



Circular economy in wood processing sector, challenges, opportunities and solutions

Ina Vejsiu ^{*1}, Erald Kola ¹

¹ Agricultural University of Tirana, Department of Wood Industry, Tirana, Albania, inavejsiu@ubt.edu.al, erald.kola@ubt.edu.al

Cite this study: Vejsiu, I., & Kola, E. (2024). Circular economy in wood processing sector, challenges, opportunities and solutions. *Advanced Engineering Science*, 4, 35-44

Keywords

Circular economy
Wood
Sustainable
Green
Industry 4.0

Research Article

Received: 24.12.2023
Revised: 19.01.2024
Accepted: 03.02.2024
Published: 11.02.2024



Abstract

Economic circulation is a concept that is closely aligning with sustainability. For this reason, various stakeholders strive to collaborate in defining basic concepts, analyzing key issues, and directing solutions to these problems. In this study, we have attempted to address the challenges of the wood processing sector in Albania concerning the increase in the use of wooden products and the potential export of these products. During the last years, the concept of the circular economy has taken an important role in the literature, as well as in the production sector all over the world. Saying this, in Albania we are facing the same problem. The concept of the circular economy in our country was introduced lately. The companies that operate in the wood processing sector must step forward from a linear economy to a circular one as soon as possible. This material presents some information collected based on interviews conducted with some of the wood processing companies in Albania. For this study we prepared a closed answer questionnaire in order to have a simple analysis of the results gathered. As a result of this interview, skills and competencies supporting the transformation to circular business models were presented. The companies need some innovative design idea for the reuse of their basic products.

1. Introduction

One of the dangers that threatens humanity is climate change. these changes, besides the fact that they affect the economic and health aspects, certainly also have their impact on the environment as well as on the sources of material goods. as we know well, wood is a scarce material, which should be used in the most rationalized and efficient way. a large number of different institutions and governments are making great efforts to curb this phenomenon.

The European Union, in particular, is highly committed to making this business and societal model a reality as soon as possible to help deal with the environmental and climate challenges of the present, through such globally recognized strategies as: the European Green Deal [1], the Circular Economy Action Plan [2] and A sustainable bio-economy for Europe [3] strategy.

The concept of CE is a new concept but if we speak about applying CE and sustainability in the wood industry it is even newer. A circular economy (CE) is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products for as long as possible [4]. This is a departure from the traditional, *linear* economic model, which is based on a take-make-consume-throw away pattern. This model relies on large quantities of cheap, easily accessible materials and energy [5].

The concept of the circular economy in Albania, was previously used in the draft of the National Integrated Waste Management Strategy (2018-2023). The main goal of the document is to introduce this concept to the interested parties with the transition needs and requirements to move from a linear economy toward a circular one [6].

This study was undertaken to create an idea about the approach that Albanian businesses operating in the field of wood processing and furniture production have in relation to the circular economy. it is based on a face to face interview structured in twenty-eight questions. The possibilities of the answers are limited in order to be better

interpreted during the analysis of the data. the questions are of an informative nature focused on areas such as the number of employees, the male-female ratio in the company, the technological level, the provision of various services, the composition of the technical office for each company, etc.

Six companies were selected as interviewed subjects, from the most representative ones in the country, with a satisfactory technological level and with large work capacities. All six companies are part of Wood Industry Cluster of Albania (WICA). Wood Industry Cluster of Albania -Tirana (WICA) is a non-profit NGO, whose primary goal is improving companies' competitiveness, thus registering world trends and changes in the global market, as well as adjusting the participants' own production to such trends and changes [7].

A special focus in this study, based on the questions addressed to the interviewers as company representatives, is directed towards the fact that companies are ready to deal with the recycling of objects or their repair, based on a practice or standardized work methods.

2. Material and Method

This is a study based on a questionnaire with 28 questions in total. The questions include the activity of the companies as a whole, as well as special issues regarding the circular economy. At first, we turned to the literature to get more detailed information. Google Scholar, ScienceDirect, Elsevier, etc. were used as the basis of the data. As keywords in the search, of course, words related to the study were used, such as circular economy, furniture, ecological, wood industry, technological development, environment. It must be said that we have not set limits regarding the time criteria for the publication of articles and studies. During the review of the literature, the articles that meet the "most relevant results" criterion were selected.

