in Kosovo's manufacturing industry operate in different sectors, with the majority being in the food and beverage industry, followed by the textile industry and the metal and furniture industry.

Delphi survey method [19] has been used to collect data and semi-structured questionnaires and interviews have been prepared as the research instrument. In this study, three phases have been used in preparing questionnaires, interviews, and data collection, as follows:

Phase 1: Preparatory visits to enterprises have been made to identify the research problem with the panel of experts;

Phase 2: Preparation of questionnaire, semi-structured interview with the list of questions, and selection of enterprises has been done;

Phase 3. Data are collected by the distribution of questionnaires in two forms, some questionnaires have been sent by e-mail and some of them have been delivered physically; then in the meantime interviews have been conducted. During all interviews notes have been taken and recorded to facilitate analyses.

Fig. 1 presents the flow diagram of our research methodology.

Out of 455 questionnaires that have been delivered (most of them have been sent to companies by email), 328 have been received and 298 answered completely and are accepted as the sample size of research. A considerable number of interviews have facilitated data analyses. The address of businesses and the list of the respondents have been taken from the Business Registration Agency, which operates within the Ministry of Trade and Industry of Kosovo.

The respondents have been asked about formal environmental policies in their company, greenhouse gas emission management and reduction plan. Among other questions, the respondents have responded about actions that the company has taken to reduce water and energy consumption. They also answered about the type of electricity sources that the company uses and what kind of renewable energy sources may be produced. The two other questions that we considered important were about barriers in implementing Green Manufacturing Principles and important factors that affect Green Manufacturing.

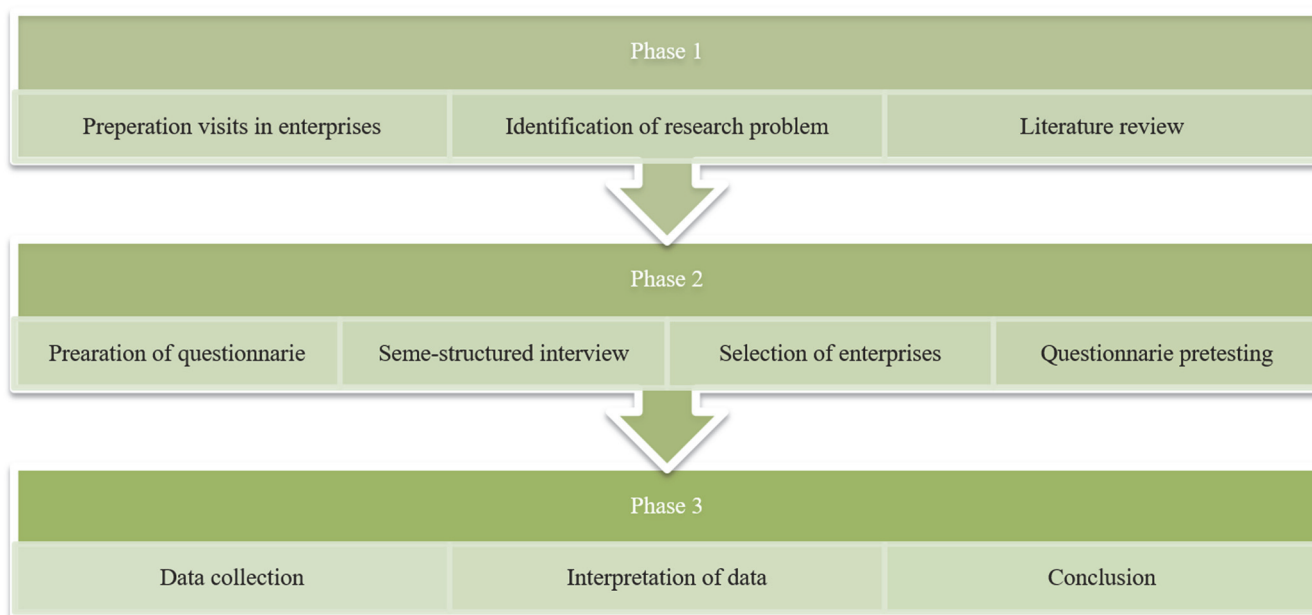


Figure 1 Flow diagram of our working research methodology

#### 4 DATA ANALYSIS AND DISCUSSION

After receiving questionnaires and conducting interviews with companies, the data were analyzed using a spreadsheet and SPSS packet program. Descriptive and inferential statistics were used to analyze the collected data. This section presents the data from the questionnaires and interviews, focusing on three main questions: 1) Have the enterprises installed or implemented equipment to reduce energy, waste, water consumption and take any action to recycle waste? 2) Which are the most important factors that affect Green Manufacturing? and 3) Which are the main barriers to the implementation of Green Manufacturing Principles?

