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Leverage intellectual property to boost circular economy

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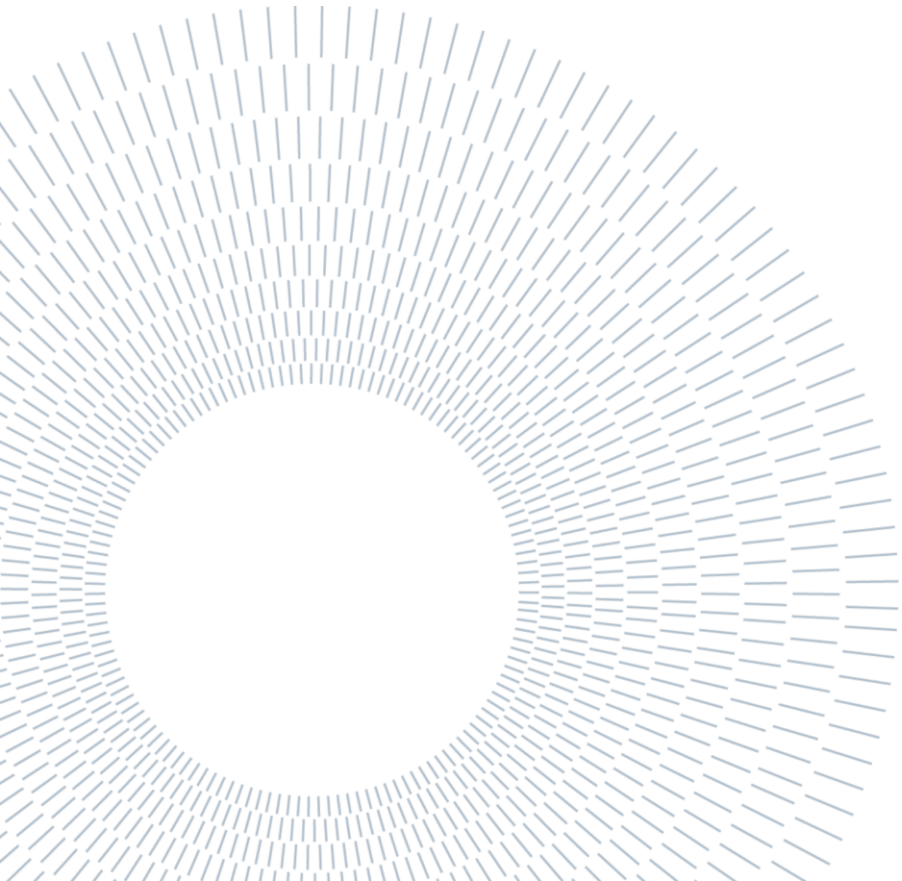

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Variable	Description	SI unit
CE	Circular Economy	-
IP	Intellectual Property	-
IPC	International Patent Classification	-
CPC	Cooperative Patent Classification	-
ESG	Environmental, Social, and Governance	-
CSR	Corporate Social Responsibility	-

Abstract

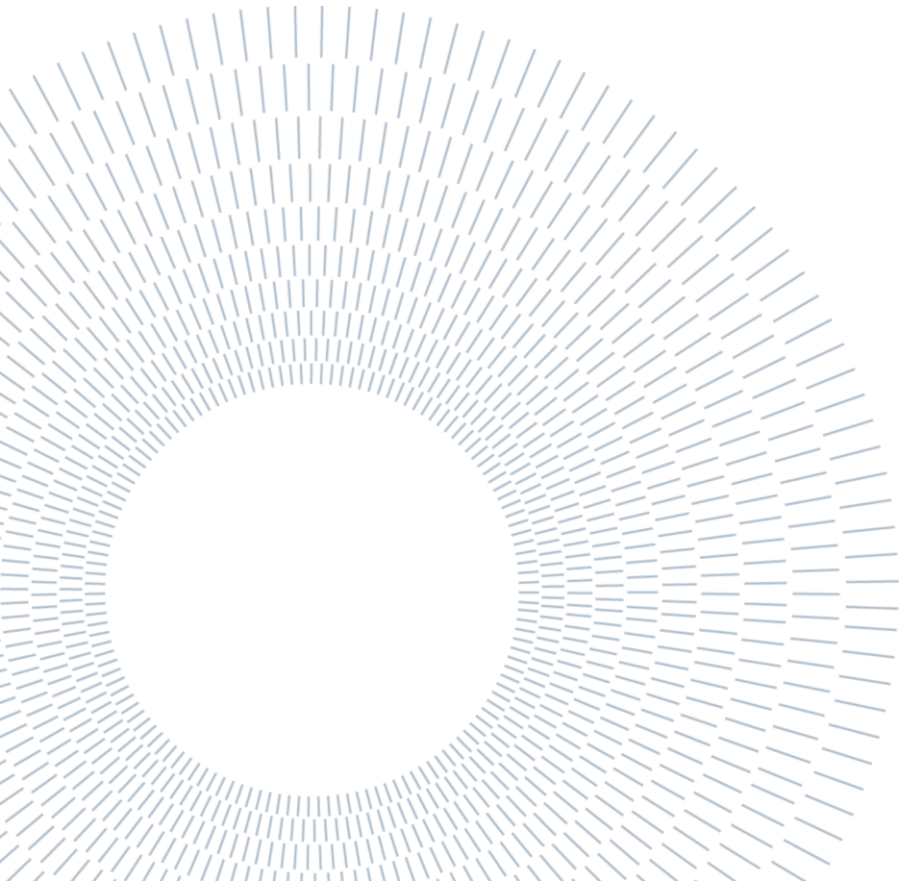
The intricate relationship between intellectual property, specifically patents, and the Circular Economy necessitates a delicate balance between protection and collaboration. This study examines the significance of patent search guidelines in the context of the Circular Economy, while identifying areas for improvement in terms of conciseness and user experience. By analyzing success stories within the industry and leveraging existing knowledge on patent searching, specialized guidelines were developed to enhance the utilization of intellectual property for promoting circular economy practices. Feedback from stakeholders in the industry was collected and analyzed, leading to conclusions and suggestions for future development. This investigation underscores the importance of transformative insights at the intersection of intellectual property and the Circular Economy, fostering sustainable development and innovation.

Key-words: Circular Economy; Intellectual Property; Sustainability; Patent searching;

Abstract in lingua italiana

La correlazione tra la proprietà intellettuale, in particolare i brevetti, e l'Economia Circolare richiede un equilibrio sfumato tra protezione e collaborazione. La ricerca mette in evidenza il ruolo cruciale delle linee guida per la ricerca di brevetti, sottolineando il loro valore per l'Economia Circolare e individuando al contempo aree di miglioramento in termini di concisione e user experience. Per il presente studio, sono state analizzate storie di successo nel settore dell'Economia Circolare. Sulla base di tali analisi e delle conoscenze comuni sulla ricerca di brevetti, sono state elaborate linee guida specializzate che aiutano a sfruttare la proprietà intellettuale per promuovere l'economia circolare. Successivamente, sono stati raccolti i feedback degli stakeholder del settore e, basandosi su tali feedback, sono state tratte conclusioni e suggerimenti per lo sviluppo futuro. Questa indagine sottolinea l'importanza di approfondire le conoscenze all'intersezione tra proprietà intellettuale ed Economia Circolare per promuovere lo sviluppo sostenibile e l'innovazione.

Parole chiave: Economia circolare; Proprietà intellettuale; Sostenibilità; Ricerca brevetti;



Introduction

The dominant industrial approach of today is identified as the Linear Economy. In this model, virgin materials are sourced, transformed into products, and eventually discarded without giving due consideration to environmental impacts or the indirect repercussions of production and disposal [1]–[3]. Chosen for its simplicity and cost-effectiveness, this traditional model has been favored for a long time. However, its alignment with emerging sustainable practices is now being increasingly questioned [4]. For the transition to a Circular Economy (CE), a fundamental change in product perspective is imperative. The Circular Economy champions a closed-loop system, placing emphasis on maintenance, reuse, remanufacturing, and recycling of products, thus avoiding the need for virgin materials [5]. Such a transformation not only reduces environmental harm but also aligns with emerging global values and regulations, promoting an accountable, forward-thinking approach to production and consumption [6]. However, the road to this transformation is marked by complexity, necessitating a reassessment of prevailing business models, encouraging sectoral collaboration, and demanding dedication to technological and logistical innovation [5].

A core objective of the CE is to decouple economic growth from the consumption of finite resources, aiming simultaneously to minimize waste. This transition, however, is met with several challenges:

- Consumer Convenience Expectations: There's a prevailing consumer preference for disposable, single-use plastic items and packaging. Altering these deeply entrenched behaviors and expectations poses significant challenges [7].
- Regulatory Obstacles: Existing laws and regulations can, at times, inadvertently promote wasteful behaviors among businesses and consumers [7].
- Limited Awareness and Understanding: Many individuals and enterprises might lack a comprehensive understanding of the circular economy concept, its benefits, and the necessary changes in attitudes and practices[8].
- Absence of Regional Enabling Conditions: Certain regions lack the conditions conducive for implementing the circular economy. A glaring example is the shortfall in waste management infrastructure, especially in developing nations, posing significant challenges in countering waste pollution [7].
- Financial Barriers: Shifting to circular economic practices often demands initial investments and model alterations. Such demands can be financially challenging, particularly for small and medium-sized enterprises (SMEs) [9].
- Complex Network Creation: Establishing networks amongst entrepreneurs is essential for knowledge exchange and effective communication. Such interconnections across various industry sectors become pivotal for enhancing circular economy practices (Fischer et al., 2020) [10].

- Supply Chain Complexities: Introduction of circular economy principles frequently necessitates an overhaul of supply chains. This includes establishing reverse logistics mechanisms and promoting stakeholder collaboration. Especially in sectors with intricate supply chains or dispersed markets, navigating these complexities can be daunting [11].
- Technological Limitations: Certain practices within the circular economy demand state-of-the-art technology for effective resource recovery or remanufacturing. The absence of affordable and efficient technologies can impede the comprehensive adoption of such circular methodologies [12].

To effectively tackle these challenges, the CE adopts a complex approach, integrating methods like recycling, remanufacturing, refurbishing, reusing, and repurposing [1]. These strategies not only promote resource efficiency but also underscore the importance of creating sustainable loops within production and consumption processes [13].

Remanufacturing and refurbishing, for instance, are processes designed to revitalize products, allowing them to enjoy an extended lifecycle while fulfilling their primary purpose. These methods encompass activities that seek to rejuvenate the product's functionality, appearance, and overall quality. Through the adoption of these practices, resource conservation, waste curtailment, and sustainable consumption are facilitated [14].

Concepts of repurposing and reusing are equally pivotal. Repurposing assigns a new function to products, whereas reusing involves their continuous application, possibly after retrieval or reprocessing. Repurposing is driven by multiple factors, such as creativity, need, and environmental concerns. To amplify a product's repurposing potential, qualities like functional adaptability and durability should be accentuated [15].

Furthermore, sustainable revalorization is introduced to capture these principles. It refers to the reinstatement of a product's value without needing its disassembly. This principle especially recognizes the worth of items once considered valueless. Revalorization injects new vitality into a product's lifecycle without demanding significant resources [14].

Intellectual Property

Intellectual property plays a multifaceted role in supporting the CE. Although IP rights can sometimes be perceived as potential barriers to achieving circularity, they also serve as crucial incentives for innovation and technological advancements that underpin the transition towards a more sustainable economy [16]. Firstly, IP encourages innovation by granting legal protection and exclusive rights to inventors and creators, fostering investment in research and development [17]. This leads to the creation of new technologies, processes, and business models that support the principles of the CE. Secondly, IP rights promote sustainable innovations by providing inventors and creators with exclusive rights for a specific period,

enabling them to commercialize their sustainable inventions and recover their investments [17]. This incentivizes the adoption of more sustainable practices and technologies. Thirdly, IP facilitates collaboration and licensing agreements between various stakeholders, promoting the sharing of knowledge, technologies, and best practices that are critical for implementing circular business models and scaling up circular solutions [18]. Moreover, IP protection ensures the preservation of brand value through trademarks and branding [19], enabling consumers to identify and choose sustainable products and services. This drives companies to invest in sustainable branding, contributing to the market uptake of circular products. IP rights also support circular business models, such as product-as-a-service or sharing economy platforms, by protecting their uniqueness and value, thus encouraging their implementation and growth [16]. Furthermore, IP plays a role in facilitating access to knowledge by encouraging inventors to disclose their inventions and share knowledge through patent applications and publications [17]. This dissemination of information allows others to build upon existing knowledge and develop further innovations in the Circular Economy. In summary, IP rights, when appropriately balanced, support the Circular Economy by incentivizing innovation, promoting collaboration, protecting brand value, enabling circular business models, and facilitating the sharing of knowledge and technologies [16].