For developing the proposed approach, the research has included 4 main stages, as shown in Figure 1.

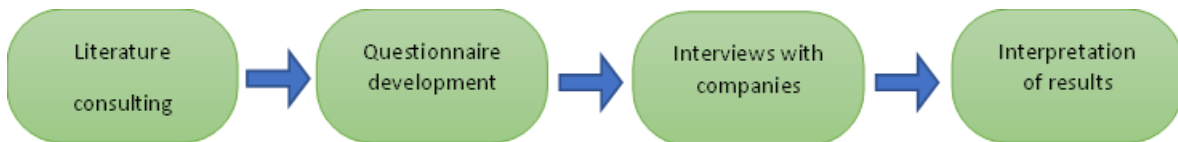


Figure 1. 4 Stages of research development.

Interviews were held at company's offices and took approximately 120 minutes to be fulfilled. During the interviews, a series of problems related to the progress and development of daily work came to light.

Some questions have simple answers, with choices "yes" or "no", "a little" or "a lot". This comes as a result of the fact that it is very difficult to quantify the level of knowledge and the activity undertaken to implement the principles of the circular economy. Based on the answers received, graphics were built to display the information visually. Data analysis was done using the Microsoft Excel program.

3. Results

After the analysis of all the interviewed entrepreneurs the result obtained was that the market for production of recycled wood production was not ready and unsatisfied. These companies are not focused on this process but they are willing to go further this process if they have some inputs from the government or even the help of the WICA (which is a new entity by still is operational in supporting the wood industry sector) [8].

The first questions are related to the fact how much knowledge the companies have about the circular economy and how much they know its principles (Figure 2).

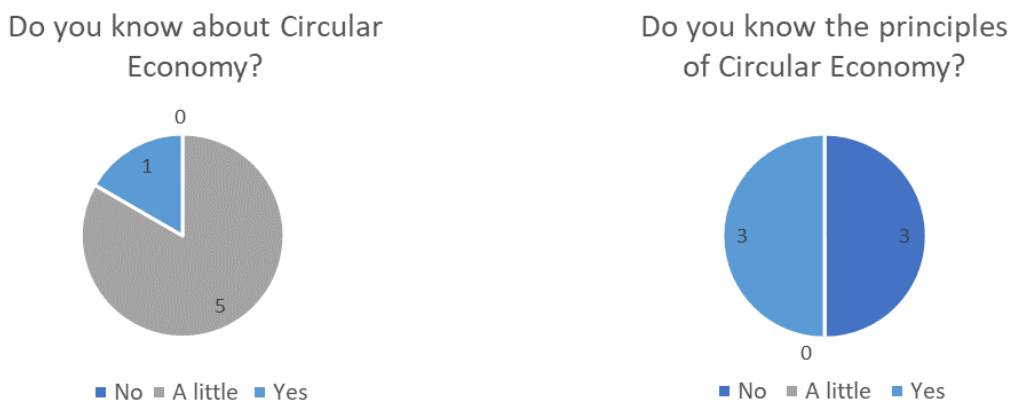


Figure 2. Do the companies have knowledge about Circular Economy knowledges and its principles?

From the answers to these two questions, we can reach the conclusion that the companies interviewed do not have real knowledge about the Circular Economy. They simply have some initial concepts which they have heard, but no in-depth knowledge in this field.

The next question is related to the total number of employees, the number of employed women and the level of education of the employees. The info gathered for this question is showed in [Table 1](#).

Table 1. Number of total workers, female workers, education level and number of engineers employed.

Questions	Bolt	Dafinor	RoAl	SHAGA	Ardeno	Erald
Total number of workers	42	75	120	110	76	55
Female workers	7	29	40	30	32	15
Highly educated workers	8	3	20	18	17	5
Number of engineers	2	1	2	5	4	2

This question gives us information about the composition of the company's staff and the approach it may have towards taking steps towards applying the principles of the circular economy. as expected, companies that employ staff with higher education are more inclined to recognize and apply the principles of the circular economy. This of course comes as a consequence of the staff's approach to knowledge and continuous training.

Another important question is about the composition of the technical office staff. depending on the answer to this question, we look at what is the best combination of professionals in the technical office. thus, a technical office composed of architects and engineers is more inclined to make repairs and material reuse, as well as to find the most economical solutions for the realization of various projects ([Figure 3](#)).