None of the companies involved in the research had a formal environmental policy in place, according to the responses of the respondents. Out of 298 companies, 109 (36,58%) had conducted Toxicity Testing (TT) or an Environmental Impact Assessment (EIA) for their wastewater, and 112 (37,58%) had taken action to reduce water consumption and wastewater.

When asked if they were interested in receiving technical support to develop a wastewater management improvement plan, 64,7% of respondents answered positively.

The companies included in the research did not monitor the compliance of sub-suppliers with corporate environmental policies, such as greenhouse gas emissions, wastewater, and hazardous chemicals.

Almost all enterprises (98,99%) used the state grid for electricity supply, with only 1,34% using captive generators as an alternative source and 0,67% using co-generators.

Regarding the use of equipment to reduce/recycle energy in facilities, 4,36% of respondents reported using "natural air blowing systems," 4,03% reported using "heat exchangers," 4,36% reported using "insulation of steam pipes," 4,70% reported using "condensate recovery," and 5,37% reported using other equipment.

When asked if their company used or produced electricity from renewable energy sources (e.g., solar, wind, biomass, etc.), only 2,39% of respondents answered positively.

According to the respondents, 56,38% of companies had undertaken action to reduce, reuse, and/or recycle waste at their facilities (RQ1).

Tab. 1 presents the main barriers to the implementation of Green Manufacturing Principles (GMP) in Kosovo's SMEs.

Table 1 The main barriers to the implementation of green manufacturing (RQ3)

Barriers	Number	Percentage
Lack of training from the company	275	92,28%
Weak organizational structure to support GMP	265	88,93%
Management hesitation towards GMP	230	77,18%
High hesitation to convert traditional practices to GMP	215	72,15%
Limited resources affect the organization's ability to adopt GMP	198	66,44%
Lack of technical expertise in GMP	270	90,60%
Lack of GMP knowledge	268	89,93%
Lack of awareness of green products/processes among customers	234	78,52%
Lack of new technology, materials and processes to support GMP	212	71,14%
Lack of flexibility to switch over to GMP-based systems	230	77,18%
Lack of GMP technological capabilities	199	66,78%
Lack of GMP training courses/consultancy provided by the government	231	77,52%
Absence of financial incentives and policies for the implementation of GMP	189	63,42%
High initial capital cost to implement GMP	199	66,78%
Public awareness of Green initiatives	150	50,34%

As it can be seen from the tab. 1, all barriers listed have a value above 50%. Lack of training from the company, lack of expertise in GMP, lack of GMP knowledge, weak organizational structure to support GMP, lack of awareness of green products among customers, lack of GMP training provided by the government, management hesitation towards GMP, lack of flexibility to change and switch over to GMP-based systems, high hesitation to convert

traditional practices to GMP and lack of new technology materials and processes to support GMP are ten main barriers in the implementation of Green Manufacturing Principles in Kosovo's SMEs.

The respondents were asked about the most important factors that affect Green Production. Fig. 3 presents the main factors according to respondents (RQ2).