PESTEL analysis

The PESTEL analysis was performed to provide a comprehensive overview of the external macro-environmental factors that could influence the intersection of IP and the circular economy. This systematic approach identifies potential challenges, opportunities, and implications for organizations and policymakers in leveraging IP for circular economic growth.

Factor	Implications (Circular Economy)	Implications (Leveraging Patents)
Political	Circular Economy is positively perceived in political circles. Implementation heavily depends on corporate leadership and market mechanisms. Top-down legislation promoting the Circular Economy is essential.	Governments may encourage patenting sustainable innovations. Political emphasis on sustainable growth can increase patent activity in green technologies.

Economic	The development of a robust network among upcycling entrepreneurs is vital. Identifying business opportunities and ensuring substantial investments for long-term growth is crucial.	The economic benefits of patenting include competitive advantage and potential revenue streams through licensing. Patents can serve as assets in negotiations or as collateral in financing.
Social	Ensuring product quality in the Circular Economy is paramount. Increased social engagement and raising awareness are critical for broader adoption.	Public perception of patents varies; however, there's growing interest in sustainable innovations. Educating stakeholders on patent importance in the Circular Economy can foster trust.
Technological	The Circular Economy often demands high technology and innovation. Patenting and technology development are crucial.	Advancements in technology increase the number of patentable innovations. Continuous R&D supported by patents can accelerate Circular Economy adoption.
Environmental	Anticipating future regulations, ensuring no virgin material depletion, and reducing environmental footprint are key.	Patents in green technologies can lead to rapid dissemination of best practices, helping address environmental challenges more effectively.

Legal	The current legal landscape may not support the Circular Economy comprehensively. Advocacy and dialogue are needed to evolve the legal frameworks.	Patent laws must adapt to accommodate the nuances of sustainable innovations. Effective patenting ensures protection and promotes Circular Economy-driven innovations.

Table 1: PESTEL analysis of Circular Economy and Leveraging Patents

The PESTEL analysis provides a detailed understanding of the macro-environmental factors impacting the relationship between IP and the CE. This analytical framework reveals the significant implications both for circular economic practices and the leveraging of patents.

From a political standpoint, there is favorable perception towards the Circular Economy, indicating potential support for patenting sustainable technologies. Economically, the emphasis is on fostering a robust entrepreneurial network in upcycling and recognizing the benefits patents offer in terms of competitive edge and revenue. Socially, while maintaining product quality and raising awareness is vital for the Circular Economy, understanding and promoting the significance of patents in sustainable innovations is essential to garner trust among stakeholders.

Technologically, the Circular Economy's success hinges on the rapid development and patenting of innovative solutions. This links closely with the environmental aspect, where the focus is on minimizing the use of virgin materials and reducing environmental impacts, with patents playing a role in quickly spreading effective green technologies.

Legally, the current framework might not be entirely conducive to the Circular Economy, suggesting the need for evolved legislation. In tandem, patent laws should be adapted to cater specifically to the intricacies of sustainable innovations.

In conclusion, the intersection of IP and the CE is a dynamic and multidimensional domain. Organizations and policymakers should be cognizant of these PESTEL insights to ensure that IP effectively facilitates the growth and adoption of the CE.

Objectives

The central aim of this thesis has been set to conduct a thorough exploration of the relationship between IP and the CE. In this investigation, the foundational principles of CE will be elucidated, emphasizing their significance in the modern global economic landscape. A critical evaluation of the current IP structures will be carried out, highlighting their strengths

and vulnerabilities in the context of the Circular Economy. Through the examination of various real-world applications, exemplary case studies that demonstrate the potential of harmonious alignment between IP and CE will be identified. Moreover, the challenges will not be overlooked; potential impediments that might obstruct the seamless integration of IP within a circular economic model will be analyzed. With these challenges in mind, strategies designed to leverage IP optimally, thereby maximizing both economic and environmental outcomes, will be proposed. In a rapidly changing world, this thesis is intended to act as a reference point, shedding light on the intersections between IP and CE for various stakeholders. Practical guidance and solutions will be offered, alongside best practices that can guide stakeholders in their endeavors. In conclusion, the overarching goal of this research is to contribute to a deeper understanding of how the harmonization of IP and the Circular Economy can be seen as a pivotal element in the global transition towards a more sustainable and circular economic model.

Additionally, the objective of this thesis is to provide a comprehensive analysis of the factors that influence the intersection of IP and the CE. This entails exploring the significance of a robust upcycling entrepreneurial network and understanding the economic advantages of patents within this context. The research seeks to evaluate the importance of product quality and the need for heightened social engagement and awareness for broader Circular Economy adoption. The role of technological advancements and their correlation with patents will be assessed, while also emphasizing the critical need to anticipate future environmental regulations and the role of patents in advancing green technologies. The thesis will support stakeholders with the patent searching process and forecasting the future trajectory of the CE in light of IP's evolving landscape.

1. State of the art

1.1 Patent Search

The patent search is a pivotal activity for inventors, researchers, and businesses. It serves multiple purposes, from determining the novelty of an invention and avoiding potential patent infringements to monitoring competitors' patenting activities. With the continuous rise in technological advancements and the escalating number of patent filings, effective methods and tools for patent searching have gained increased significance.

The understanding of the state of the art in a specific field stands as the primary goal of a patent search. Such searches play a significant role in various aspects. First, they assist in determining if an invention holds a novel standpoint. By doing so, inventors and researchers can validate their innovation's uniqueness and its potential patentability. Secondly, a patent search aids in avoiding potential patent infringement. This becomes particularly crucial for businesses that aim to launch a new product in the market, ensuring that they aren't unknowingly infringing on existing patents. Lastly, staying updated with competitors'

patenting activities provides a competitive edge. This knowledge allows businesses and researchers to anticipate market movements and adjust their strategies accordingly [20].

Different scenarios necessitate varied types of patent searches. The Novelty Search, often the first step for inventors, focuses on identifying whether an invention is indeed novel. This helps in establishing the foundation for filing a patent. The Infringement Search, on the other hand, is more about determining that a particular product or process doesn't violate another entity's patent. It acts as a protective measure. Additionally, the State of the Art Search provides an understanding of the current technological landscape in a specific field, shedding light on advancements, gaps, and potential areas of innovation [21].

The strategy chosen for a patent search can significantly influence the results. A Keyword-based search primarily involves using specific terms or phrases directly related to the invention. This is the most straightforward approach, yet requires careful selection of keywords to ensure comprehensiveness. Classification-based searches leverage international classifications, such as IPC or CPC, guiding searchers to patents categorized under specific technological areas. Meanwhile, the Citation-based search is a nuanced approach where one checks references and citations of a known relevant patent. It's especially useful when starting with a benchmark patent and wanting to explore its technological surroundings [22].

The domain of patent searching isn't static. With technological advancements, new methods are being incorporated into the process. Artificial Intelligence, for instance, has started making its mark on patent search tools. These tools, powered by machine learning and AI, are not only predicting relevant classifications but also delving deep into analyzing patent claims. Natural Language Processing (NLP) is another tech enhancement that's refining keyword-based searches by adding a layer of semantic understanding. Moreover, given the global nature of inventions, the challenge and necessity of cross-language patent searches have emerged. Modern tools aim to bridge language barriers, ensuring that patent searches are comprehensive across different linguistic landscapes [23].

The realm of patent searching is vast and continuously evolving. Regularly updating search strategies and leveraging the latest tools are pivotal to guarantee thorough and effective patent searches.

The guidelines for conducting patent searches are usually explained in a clear and simple manner. One commonly utilized technique is keyword searching, which involves identifying important terms that are relevant to the specific invention or idea being investigated. However, the guidelines may not provide detailed instructions on how to create effective keywords, which are essential for a successful search. Another widely employed method is the classification-based search, which relies on international categorizations like the International Patent Classification (IPC) or the Cooperative Patent Classification (CPC) to

organize and classify patents. These classifications provide a structured framework for patent searching [24].

The citation-based search approach offers significant advantages when delving deeper into patent research. Researchers begin with a relevant patent and then explore its citations and referenced material, often uncovering a multitude of associated patents. Modern patent databases not only serve as storage hubs but also function as platforms integrated with advanced analytical capabilities. These tools excel in mapping patent trends, creating comprehensive landscapes, and providing a wide range of data-centric insights [25].

An innovative technique is introduced that combines text-mining with patent network analysis. This integration brings about a more analytical and data-focused approach to patent searches. With the continuous advancements in technology, some patent databases offer semantic search capabilities, which enable a deeper and more contextually enriched understanding of patent content. This surpasses the limitations of traditional keyword-based searches. Another paper, while primarily focused on academic research, sheds light on these semantic search methods and emphasizes their growing significance in patent search efforts [26].

The field of patent search is continuously evolving, with advancements in technology, changing regulations, and the sheer volume of patents filed every year. While the tools and techniques have come a long way, there are still gaps and challenges in the domain. Some of the areas need further development and study:

- Natural Language Processing (NLP) and Semantic Search

While there are tools that have started integrating NLP for patent search, the unique language and terminologies used in patents present challenges. Understanding the context and semantics behind patent language is crucial. Existing tools may not fully grasp the nuances and complexities of patent language, leading to missed patents or false positives in search results.[27]

- Cross-Language and Multi-Jurisdictional Searches

As innovations become global, there's a pressing need for tools that can seamlessly search patents across languages and jurisdictions. Current tools often require manual translation or offer basic machine translations, which might miss out on nuances, leading to incomplete searches [28].

- Updating Classification Systems

Classification systems like IPC and CPC are vital for patent search. However, as technology evolves, these systems need regular updates. There can be delays in updating classifications, and some emerging technologies might not fit neatly into existing categories [29].

In summary, while there have been significant advancements in the domain of patent searching, the field is ripe for innovations, especially with the integration of modern technologies like AI and NLP. Continuous research and development in this domain will not only improve the efficiency of patent searches but also enhance the quality of results.

1.2 State of the art Circular Economy

The CE paradigm has risen as an influential model challenging the traditional linear 'take, make, and dispose' approach. Embracing CE means engaging in a systemic shift to close the loop of the production and consumption cycle. By focusing on reusing, repairing, refurbishing, and recycling existing materials and products, the goal is to create a more regenerative system, minimizing the reliance on finite resources [30].

There are several emerging trends that show great potential for boosting the circular economy [31]:

- Product-as-a-Service: This trend is transforming the traditional sales model. Companies retain ownership of the product, while consumers lease or rent, promoting longevity and proper end-of-life treatment of products.
- Extended Producer Responsibility (EPR): This places the onus on manufacturers to manage the product through its life cycle, including recycling and disposal, incentivizing eco-friendly product designs.
- Digital Platforms: Emerging platforms are facilitating shared use, re-sale, and repurposing of goods. These platforms not only reduce waste but also connect the value chain actors, driving efficiency and innovation.

In the context of the circular economy, there are distinct strengths and gaps to consider. Among the strengths, waste reduction stands out as a significant benefit. The principles of CE directly address and mitigate excessive waste, which in turn reduces the strain on landfills. Furthermore, there are economic opportunities associated with the circular economy. Companies that embrace CE principles often discover new avenues for revenue and penetrate new markets, which consequently results in job creation. From an environmental standpoint, the circular economy is a benefit as it actively reduces wastage and pollution, thereby contributing to the preservation of the environment. However, there are also gaps in the circular economy model. One concern revolves around scalability. While many CE practices prove effective on a smaller scale, they encounter obstacles when attempts are made to implement them on a larger scale. Another gap lies in the realm of technical limitations. Not every material is recyclable, which introduces technological hurdles to the CE model. Lastly, market structures present a challenge. Given that the predominant market models have followed a linear approach for many years, there's noticeable resistance when transitioning to a circular economy framework [32].

In terms of drivers promoting the adoption of the circular economy (CE), the growing intensity of environmental crises is heightening the urgency to embrace more sustainable models. Additionally, as worries mount over the rapid depletion of resources, the circular economy presents a viable solution to sustain production without tapping into new resources. Another driving force is the increasing consumer demand. With consumers becoming more informed and conscious, there's a growing push on companies to implement sustainable practices and be more transparent about their operations. However, several challenges hinder the seamless transition to CE. One major obstacle is the deep-rooted behavioral patterns of consumers. These long-standing habits are difficult to alter, making the adoption of CE principles more challenging. The regulatory landscape also poses problems. In certain regions, the existing regulatory frameworks might not be supportive of, or may even obstruct, CE initiatives. Another hurdle is of a financial nature. The shift to a circular economy often mandates initial financial outlays, leading to reluctance among many businesses considering the transition [33].