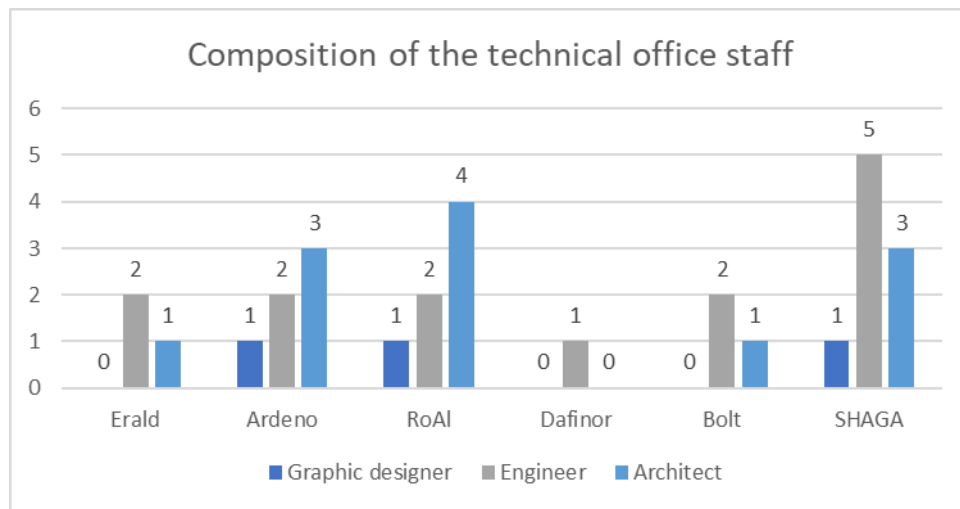
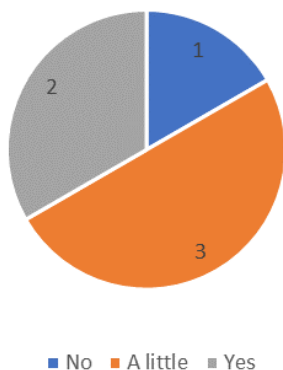


Figure 3. Composition of technical office staff.

The questions "Do you conduct trainings?" and "Do you have a stable partner for the development of trainings?" are questions that point to a big gap in this direction. The results for these questions are shown in [Figure 4](#).

Do you conduct training for your staff?



Do you have a stable partner in the field of staff training?

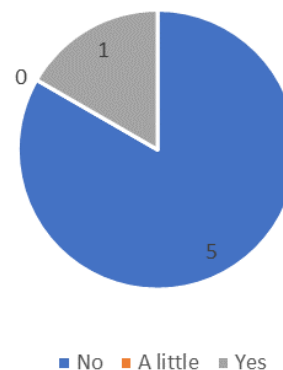


Figure 4. Answers for questions about staff training.

The next question is "What training do you see as the most important?". here, the interviewees can choose four training areas to which they give points according to their importance, a maximum of 4 points and a minimum of 1 point. the information obtained from this response is presented in [Table 2](#).

Table 2. Responses for the question "What training do you see as the most important?".

What training do you see as the most important?	For raw materials	For secondary items	For sales	For digital marketing
Bolt	3	2	4	1
Dafinor	2	1	4	3
Ardeno	3	1	4	2
Erald	2	3	4	1
SHAGA	4	1	3	2
RoAl	2	1	4	3

A Single Factor ANOVA Analysis is used to process these numbers. we can say that the interviewed companies are more oriented towards sales and give them more importance ([Table 3](#)).

Table 3. ANOVA Analysis summary report.

Groups	Count	Sum	Average	Variance
For materials	6	16	2.666667	0.666667
Secondary items	6	9	1.5	0.7
For sales	6	23	3.833333	0.166667
For digital marketing	6	12	2	0.8

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	18.33333	3	6.111111	10.47619	0.000235	3.098391
Within Groups	11.66667	20	0.583333			
Total	30	23				

The next question in the interview is related to the first subject used in the production structure. the use of the raw material is given as a % value in relation to the total used. as noted, three companies (Erald, Ardeno, Dafinor) use wooden material as raw material, while the other three companies (ShAGA, RoAl, Bolt) use melamine panels as raw material. in this case, a potential is seen for the use of production waste as heating material, for the production of pellets or for the production of melamine panels (in reduced quantities) ([Figure 5](#)).