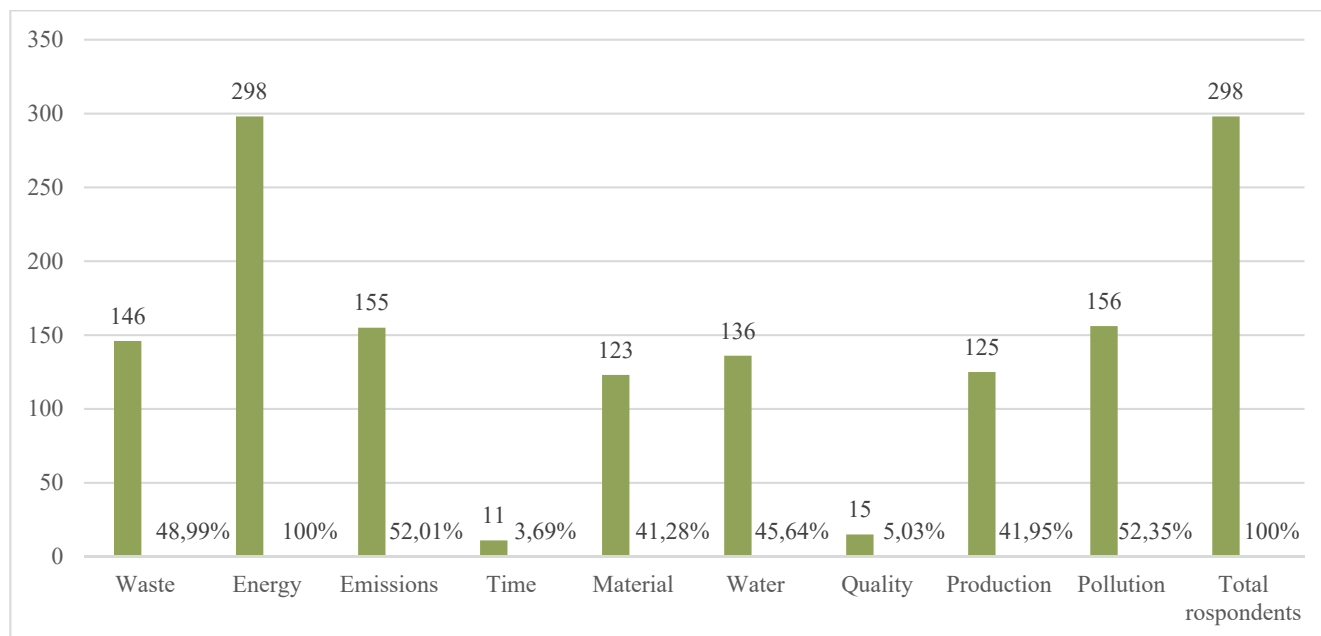


Figure 2 Factors that respondents consider to be the most important in affecting green production

Fig. 2 shows that Energy (298 respondents or 100%), Pollution (156 respondents or 52,35%), Emissions (155 or 52,1%), Waste (146 or 48,99%) and Water (136 or 45,64%) are considered the most important things that affect Green Production according to respondents (questionnaires and interviews).

## 5 CONCLUSION

This study aimed to analyze the state of Green Manufacturing and Environmental Sustainability Manufacturing in Kosovo's SMEs and determine the barriers to implementation within the Small and Medium Enterprises of Kosovo's Manufacturing Industry. The Delphi survey method was used to collect data, and semi-structured questionnaires and interviews were used as research instruments.

The findings indicate that the implementation of a formal Environmental policy in Kosovo's SMEs remains limited, and that regulatory instruments are almost non-existent. None of the companies involved in the research monitor the compliance of sub-suppliers with corporate environmental policies. The most important factors that affect Green Production in Kosovo's SMEs are Energy, Pollution, Emissions, Waste, and Water. The main barriers to the implementation of Green Manufacturing Principles in Kosovo's SMEs are lack of training, expertise, knowledge, weak organizational structures, lack of awareness, lack of training provided by the government, management hesitation, lack of flexibility, and high hesitation to convert traditional practices to GMP-based systems.

The study found that 36,58% of companies have conducted toxicity testing, and 37,58% of companies have taken action to reduce water consumption and wastewater. Most companies are interested in receiving technical support, and almost all enterprises use the state grid for electricity supply, with only 2,39% of companies producing renewable energy sources.

According to the literature review, the main identified problems in sustainable development in Kosovo are air pollution, illegal landfills, destructive forests, lack of sewage systems, erosion, and industrial leftovers. The study updates this literature by identifying the specific factors that affect Green Manufacturing in Kosovo's SMEs and present the barriers to implementation.

Further research could investigate the effectiveness of different strategies for overcoming these barriers and increasing the implementation of Green Manufacturing Principles in Kosovo's SMEs. Additionally, policy makers and industry leaders could use these findings to develop targeted interventions to support the implementation of Green Manufacturing Principles in Kosovo's SMEs, ultimately contributing to a more sustainable and environmentally conscious manufacturing industry in Kosovo.

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