When looking at tools that can amplify the impact of the circular economy Life Cycle Assessment, often referred to as LCA, stands out. It's an all-encompassing evaluation method that quantifies the environmental impacts of a product or service during its entire lifespan, starting from the extraction of raw materials all the way to its eventual disposal. Another valuable tool is the Material Flow Analysis, or MFA. It examines the trajectory and application of materials within an economy, putting light on inefficiencies and highlighting potential areas for refinement. Additionally, there's Eco-design, a process that incorporates environmental considerations right at the product's design stage, ensuring that items are primed for a longer life, efficient reuse, and effective recycling [34].

Academic and industrial literature extensively discusses the transformative potential of CE. While the promise of a balanced interplay between economic growth and environmental sustainability is acknowledged, emphasis is also laid on the significant shifts required at systemic, organizational, and individual levels [35].

The move towards a Circular Economy signifies a profound shift in how societies produce, consume, and conceive value. While the journey is challenging, the numerous benefits to the environment, economy, and society make it a compelling path forward.

1.3 Intersection between Intellectual Property and Circular Economy

The dynamic between intellectual property, particularly patents, and the circular economy is complex. The former seeks exclusive rights to promote innovation, while the latter strives for openness to enable sharing, reuse, and recycling. This duality leads to both challenges and opportunities for sustainability and innovation.

Patents play a pivotal role in fostering innovation within the circular economy (CE) landscape. Innovators developing sustainable technologies, recycling methods, or eco-designs often seek patent protection to safeguard their inventions and gain a competitive edge.[36]

While patents can incentivize innovation in CE, they can also impede the free flow of knowledge essential for widespread CE practices. The exclusivity provided by patents may hinder collaborative efforts and limit the sharing of sustainable technologies.[37]

Contrary to being barriers, some argue that patents can facilitate collaboration in CE. Licensing agreements and patent pools can lead to the sharing of sustainable technologies, promoting both innovation and circular principles [38].

Companies in the CE domain adopt various patent strategies. While some prefer open-source models to foster collaboration, others employ strategic patenting to block competitors or generate revenue through licensing [39].

The need for a balance between protecting intellectual property and promoting sustainability presents challenges. Policy gaps, potential patent infringements in recycling processes, and debates on the extent of patent protection are all concerns at this intersection [40]

To harmonize the goals of CE and patent protection, there's a call for reimagining patent frameworks. Flexible licensing, reduced patent durations for green technologies, or incentivizing open-source models are some proposed solutions [41].

The relationship between patents and the circular economy is multifaceted, with both supporting and conflicting elements. Bridging the divide requires understanding the nuances of each domain and crafting policies that promote both sustainable innovation and the broader goals of the circular economy.

Now, the relationship between the circular economy and intellectual property seems vague. While there are some studies, they mostly focus on the views and actions of intellectual property creators. These papers often discuss how these creators can promote sustainability and ensure they aren't hindering its growth [42], [43]. Yet, a gap exists in studies that delve into how the circular economy and intellectual property intersect, especially when considering how to enhance the circular economy by leveraging information extracted from patents. This presents an opportunity for a novel approach to be developed, which could have promising potential. Investigating the relationship between the circular economy and intellectual property through the lens of patents could provide valuable insights.

2. Methodological approach

A mixed-methods approach was adopted for this thesis to gain a thorough understanding of how Intellectual Property could contribute to the advancement of Circular Economy practices. Both qualitative and quantitative techniques were blended in the methodology.

Qualitative and quantitative methodologies are two distinct research approaches used in scientific studies. Qualitative methodology involves collecting non-numerical data to gain an

in-depth understanding of a phenomenon. It focuses on subjective experiences, perspectives, and meanings. This approach typically involves methods such as interviews, observations, and analysis of textual or visual data [44].

Quantitative methodology involves collecting numerical data to analyse and quantify relationships, patterns, and trends. It focuses on objective measurements and statistical analysis. This approach typically involves methods such as surveys, experiments, and statistical data analysis [45].

Qualitative and quantitative methodologies were used in the development of guidelines for several reasons [46]–[48]:

- Comprehensive Understanding: Qualitative research provides an in-depth understanding of the phenomenon under study. It allows for the exploration of nuances, contexts, and complexities that are often missed by quantitative methods. This can be particularly useful in guideline development where understanding the context and experiences of those affected by the guidelines is crucial.
- Objective Analysis: Quantitative research, on the other hand, allows for objective measurement and analysis of data. It provides a way to quantify relationships, patterns, and trends, which can be essential in assessing the effectiveness of guidelines and making necessary adjustments.
- Triangulation: Using both qualitative and quantitative methods allows for triangulation, which can increase the validity of the research findings. Triangulation refers to the use of multiple methods or data sources in research to develop a comprehensive understanding of phenomena. In the context of guideline development, this could mean using qualitative methods to explore how the guidelines are implemented and experienced on the ground, and quantitative methods to measure the outcomes or impacts of the guidelines.
- Flexibility: Both methodologies offer flexibility in terms of data collection and analysis. Qualitative research can be adapted as new themes or issues emerge from the data, while quantitative research can handle large amounts of data and allow for comparisons across different groups or time periods.

In conclusion, both qualitative and quantitative methodologies have their strengths and can complement each other in providing a more holistic understanding of the phenomenon under study. Therefore, they should both be considered in the development of guidelines.

2.1 Development of the guidelines

The development of the guidelines offers a comprehensive overview of the formulation process and rationale behind their creation, emphasizing their crucial role in driving the Circular Economy through Intellectual Property. This development is supported by an

exploration of non-patent literature, which contributes to the overall structure and adaptation of the guidelines.

2.1.1 Identifying the need for guidelines

In the context of the guidelines for advancing Circular Economy practices through the use of Intellectual Property, the need would be to provide a framework for using Intellectual Property to support the Circular Economy. The owner of this need would be organizational, regulatory, and community stakeholder groups who are interested in promoting the Circular Economy and using Intellectual Property as a tool to do so. The guidelines are designed to assist stakeholders involved in production, as they bear significant responsibility and have a substantial impact on global industrial growth and the climate crisis [49], [50]. The user utilizing these guidelines is a member of a stakeholder group entrusted with the task of promoting sustainable development within its operations.

2.1.2. Stakeholders' concerns

The content should be directly related to the issues or concerns raised by stakeholders and provide solutions or guidance pertinent to their needs [51].

Stakeholders have raised several issues and concerns in relation to the circular economy. One of the main concerns is the need for collaboration between diverse stakeholders to achieve a circular economy. This often happens in socio-technical ecosystem settings, where complementary stakeholders can pursue the system-level goal of improving circularity [52].

Another concern is the influence of organizational, regulatory, and community stakeholder groups on the adoption of circular economy principles and how these affect internal and external stakeholder satisfaction and green legitimacy. Research has shown that regulatory stakeholders have the most influence on the adoption of circular economy principles, followed by organizational and community stakeholders. Adoption of circular economy principles robustly influenced external stakeholder satisfaction and green legitimacy while moderately influencing internal stakeholder satisfaction [53].

2.1.3 Exploring Non-Patent Literature for guidelines research

To begin with, an extensive non-patent literature review and analysis of case studies were conducted to identify successful examples of Circular Economy implementation in industrial contexts. The aim was to uncover critical factors that have contributed to the integration and operation of Circular Economy principles in specific industrial scenarios.

The shift from traditional linear production models to sustainable practices, particularly the circular economy, is becoming increasingly evident in the wake of global environmental challenges. The circular economy, which emphasizes resource efficiency and waste reduction, offers both environmental and economic advantages. However, its application varies across different industrial sectors. The aim is to clarify these variations by critically examining

successful implementations of the circular economy in diverse industrial contexts. Through the examination of non-patent literature, a comprehensive understanding of the key factors that contribute to the success of the circular economy in various industries is provided [54].

Non-patent literature, such as scientific articles, company sustainability reports, and information available on company websites, offers a rich and diverse resource for exploring the circular economy. Scientific articles provide up-to-date and authoritative knowledge, while sustainability reports highlight a company's eco-friendly efforts, including their work in the circular economy. Additionally, checking the websites of companies involved in the circular economy can offer valuable insights into their strategies and achievements. These non-patent literature sources serve as valuable repositories of information, providing researchers with a wealth of data to support their exploration and understanding of the circular economy.

To conduct comprehensive research on successful implementations of Circular Economy practices, a table of Organizations (Appendix A) was created, consisting of 60 diverse examples. These organizations have successfully integrated the principles of Circular Economy into their core operations. The purpose of this table is to provide a foundation for analysing the strategies employed by these organizations, which have contributed to their successful implementation of Circular Economy practices. By studying these organizations, valuable insights can be gained, helping to identify key factors and approaches that enable the effective adoption of Circular Economy principles. Through this analysis, it was possible to deepen the understanding of the strategies that have proven to be successful in implementing Circular Economy practices across various sectors and industries. Significant aspects were considered while reviewing success stories of organizations to ensure a comprehensive analysis of their operations, facilitate comparative studies, focus on key factors influencing success, identify benefits and opportunities, understand limitations, and provide practical insights. By categorizing the organizations based on various aspects the research aimed to gain a deeper understanding of their specialization, analyse commonalities and trends, highlight critical success factors, showcase the positive impact and advantages of circular economy practices, and address potential challenges. This approach enhances the overall comprehensiveness, comparability, and practical applicability of the research findings.

The table of Organizations construction appears to follow a structured format where each aspect of the organization is categorized under a specific title. Here are the titles and a brief understanding of what they represent:

- Enterprise: Refers to the name of the company or initiative.
- Activity: Describes the primary area of business or operation.
- Description: Provides a more detailed account of business activities and areas of specialization.

- Area: Might refer to the business domain or the segment of the circular economy in which the enterprise operates.
- Object: Indicates the focus or key output of the business.
- Stage of Life Cycle: Refers to the product's stage in its life cycle.
- Business Model: Identifies the main business and customer relationships.
- Factors: Represent the crucial elements that influence the operation or success of the business.
- Benefits and Opportunities: Outlines the potential advantages or opportunities provided by the enterprise.
- Focus Areas/Sector of Industry: Refers to the primary industries or sectors the business interacts with.
- Country and Continent: Provides geographical information about the enterprise's location.
- Implementation: Describes how the business model or services are applied.
- Extent of Circularity: Describes the enterprise's contribution to the circular economy.
- Limitations: Highlights potential challenges or limitations faced by the enterprise.

In terms of the research process, it involved a combination of the following elements:

- Publicly Available Information: Gathering and analyzing data from the company's website, press releases, and other public documents.
- Market Reports & Industry Analysis: Utilizing existing reports and analyses about the circular economy and related industries for contextual understanding and data.
- Regulatory Filings: Reviewing filings with business registries or patent offices, if applicable, to gather additional information.

To track organizations focused on the Circular Economy and gather comprehensive information about them, the research begins with publicly available information and expands to other sources if company websites are insufficient. Publicly available articles, which often feature lists of innovative companies and organizations driving circular economy development, provide a starting point. The official websites of companies are consulted, with a focus on sections like 'About Us', 'Investor Relations', and 'Sustainability Reports'. Search engines and platforms like PR Newswire and Google News aid in finding company-related press releases. Databases such as Statista and IBISWorld offer insights into circular economy trends and related industries. Diving deeper into company operations and intellectual property is facilitated by databases like the SEC's EDGAR or the Espacenet.

Searches initially employ broad terms related to the circular economy and the company's name, with refinements made based on the obtained results. The accuracy of information is ensured through cross-referencing from various sources.

2.1.3.1 Selection of success stories

The selection of organizations or initiatives represented in the 'Organizations CE' table was based on several specific criteria:

- Innovation and Pioneering Concepts: These are organizations that have introduced innovative ideas or methodologies that stand out in the market. They are pioneers, often breaking new ground in their industries.
- Commitment to circular economy principles: These organizations actively integrate the principles of the circular economy into their business models. The organizations listed have demonstrated a commitment to implementing circular economy principles in their operations.
- Adoption of unconventional trends: The organizations listed are those that follow Circular Economy trends that are not widely accepted in the wider market. In this way, they serve as examples of organizations pushing boundaries and defying traditional norms in pursuit of more sustainable and circular practices.
- Impact and scalability: Initiatives have a significant positive impact on environmental sustainability and can be scaled to further increase their positive impact.

After reviewing the general information, if an organization meets any of the criteria, a deeper analysis is conducted. If, at the end of the analysis, all the criteria are generally fulfilled, the organization is included in the list of success stories.

Organizations that primarily rely on traditional methods without demonstrating active commitment to circular economy principles are excluded. Additionally, those only adopting mainstream market trends and exhibiting minimal environmental impact without scalability potential are not considered.