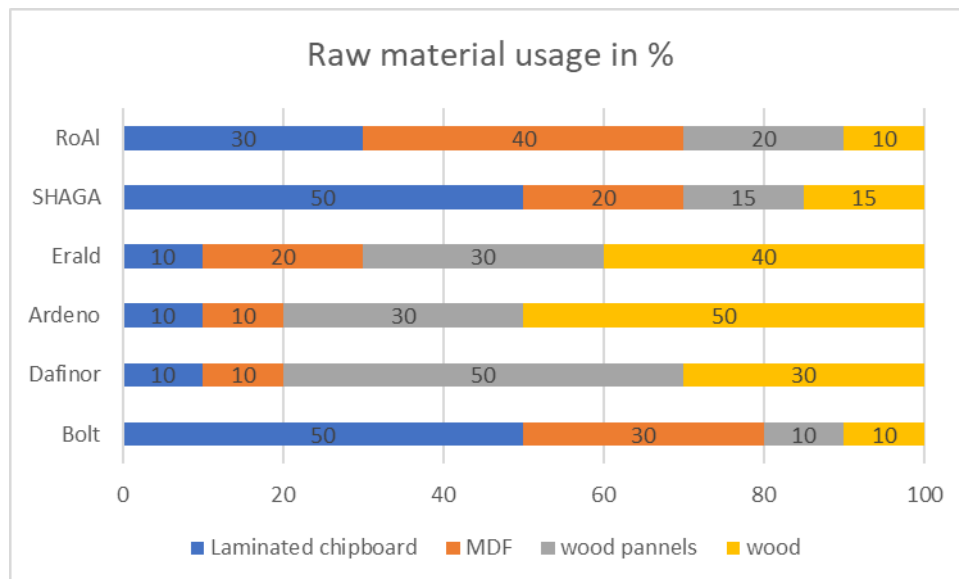


Figure 5. Raw material usage in %.

The question "Do you have a market study for the final products?" it may seem like a simple question to answer, but it gives us information about how a product is developed, what is the force that guides the development of a new product. combined with the question "How is a new product developed?", based on the answers we noticed that these companies operate mainly on the basis of individual customer orders and few companies operate on a contractual basis ([Figure 6](#)).

Do you have a market study for the final products?

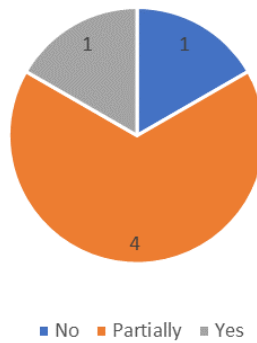


Figure 6. Answers for the question "Do you have a market study?".

As we see, a small part of the projects is developed by the technical offices of the companies. They mainly come from third parties related to production. this also brings a less pronounced focus on recycling and reuse. Companies that mainly develop their own products certainly have the potential for material reuse and recycling.

Another interesting question is the question "Do environmental issues affect the selection of suppliers?". From the answers received to this question, it can be seen that companies that work with wood as raw material show interest in the origin of the material. this comes more as a consequence of the need for long-term continuity of the activity (Figure 7-8).

How is a new product developed?

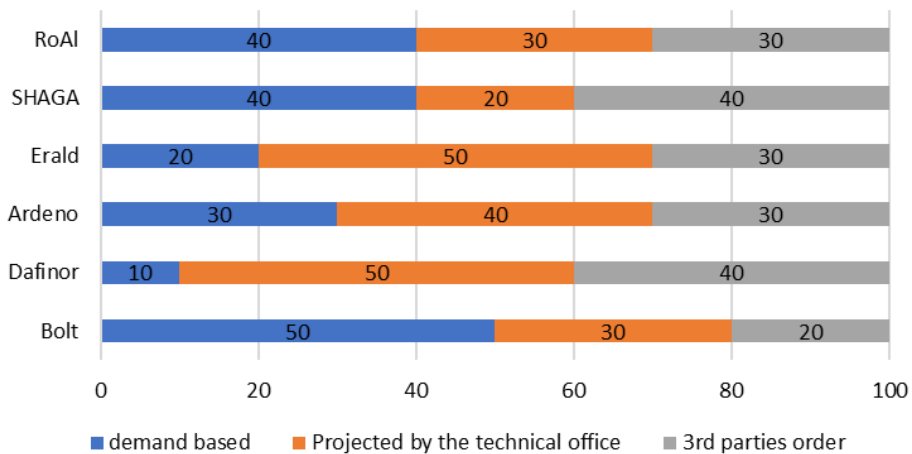


Figure 7. Answers for the question "How is a new product developed?".

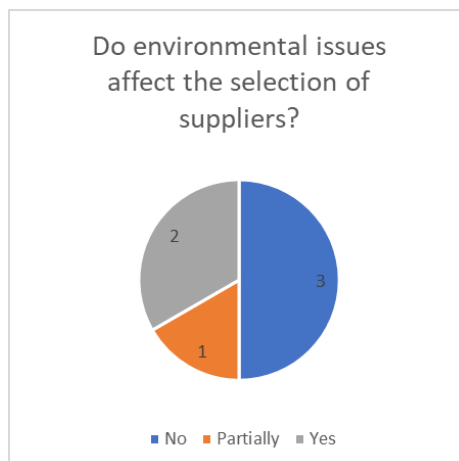


Figure 8. Answers for the question "Do environmental issues affect the selection of suppliers?".

The question "What affects the development of the new product?" was asked with the aim of seeing which aspects the company sees as the most important in relation to the development of a new product. From the answers it is noticed that companies in a general trend value the selling price of an object and the cost of the raw material the most. Further, the importance is given to the method of realization of the product, because in general the production departments are equipped with modern machines and the production of even complex objects is not challenging. Of course, less importance is given to the part of comfort and aesthetics, this also for the reason that some companies work on the basis of orders from different clients and comfort and aesthetics are at the choice of the client. This is also shown by the Table 4 of results of the Anova analysis for the factors that influence the development of a new product.

To the question "are you ready to export your product?" no company has responded negatively. All companies are ready to export the product, even partially. once again in these answers the sales orientation of our companies. to the question "are you ready to export your product?" no company has responded negatively. All companies are ready to export the product, even partially. Once again in these answers the sales orientation of our companies. but what prevents these companies from exporting their product to foreign countries? one of the obstacles is product certification. The companies interviewed for the realization of this study and the certification process do not have a common work practice in their daily work. certification in these cases is necessary when they have contractual relations with foreign companies that establish product certification as a condition for the development of cooperation (Figure 9).

Table 4. ANOVA Analysis summary report.

SUMMARY						
Groups	Count	Sum	Average	Variance		
Comfort	6	17	2.833333	0.566667		
Aesthetics	6	11	1.833333	0.966667		
Method of realization	6	19	3.166667	2.166667		
Cost of raw material	6	19	3.166667	4.166667		
Selling price	6	24	4	1.2		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	14.66667	4	3.666667	2.022059	0.122006	2.75871
Within Groups	45.33333	25	1.813333			
Total		60	29			

Are you ready to export your product?

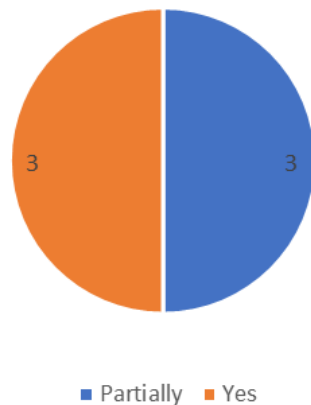


Figure 9. Answers to the question "Are you ready to export your products?".

The certification process is seen as a non-profit activity for these companies, especially for those whose work is based on customer requests. If we add here the fact that companies do not have a protected and exclusive product, the certification part becomes more difficult. to be mentioned and not to be forgotten is the fact that in Albania there is no testing laboratory for wood products. product certification is done in countries such as Italy, Germany, etc. This, of course, brings a cost to the company, something which, if seen in relation to the number of staff (especially technical staff), becomes even more difficult process (Table 5).

Table 5. Anova analysis summary report.

SUMMARY						
Groups	Count	Sum	Average	Variance		
lack of information	6	14	2.333333333	1.066666667		
lack of a testing laboratory	6	22	3.666666667	0.266666667		
Process cost	6	13	2.166666667	1.366666667		
Bureaucratic obstacles	6	11	1.833333333	0.966666667		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	11.66666667	3	3.888888889	4.242424242	0.017892	3.098391
Within Groups	18.33333333	20	0.916666667			
Total		30	23			

A question that shows a lot is the question "Do you use thermally treated or impregnated wood?". The answers to this question tell us about the value that is added to the material, with the aim of increasing its lifespan and physical-mechanical properties (Figure 10).