2.1.3.2 Limitations and obstacles encountered

During the process of searching for success stories, there were several limitations and obstacles that were encountered. These challenges can be attributed to the following factors:

1. Regional differences: The level of circular economy adoption and maturity can vary across regions and countries. This can make it challenging to find a diverse range of successful organizations from different geographical areas.
- Language Barriers: Often, the primary language for these companies is not English, making it challenging for non-native speakers to find and interpret the available information.
- Cultural differences: There may also be cultural differences in the way these companies operate and disclose information. In some cases, companies may favor local audiences or specific types of disclosure over comprehensive, globally available data.

- Internet Access and Digitization: Some regions may not yet have fully adopted online platforms for sharing corporate data, or the platforms they use are not widely used or available in the West.
- Corporate Transparency and Governance Issues: In some cases, the lack of data may also be related to wider issues of corporate governance and transparency.
- Differences in disclosure norms and standards: Countries in the Asia may have different rules and regulations regarding the disclosure of corporate information, including sustainability practices. These rules may be less stringent than in Western countries, leading to less information being publicly available.
- Lack of Infrastructure: In some regions of Africa, there is a lack of necessary infrastructure, such as widespread, reliable internet access, that can make it difficult to share and access information.
- Lack of Awareness and Support: There may be a lack of awareness about the importance of sustainability, both within the business community and among consumers, which can make it harder to find companies that prioritize and document their sustainability efforts. Additionally, support from governments or non-profit organizations to promote sustainability reporting may also be lacking.
- Market Development: Market is still in the process of developing, and sustainability practices may not be as widespread or as well-documented as in more developed markets.

2. Time lag in reporting. Sustainability reports or other relevant documentation may have a time lag, meaning that the latest information may not be immediately available. This can impact the accuracy and currency of the analysis.
3. Lack of standardized metrics: One of the challenges is the absence of standardized metrics or criteria for measuring circular economy performance. This makes it difficult to compare and evaluate organizations consistently.
4. Varying definitions and interpretations: Circular economy can have different interpretations and definitions, leading to inconsistencies in identifying organizations that align with circular economy principles. This can create difficulties in selecting and categorizing organizations accurately.

2.1.3.3 Non-patent literature analysis

To facilitate the presentation of successful stories in the research, a categorization framework based on different activities within the circular economy was introduced. The categories include Sustainable Revalorization, Recycling, Management, and Sustainable Production. This classification system allowed for a more convenient and systematic analysis of the non-patent literature. By organizing the research findings into these distinct categories, it became easier to identify and examine the specific practices, strategies, and approaches utilized in each area. This framework provides a structured and comprehensive overview of the diverse ways in which organizations are implementing circular economy principles across

various activities. It enhances the understanding of the different aspects of circular economy adoption and allows for meaningful comparisons and insights to be drawn from the analyzed non-patent literature sources.

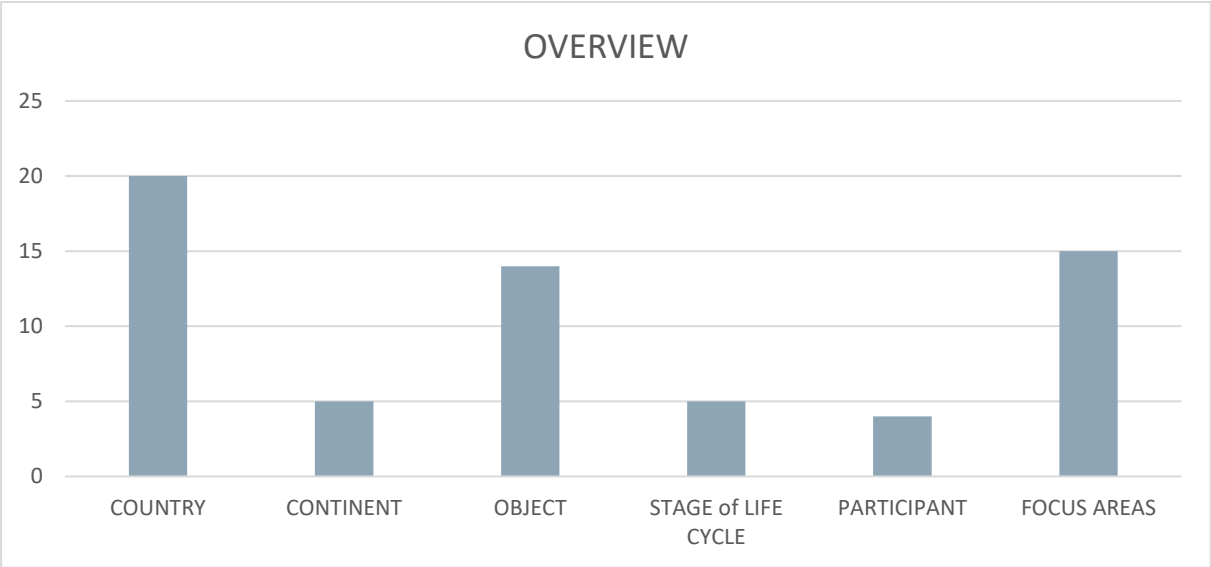


Figure 1: Organizations overview

The Figure *1*: Organizations overview provides a broad overview of the information gathered. Success stories have been sourced from 20 distinct countries spanning five continents: Europe, Australia, North America, Asia, and Africa. The life cycle stages are categorized into End of Life, Full Life Cycle, Transportation, Production, and Packaging. The nature of interactions or 'business model' is divided into four distinct business and customer relationships: Business to Business (B2B), Business to Customer (B2C), Customer to Business (C2B), and Customer to Customer (C2C). There are two primary methods of implementation: 'Third-party services,' where the organization offers support to stakeholders, and 'Enterprise,' where the organization produces its own product. Regarding Objects and associated Focus areas, 14 independent Objects and 15 separate Focus areas are identified.

To effectively present the content of the Organization table and enhance the understanding of the data, a set of charts was created for each category. These charts provide visual representations and graphical summaries of the information, making it easier to grasp the key insights and trends within each category. These charts offer a brief and accessible way to navigate through the extensive content of the Organization table, facilitating a more comprehensive understanding of the organizations and their involvement in the circular economy.

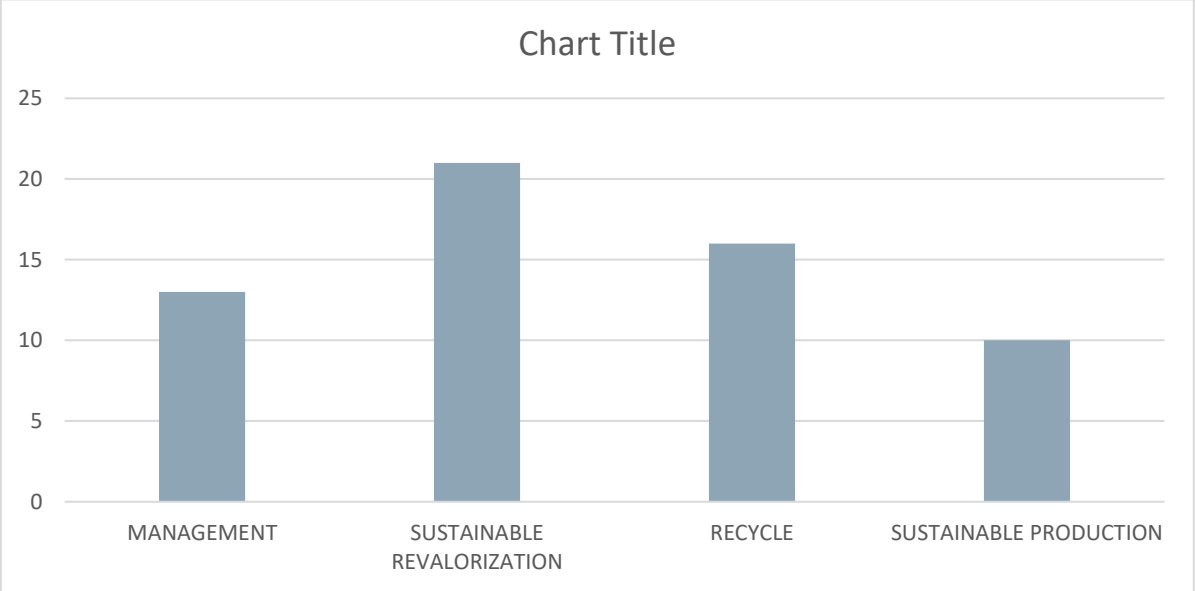


Figure 2: Overall set of success stories

In the Figure 2: Overall set of success stories the number of success stories is presented for each area.

2.1.3.3.1 Management

This area concentrates on equipping other enterprises with essential resources, guidance, and industry knowledge. The primary objective is to assist these companies in harnessing the principles of the Circular Economy, thereby promoting sustainability, reducing waste, and optimizing the use of resources in their business operations.

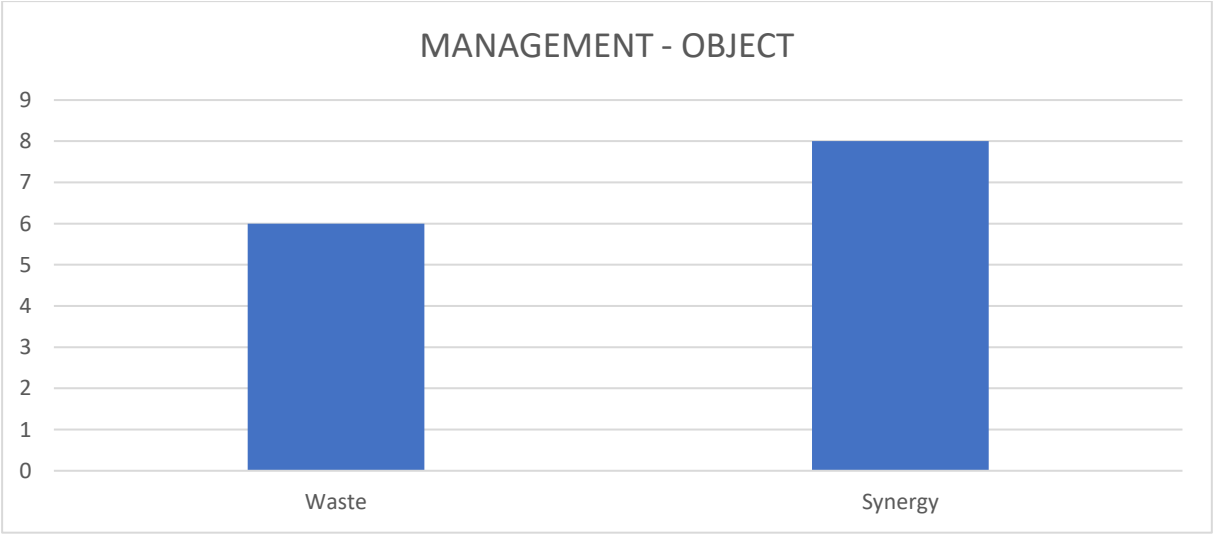


Figure 3: Management - Object

The predominating element in this context is a synergy. Synergy represents the increased effectiveness that results when two or more entities work together compared to when they operate independently. In a business context, it implies that the combined output of a collaboration is greater than the sum of their individual contributions. Management actions play a crucial role in fostering synergy by facilitating meaningful interactions among various stakeholders, establishing beneficial connections with other businesses. By identifying and leveraging these partnerships and alliances, management can significantly enhance collaborative efforts. This interconnectedness can unlock new potentials, cultivate shared learning, and uncover innovative solutions, all contributing to the acceleration of the Circular Economy. Through such collaborative endeavours, companies can not only boost their own sustainable practices but also drive the entire industry towards more sustainable resource use and waste reduction. Following synergy, waste is the next significant element, embodying the culmination of products that have reached the end of their lifecycle and thus require proper management. The third element is a plastic as a particular category of waste, that is a focus of a certain enterprise.

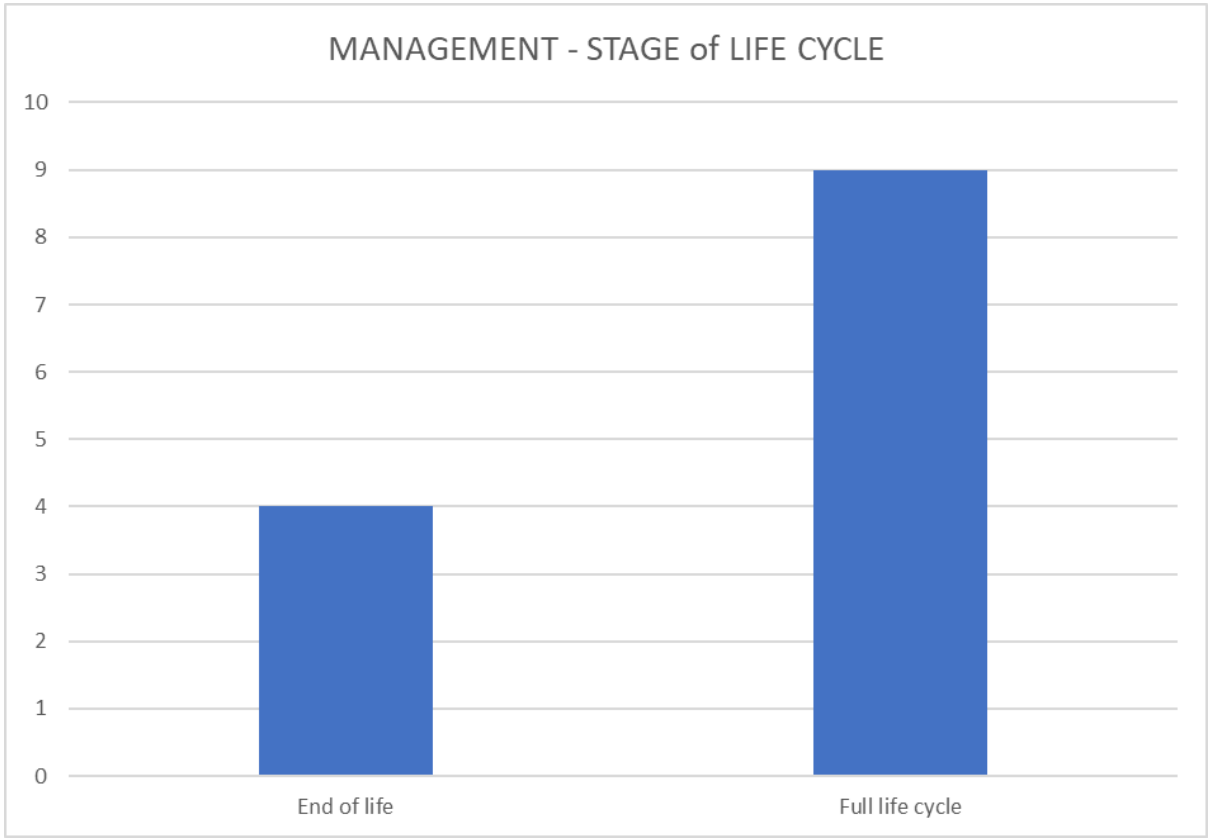


Figure 4: Management – Stage of life cycle

In the context of Circular Economy management, it's essential to encompass all stages of a product's life cycle. This approach ensures a holistic understanding and treatment of the product journey—from the initial design and manufacturing stages, through usage, to the eventual end of life. This comprehensive oversight facilitates the development of strategies and activities to minimize waste, maximize resource efficiency, and support sustainable practices at every step. By considering the full product life cycle, management can effectively promote a circular economy, where materials are kept in use for as long as possible, the generation of waste is minimized, and the value of products and materials is maintained. By prioritizing the end-of-life stage, organizations can better promote the principles of the circular economy. Taking a holistic approach, CE management facilitates the continuous reuse of materials, reduces waste generation, and preserves the inherent value of products and materials.

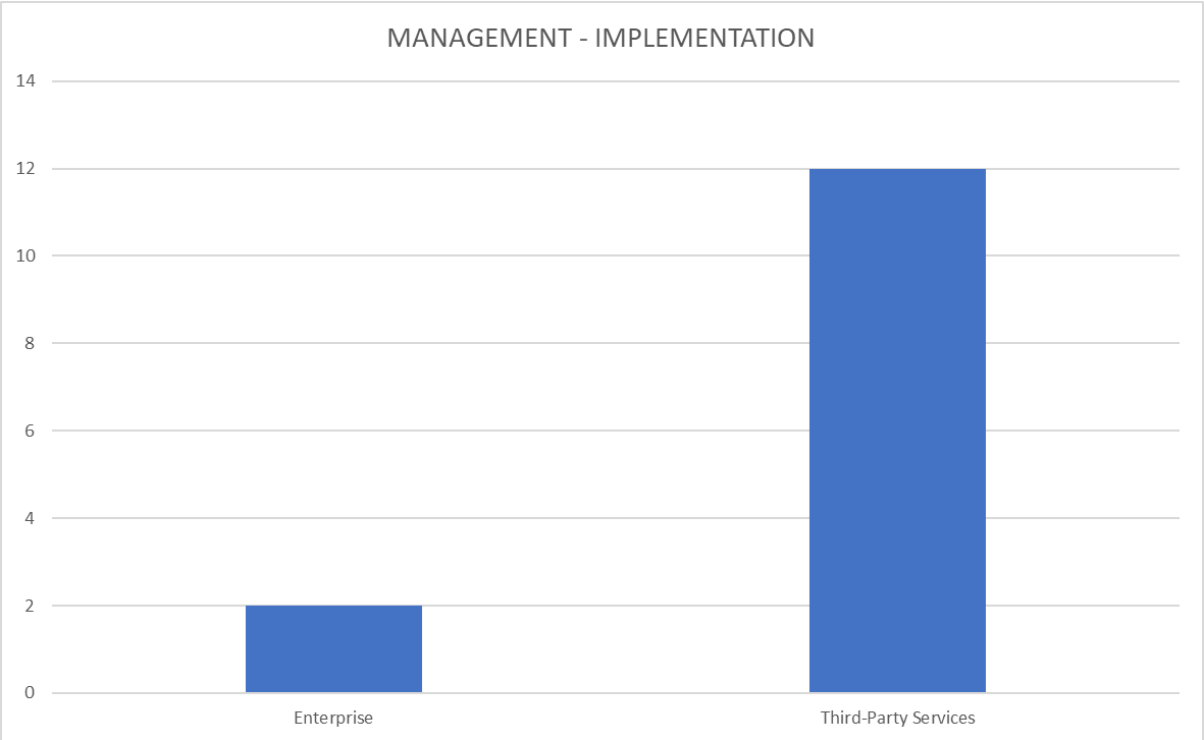


Figure 5: Management - Implementation

In the practical application of Circular Economy principles, third-party service providers play a pivotal role. They function as strategic management centers, providing vital support, resources, and expertise. Enterprises, which emerge in this space, are typically organizations dedicated to fostering the adoption and growth of the Circular Economy within local communities. They assist businesses in navigating the transition to more sustainable practices by providing guidance on waste management, resource optimization, and the integration of circular principles into product design and business models. Furthermore, they often work in

collaboration with a broad network of stakeholders, including local government bodies, educational institutions, and other businesses, to create an ecosystem that supports and promotes circularity. In doing so, they help to spread awareness, foster collaboration, and drive innovation, catalyzing a shift towards a more sustainable and resilient economy at the community level.

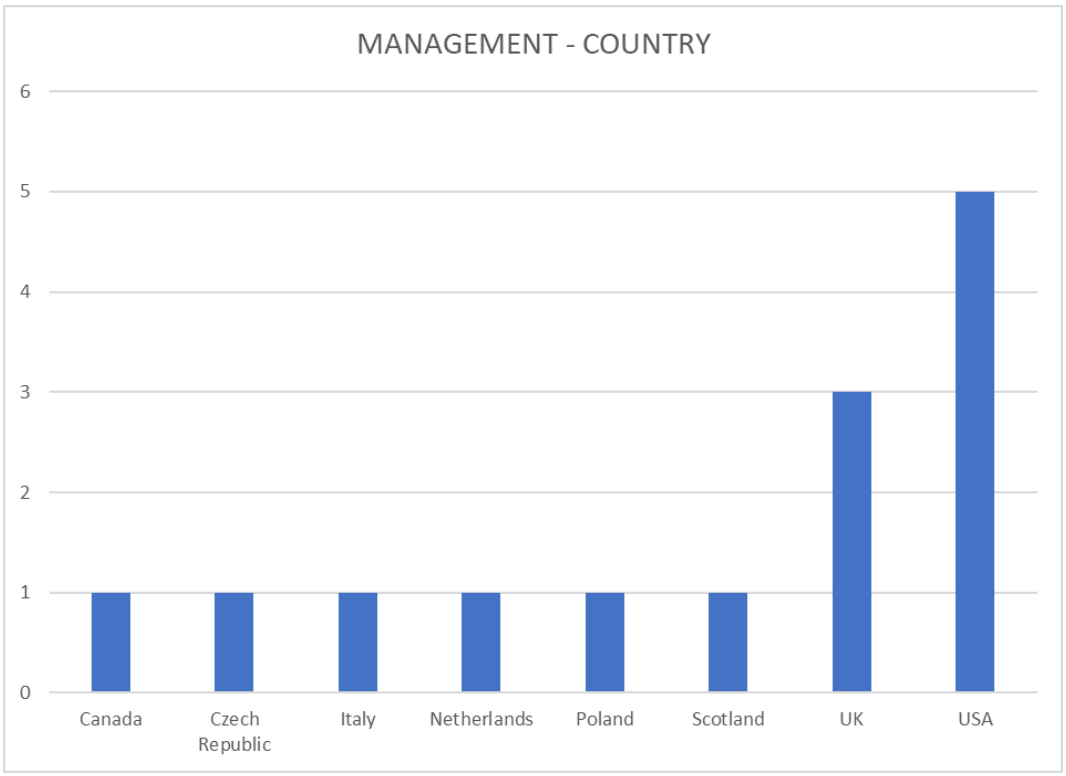


Figure 6: Management - Country

Figure 7: Management - Continent

Upon examining the global distribution of companies devoted to circular economy initiatives, it becomes apparent that a significant concentration of these activities is found in Europe and North America. These regions, characterized by advanced economies, strong institutional frameworks, and heightened environmental consciousness, provide conducive environments for the flourishing of such initiatives. The establishment of companies focused entirely on promoting the Circular Economy often requires the backdrop of a well-developed country. In these settings, the necessary resources, infrastructure, and societal awareness about sustainability are typically more common. Such external companies serve a crucial role by lending their expertise, resources, and support to other firms aiming to transition towards more sustainable business models. Furthermore, these specialized entities contribute to the growth of the circular economy by fostering collaborations, providing education and training. Their presence and activities not only stimulate circular practices within individual organizations but also contribute to the broader shift towards sustainability within their regions, effectively influencing economic development, environmental protection, and social equity.

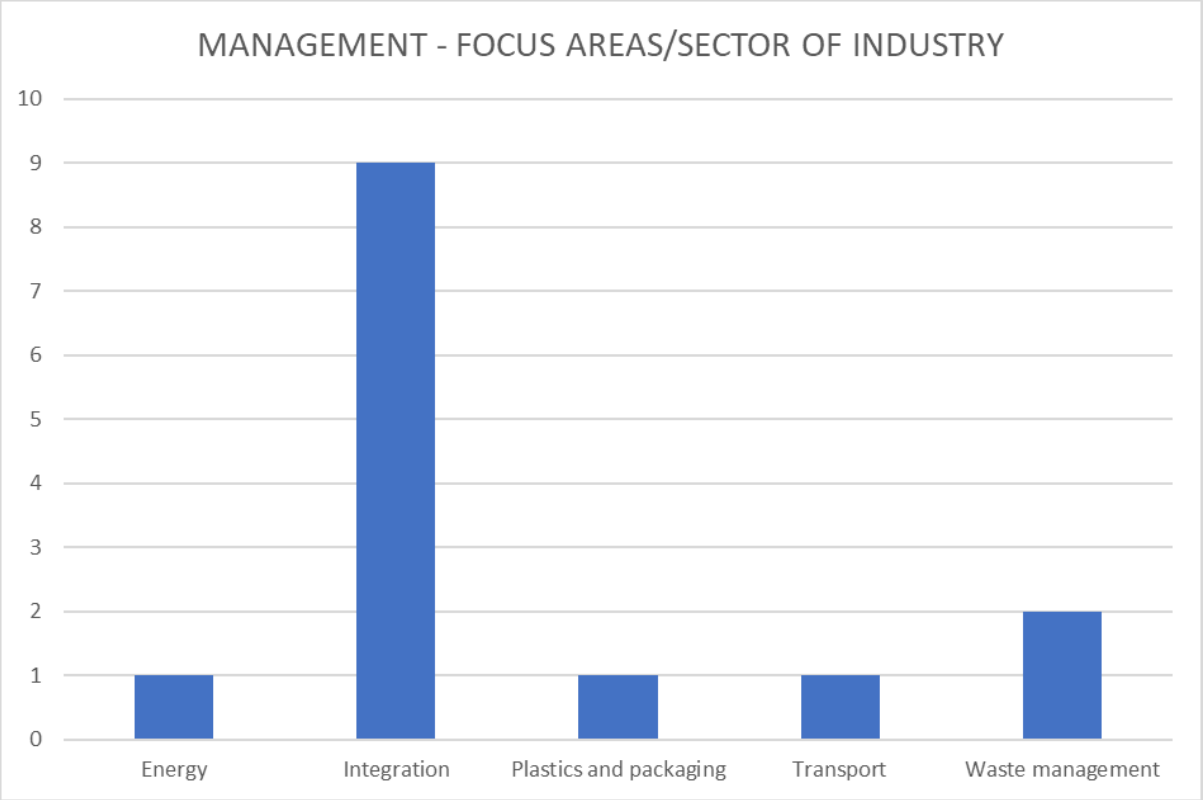


Figure 8: Management - Focus area

A substantial portion of these management companies primarily concentrates on assimilating their processes within the organizations they support. Their role involves understanding the company's operations, identifying areas for improvement, and integrating circular principles into existing processes. However, some of these management firms adopt a more specialized approach. They improve distinct areas of expertise or sectors, extending their services to specific companies that align with their focus. These companies could be involved in particular industries, be of a certain size, or operate within designated geographical areas. Moreover, some management firms extend their scope beyond corporations to engage directly with individual consumers or particular societal groups. They could offer services such as education and awareness campaigns, consultancy for green living or sustainable business practices, and platforms for consumer participation in the circular economy. By doing so, these firms can help persuade change at different levels of society, driving both corporate and consumer behaviors towards a more sustainable, circular economy.