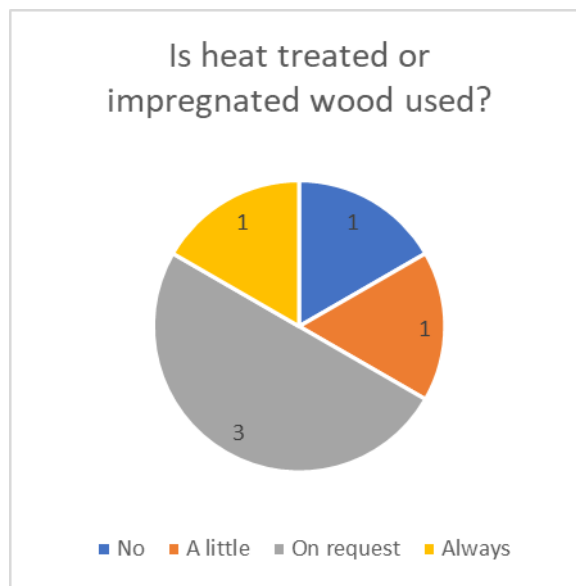


Figure 10. Answers to the question "Is heat treated or impregnated wood used?".

The next question is related to the guarantee that the companies give for the products they sell. As you can see, some companies do not offer any kind of guarantee, some companies offer partial guarantees, some offer full guarantees and some companies offer guarantees in any case and at any time. The fact that some companies offer a limited warranty, first in the context of the circular economy, is a fact that leaves something to be desired and shows a lack of responsibility and continuity in the relationship between the manufacturer-product-customer (Table 6).

Table 6. Answers to the question "Do you offer maintenance services for the objects sold by you?".

No	Within the warranty only for our product	Within the warranty for all the furniture	Always
2	1	3	0

The next question is the question "Are your products modular or demountable?". This is a question in logical continuation with previous questions, which affect the treatment of wood, product warranty and cases when we are dealing with modular or demountable furniture (Table 7).

Table 7. Answers to the question "Are your products modular or demountable?".

No	Partially	Yes
1	3	2

As you can see, most of the companies offer modular or demountable products. This means that in case of problems with the functioning of the furniture or its parts, it is not necessary to change the entire furniture, but only the problematic parts. The results of this question, combined with the question about the guarantee offered

by the company, shows once again the fact that companies are more inclined towards the sale of a product and not oriented towards repair or replacement of parts that present problems.

By asking the question "What do customers value in your company" we seek to identify a reason that affects the establishment of relations between the company and its customers. as can be seen in the answer table and in the Anova analysis table, the price level has a great influence, and furthermore the accuracy and correctness of the work (Table 8-9).

Table 8. Answers to the question "What do the customers value in our company" (5 most important, 1 less important).

Companies	Accuracy	Correctness	Readiness	Quality	Price
Bolt	4	5	2	3	1
Dafinor	3	4	1	5	2
Ardeno	5	4	2	3	1
Erald	2	3	1	4	5
SHAGA	3	2	1	4	5
RoAl	2	3	4	1	5

Table 9. Anova analysis summary report.

Summary						
Groups	Count	Sum	Average	Variance		
Accuracy	6	19	3.166667	1.366667		
Correctness	6	21	3.5	1.1		
Readiness	6	11	1.833333	1.366667		
Quality	6	20	3.333333	1.866667		
Price	6	19	3.166667	4.166667		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	10.66667	4	2.666667	1.351351	0.278946	2.75871
Within Groups	49.33333	25	1.973333			
Total	60	29				

To the question "do you use production waste for heating the environment?" only companies that mainly process wooden material have responded positively. even in these companies we use packages of production waste for heating the environment, since the environments themselves are large, with open doors, open windows and an aspiration system that works almost all the time (thus removing the heated air from the environment). the exception is the company Dafinor, which uses the production waste in the form of sawdust to produce pellets. in this line is also the answer to the following question "are you ready for investments in technology to go towards a green technology". all the contacted companies are certainly ready to make investments in the improvement of technology, to go towards Industry 4.0.

Factors that influence the inhibition of these investments, the interviewed companies see several risk factors, the fact of the lack of labor force, the lack of qualified labor force and the changes in the prices of the raw material (related to these in the international conjuncture) are the biggest, while other risk factors such as regional conflicts, exchange rate changes, resource price changes, energy price changes are seen as non-threatening and current trends companies appreciate the initiative to promote energy generation through solar panels.

4. Discussion

Based on the answers received from the interviewed companies, it turns out that the principles of the circular economy are not widely known. Company administrations have intimate knowledge about this concept. A better approach to material reuse is observed in companies that have a technical staff composed of people with studies in different backgrounds. this comes as a result of the cooperation between professionals engaged with different goals from each other. For example, we can say that a good combination is that between an engineer and an architect, the first with the aim of economizing work processes while the second is focused on innovative and challenging designs. From this study we can say that

- The principles of the circular economy in the Wood Industry in Albania are not sufficiently recognized and, as a result, no measures are taken to implement them.
- In cases where the raw material is reused, this comes as a customer request or as a need to save on the use of raw material by the company
- It is important to develop and maintain a register for the raw material used, to see the company's performance in relation to the reuse of materials. In this way, performance can also be tracked over time.

- The production of modular furniture brings an ease in the repair of objects, enabling only the damaged element, without the need to completely replace the furniture
- It is necessary to maintain a regular and updated technical documentation for the production of each piece of furniture, in such a way that at any moment we know their composition as well as the technical measures taken for the highest quality production.

5. Conclusion

The main conclusion of this study is that in our country there is a lot of work to be done regarding the recognition and implementation of the principles of the circular economy. In this direction, it is worth mentioning the fact that a better cooperation between different institutions is needed. Thus, we can say that a closer cooperation between the Faculty of Forestry Sciences, the WICA and its member companies would be a fruitful activity in this direction. Companies have low or non-existent access to support or research programs at the European level for issues related to the circular economy. This would be a point at which the cooperation between the companies, the Faculty and the WICA should be extended.

Schemes should be developed that encourage the repair and reuse of raw materials. A lot of efforts are needed to achieve a slight switch from the classical economy approach to a circular model one, and much more efforts and challenges are needed to be taken to become a full circular economy. The most difficult part is the fact that these changes and efforts are more of a psychological nature and require some time to be implemented and respected.

It should be emphasized that the transition to a circular economy also requires continuous staff training, which still presents some challenges for our companies.

Acknowledgement

This study was partly presented at the 8th Advanced Engineering Days [8].

During the realization of this work, we worked closely with Mrs. Julinda Kllapi, manager of WICA (Wood Industry Cluster of Albania), whom we thank for her willingness.

We also express our gratitude to PhD. Fatmir Basholli, who has carefully and patiently curated the formatting of the material according to the publishers' requests.

We cannot leave without mentioning and thanking the companies that were part of the study, which found the time and opportunity to respond positively to our request to be interviewed.

Funding

This research received no external funding.

Author contributions

Vejsiu Ina: Conceptualization, Methodology, Writing-Original draft preparation, realization of interviews

Kola Erald: Data curation, Data processing, Visualization, Writing-Reviewing and Editing.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. European Council. European Green Deal. (2023). <https://www.consilium.europa.eu/en/policies/green-deal/>
2. European Commission. Circular Economy Action Plan. (2023). https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
3. European Commission, Directorate-General for Research and Innovation (2018). Sustainable Bioeconomy for Europe - Strengthening the Connection between Economy, Society and the Environment-Updated Bioeconomy Strategy.
4. Iacovidou, E., Hahladakis, J. N., & Purnell, P. (2021). A systems thinking approach to understanding the challenges of achieving the circular economy. *Environmental Science and Pollution Research*, 28, 24785-24806. <https://doi.org/10.1007/s11356-020-11725-9>
5. European Parliament. Circular economy: definition, importance and benefits (2023). <https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits>
6. The National Integrated Waste Management Strategy (2018-2023).

7. Wood Industry Cluster of Albania. <https://woodcluster.al/en/how-we-started/>
8. Vejsiu, I., & Kola, E. (2023). Circular economy toward a sustainable concept in the wood processing sector in Albania. *Advanced Engineering Days (AED)*, 8, 112-113.



© Author(s) 2024. This work is distributed under <https://creativecommons.org/licenses/by-sa/4.0/>