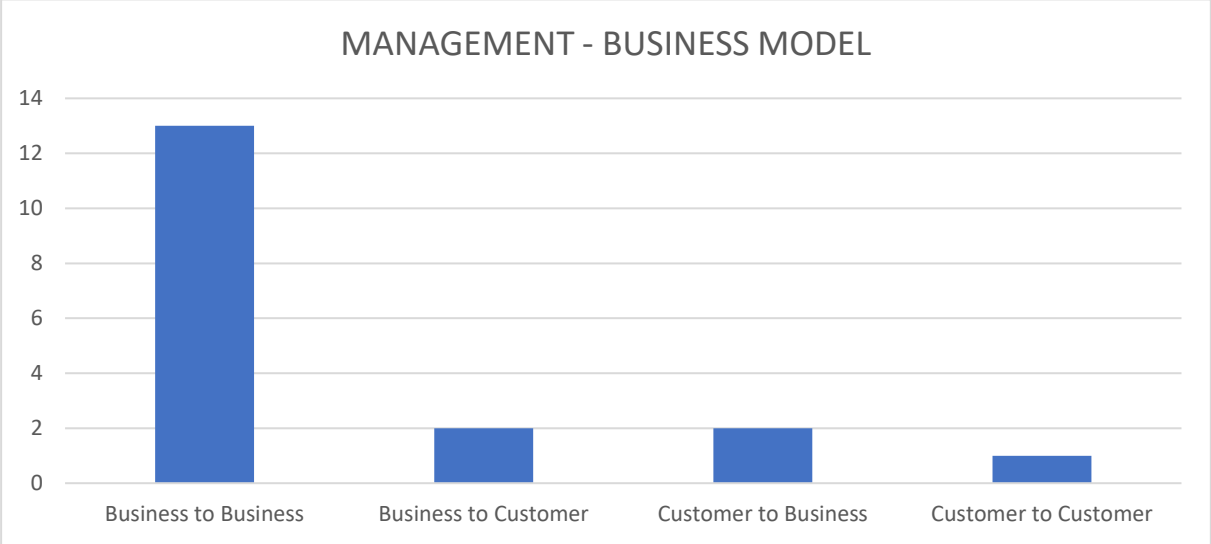


Figure 9: Management – Business model

However, it's worth noting that a significant proportion of these initiatives occur within the business-to-business (B2B) sphere. These collaborations often involve sharing of resources, transfer of knowledge, and joint development of sustainable solutions. B2B initiatives tend to dominate, largely due to the scale at which businesses operate and the potential for substantial impacts in driving sustainability practices across industries. Conversely, initiatives that involves the customer such as as business-to-consumer (B2C), customer-to-business (C2B) and customer-to-customer (C2C) initiatives—constitute a smaller portion of these efforts. The reason behind this can be attributed to the perceived lower profitability of these endeavours. Engaging consumers directly often involves considerable investments in education, awareness campaigns, and development of consumer-friendly platforms or services. The returns on such investments might appear less immediate or significant compared to B2B initiatives. However, this dynamic is not a reflection of the importance of consumer engagement in the transition to a circular economy. Consumers play a vital role in driving demand for sustainable products and services, and their participation in circular practices such as reuse, repair, and recycling can significantly contribute to reducing waste and conserving resources. Therefore, while B2C, C2B and C2C initiatives might currently be in the minority, their role and potential impact should not be underestimated.

2.1.3.3.2 Sustainable Revalorization

Revalorization, also known as Repurposing (refurbishing & reusing), signifies the practice of reinstating the value of a product without having to dismantle it. It doesn't necessitate substantial efforts or resources to breathe new life into the product's lifecycle. Revalorization entails rejuvenating the value of an item without needing to break it apart. This process is designed to be efficient and requires relatively low input to jumpstart a fresh lifecycle for the product.

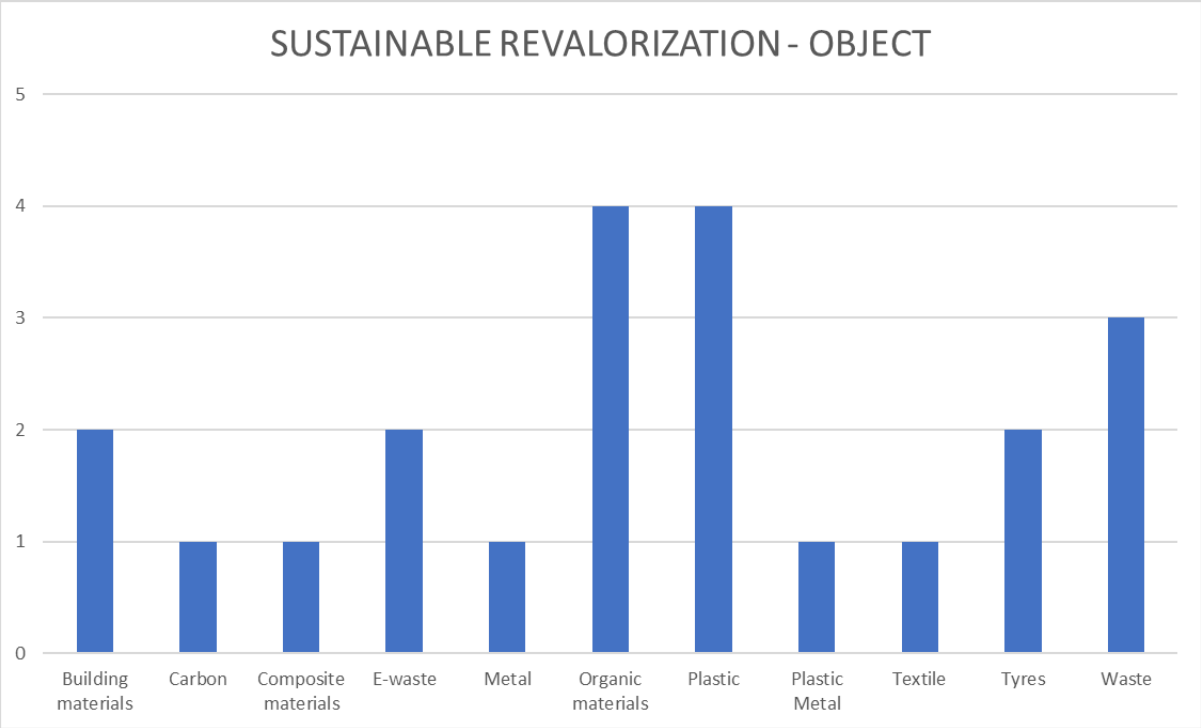


Figure 10: Sustainable Revalorization - Object

Within the field of sustainable revalorization, there's no specific item that is solely designated for the process. The spectrum of products that can undergo this rejuvenation is practically infinite, spanning from everyday household items to complex industrial components. However, when it comes to large-scale revalorization, certain materials, such as plastic and organic waste, take on a significant role. The high quantities of these types of waste make them particularly suited for commercial-scale operations and align with the immense volumes required by businesses. Further noteworthy groups include electronic waste (e-waste), tires, and construction materials. Despite fewer examples of their revalorization—primarily due to the complexity involved in repurposing these materials—they still hold a crucial role in sustainable revalorization. Electronic waste, for example, is particularly noteworthy due to the presence of numerous precious metals. The revalorization of e-waste offers a lucrative opportunity to reclaim these valuable resources, limiting the need for new extraction and thus reducing the use of virgin materials. Tires and construction materials, although presenting unique challenges, also possess immense potential for revalorization, given their pervasiveness and the environmental implications of their disposal. The effective repurposing of these materials can significantly contribute to resource conservation and waste reduction. Therefore, while sustainable revalorization covers a wide range of products, certain categories—such as plastics, organic waste, e-waste, tires, and building materials—emerge as

especially relevant due to their volume, potential for resource recovery, and alignment with commercial-scale operations.

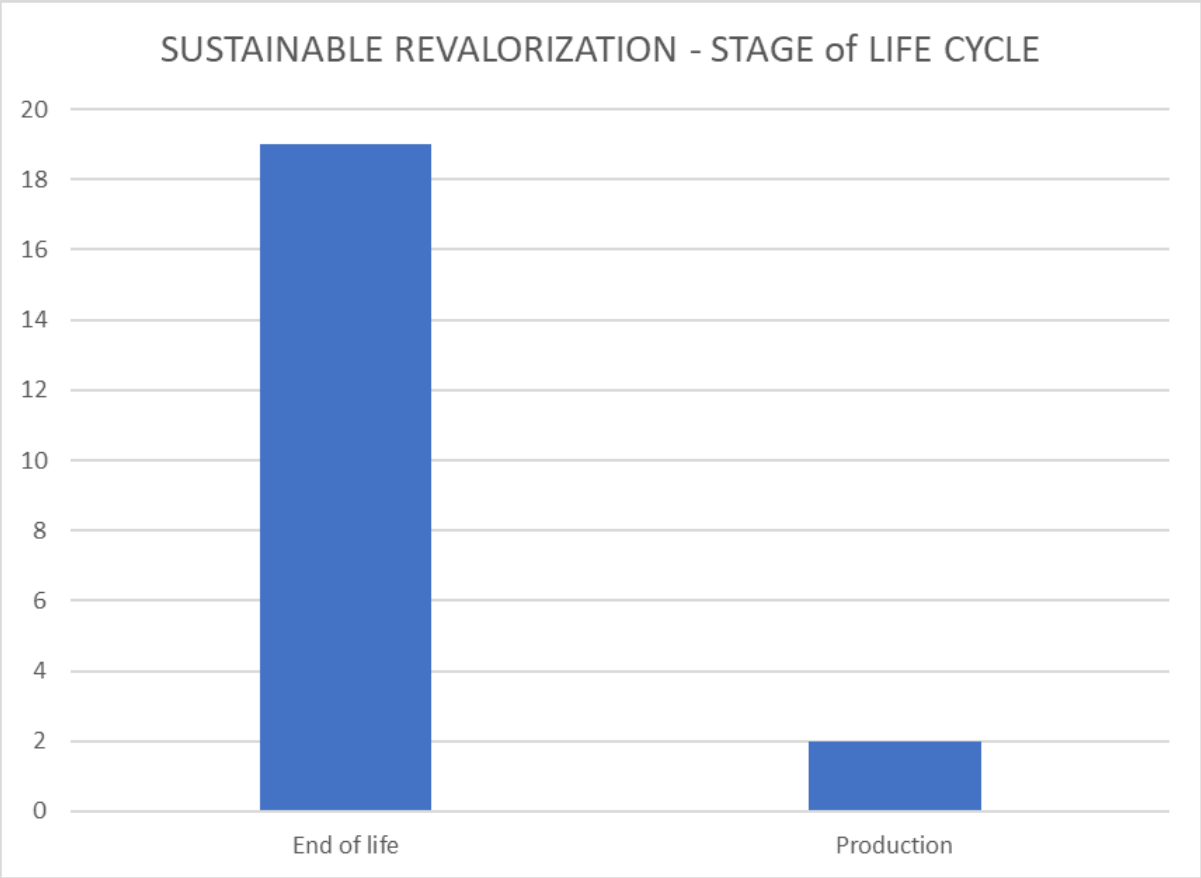


Figure 11: Sustainable Revalorization – Stage of life cycle

Sustainable revalorization primarily comes into play at the end of a product's life cycle, when it is about to be disposed. This stage represents a significant opportunity for resource recovery and waste reduction, which are central to the concept of revalorization. A noteworthy application of sustainable revalorization is in the context of production by-products. Certain innovative enterprises have devised ways to capture and utilize by-products from specific production processes that are typically difficult to manage. For example, ByFusion repurposes plastic waste into building material. ByFusion is a recycling technology company that has developed a machine that can convert plastic waste into building blocks that can be used in construction [55]. Another interesting example is Ocean Sole. It is a Kenyan social enterprise that creates art sculptures and other products from discarded flip-flops that have washed up on the shores of Kenya and other African countries [56]. By integrating these otherwise wasted materials into their own production cycles, these businesses not only mitigate waste generation but also conserve resources and enhance their operational efficiency. However, it's important to underscore that the end-of-life stage of a product's life cycle is particularly crucial

in the sphere of sustainable revalorization. This is primarily because revalorization is fundamentally about restoring value to products that have reached the end of their functional lives. The transformation of 'waste' into valuable resources embodies the essence of the circular economy and underpins the majority of sustainable revalorization efforts. Therefore, while some instances of sustainable revalorization involve the repurposing of production by-products, the overwhelming focus of these initiatives is on managing products at the end of their life cycle. By breathing new life into these products, revalorization contributes to a more sustainable, resource-efficient economy.

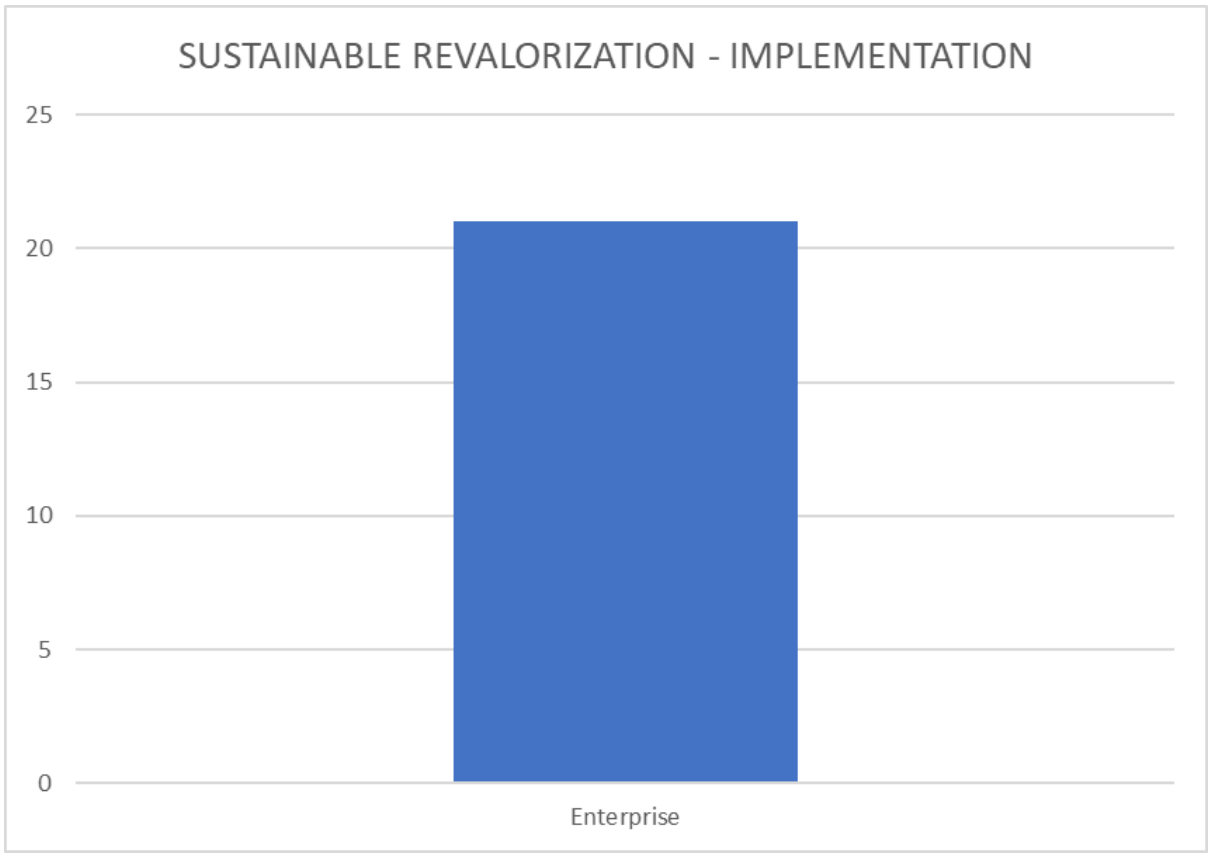


Figure 12: Sustainable Revalorization - Implementation

Sustainable revalorization is typically implemented by autonomous enterprises that have specialized in this area. The reason for this is the high degree of specificity and knowledge required for the process, making it less likely to be outsourced. Consequently, third-party involvement is relatively rare, as these enterprises generally possess the requisite expertise to handle these activities directly. This autonomy is beneficial as it allows these enterprises to have complete control over the process, enabling them to make adjustments and optimizations as needed. Additionally, it allows them to foster a deeper understanding and awareness of the materials they're working with, which can lead to innovative approaches and solutions in the revalorization process.

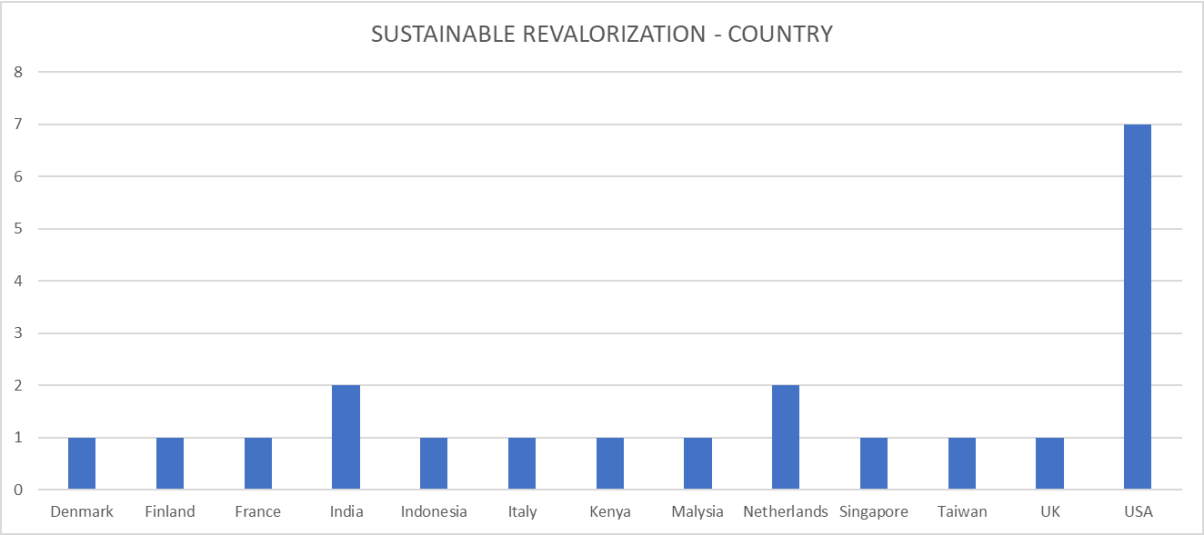


Figure 13: Sustainable Revalorization - Country

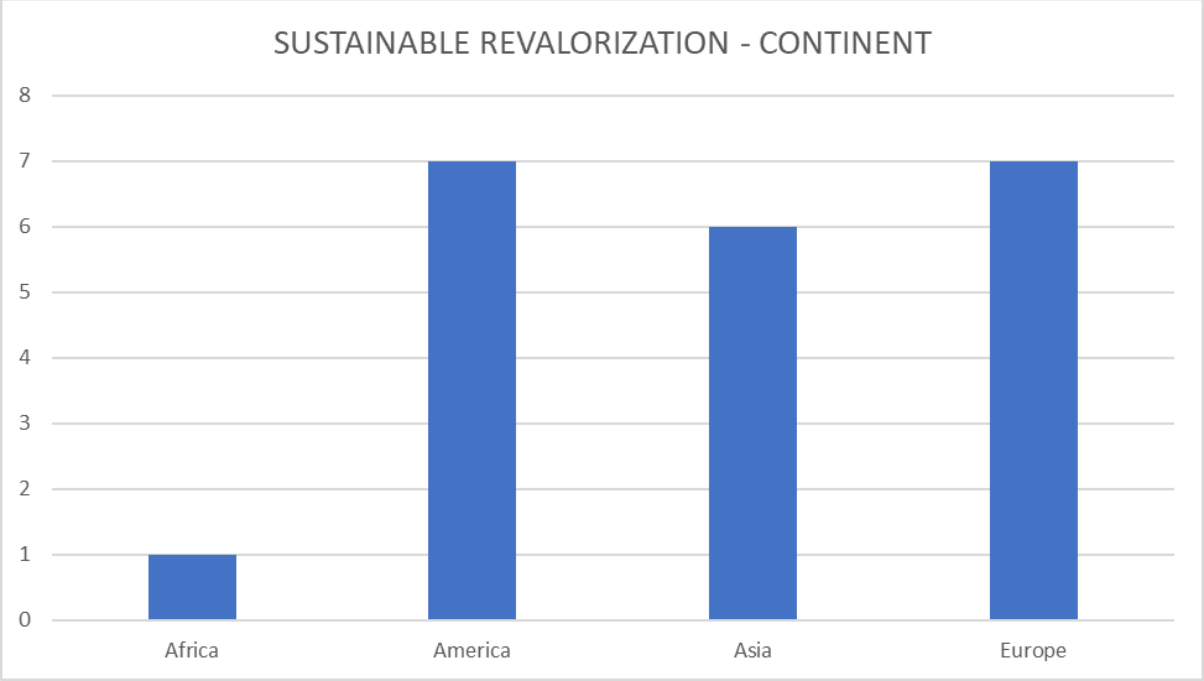


Figure 14: Sustainable Revalorization - Continent

The majority of sustainable revalorization initiatives are centered in the United States, a nation with a robust infrastructure for such ventures and a vibrant market for sustainable products. However, this isn't an exclusively American trend. There's a considerable balance among America, Europe, and Asia, each of which plays host to a multitude of these initiatives. In Europe and Asia, the concept of the circular economy has been embraced with enthusiasm, with both continents demonstrating substantial growth in revalorization activities. This growth is largely driven by heightened public awareness of the shortcomings of the linear

economy and an increasing willingness to transition towards more sustainable practices. The market in these regions has shown readiness to support the circular economy, reflected in regulatory support, investor interest, and consumer demand for sustainable products and services. Interestingly, even Africa, a continent with less developed circular economy practices, is displaying interest in sustainable revalorization. While the circular economy infrastructure in African nations may still be in its early stages, there are signs of a growing trend towards embracing these sustainable practices. This shift is encouraged by an increasing understanding of the long-term economic, environmental, and societal benefits offered by the circular economy.

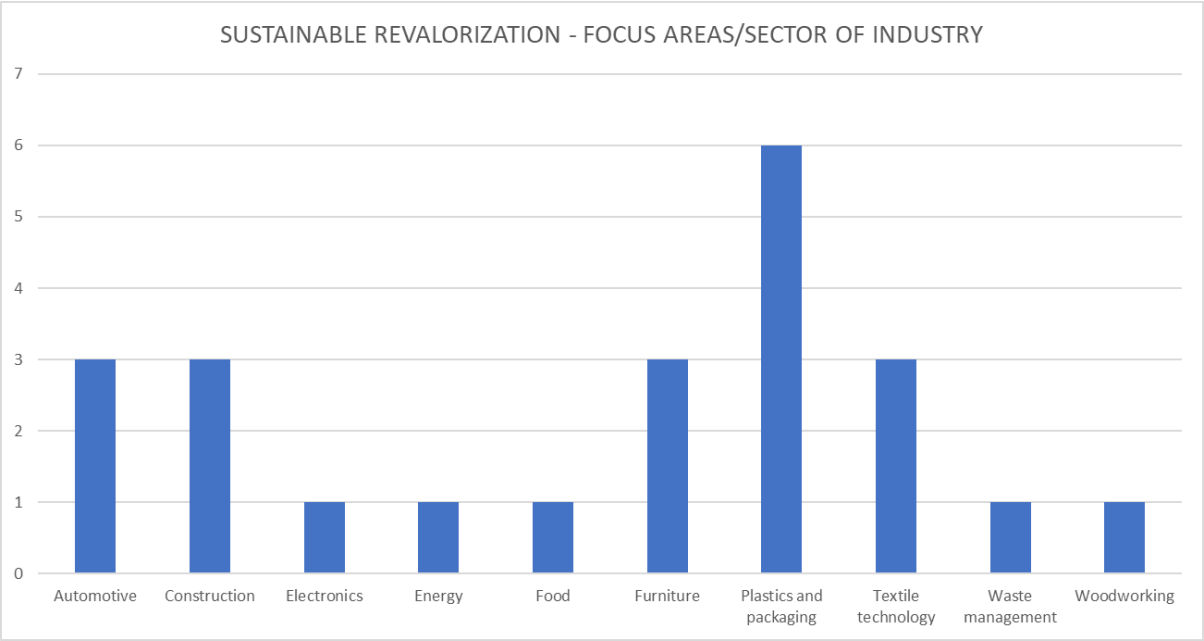


Figure 15: Sustainable Revalorization – Focus area

A substantial segment of the industrial sectors engaging in sustainable revalorization comprises those dealing with plastics and packaging. This predominance is primarily due to the significant waste challenges associated with these materials and their extensive use across a variety of industries. Other sectors that stand out around revalorization include furniture, textile technology, automotive, and construction. Each of these industries can soak large amounts of waste and discarded products, offering significant potential for revalorization. These sectors also tend to use a diverse range of materials, from textiles and metals to wood and glass, which further broadens the possibilities for revalorization. For instance, in the furniture industry, there is potential to repurpose old furniture into new, fashionable pieces or to recycle the materials into new products. In the textile industry, unused fabrics could be transformed into new clothes or other textile products. Similarly, the automotive and construction sectors offer opportunities for reusing and recycling a vast array of components and materials. However, there's still a lot of untapped potential in these sectors, and there's

much room for innovation and the development of new revalorization strategies. As consumer demand for sustainable products continues to grow and as environmental regulations become stricter, the drive for sustainable revalorization across all these industries is likely to intensify in the years to come.

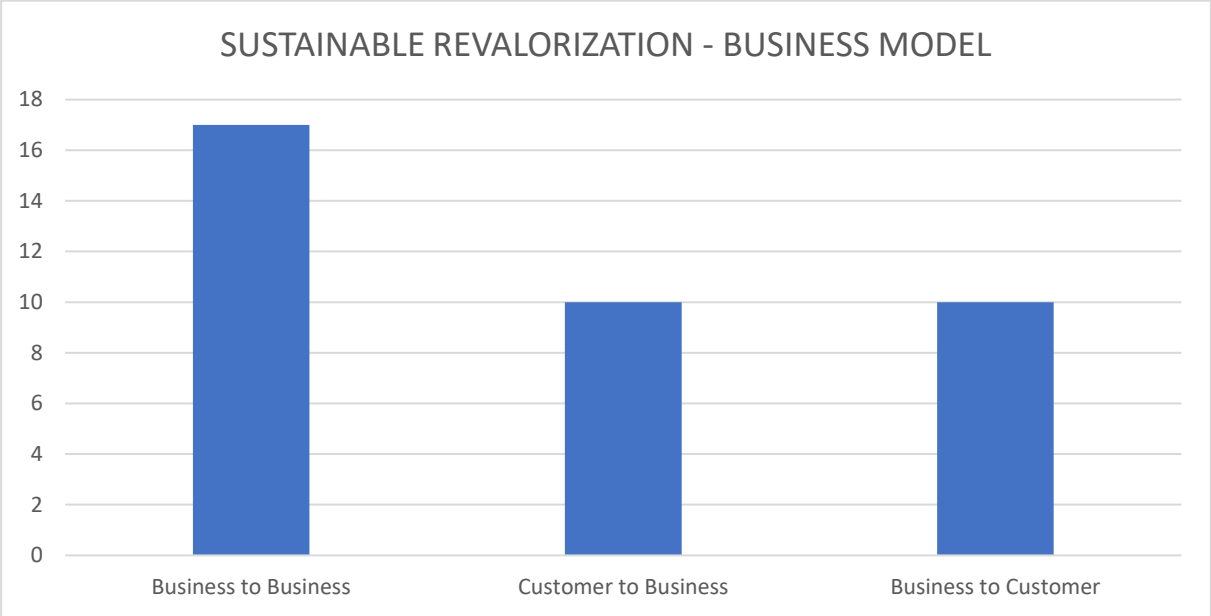


Figure 16: Sustainable Revalorization – Business model

Sustainable revalorization typically operates within a business-centric model. Interactions predominantly occur in a business-to-business (B2B) context, although the customer often plays a crucial role in this system as well. The customer's involvement often relates to the collection of products reaching their end of life, offering a crucial source of materials for revalorization. For instance, businesses may engage with customers to collect used or discarded products that could undergo the revalorization. To ensure a scale that aligns with business requirements, there needs to be a substantial aggregation of individual customers willing to part with their old products for the purpose of revalorization. This not only sustains the raw material pipeline for these businesses but also fosters a circular economy practices among customers. Once the product has been revalorized – refreshed, repurposed, or remanufactured – it can potentially be reintroduced to the same customers, completing the circular loop. This entire process not only illustrates the concept of a circular economy but also underscores the integral role that customers play in this system. Simultaneously, there are also customer-to-customer (C2C) initiatives in place that involve sustainable revalorization. These may include second-hand marketplaces, swap events, or community recycling programs. Although the scale of these C2C activities tends to be smaller compared to business-led efforts, they nonetheless play a valuable role in promoting a culture of revalorization and extending the lifespan of products. Nevertheless, the substantial potential and scale of business-driven

sustainable revalorization shouldn't detract from the importance and value of customer participation. The intertwining of business and consumer actions in this realm underscores the collective effort needed to transition towards a more sustainable, circular economy.

2.1.3.3.3 Recycle

This field is primarily dedicated to the development and implementation of innovative recycling techniques that adhere to the principles of the Circular Economy. These inventive strategies not only hold the potential for economic gains, but they also markedly bolster sustainability efforts. By harnessing the principles of a circular economy, these methods aim to turn waste into valuable resources, thereby creating a closed-loop system that reduces environmental impact and fosters economic growth. In doing so, these techniques strike a delicate balance between profitability and environmental responsibility, demonstrating that business success and sustainability can indeed go hand in hand.

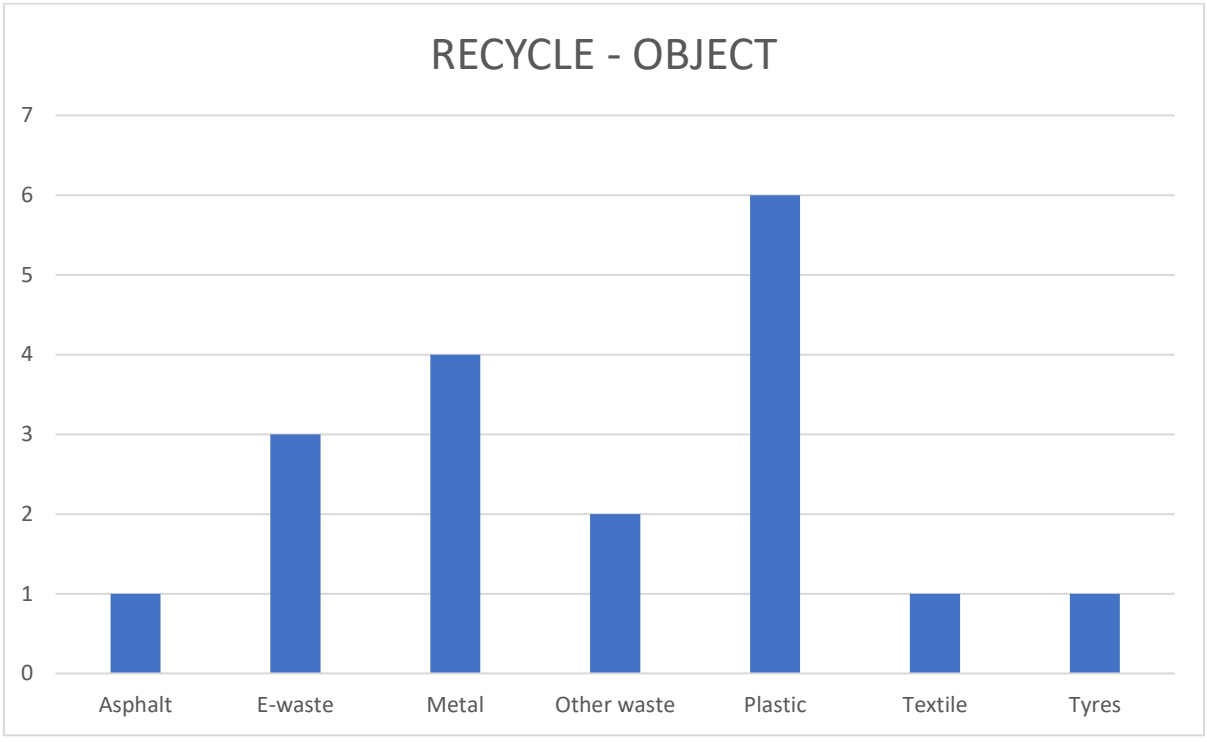


Figure 17: Recycle – Object

Recycling is a comprehensive process where specific products are systematically dismantled through a series of operations. The aim is to return these items to a state where their constituent materials can be effectively reintegrated into new production cycles. Consequently, for a product to be suitable for recycling, it must possess certain attributes that facilitate this process. Primarily, the product needs to be possible to recycle, meaning its design and materials should

allow for easy disassembly and separation. This quality is vital because recycling often involves breaking down items into their core components, which can then be repurposed or reprocessed for future use. Furthermore, the recycling process should ideally be mechanizable to ensure efficiency and scalability. The utilization of machinery in recycling operations not only accelerates the process but also significantly reduces manual labor and enhances overall productivity. In extending this concept, it's important to note that successful recycling also relies on thoughtful product design at the beginning of the product's life. Designers and manufacturers have a role to play in creating products that are not only durable and functional, but also easily recyclable once they reach the end of their lifespan. This approach, often referred to as 'design for recyclability', is a critical aspect of sustainable production and a key tenet of the circular economy.

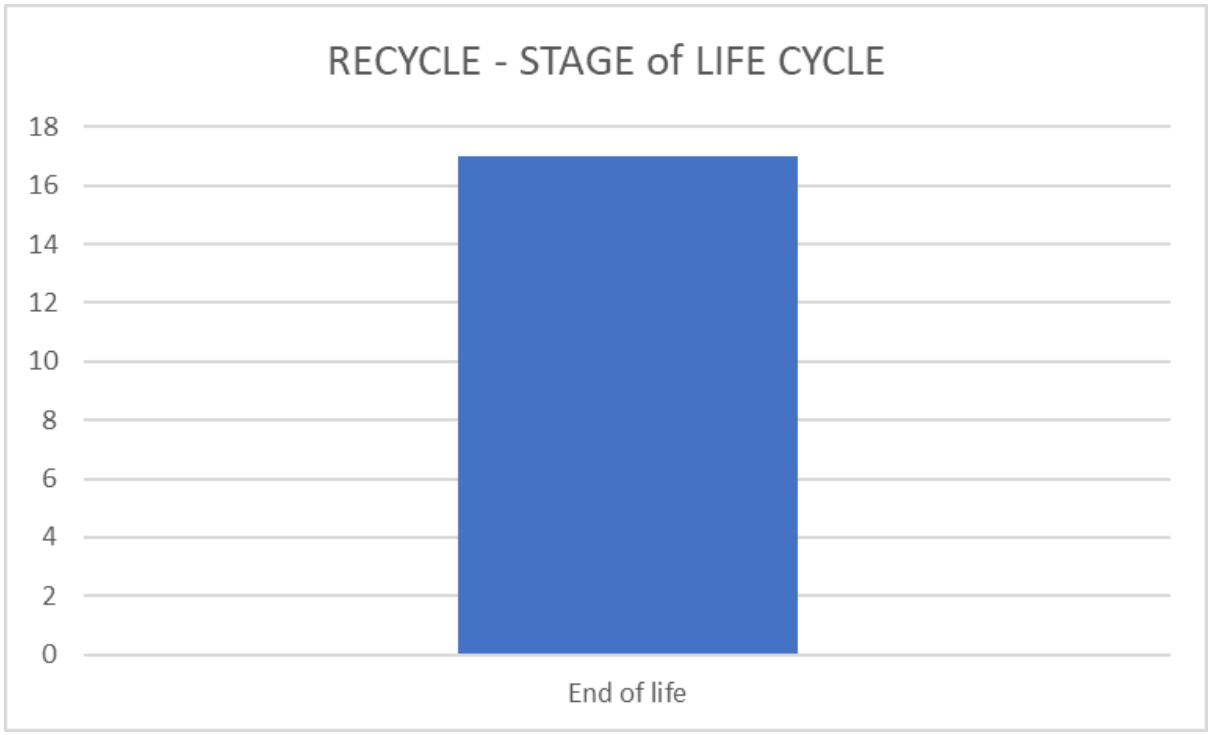


Figure 18: Recycle – Stage of life cycle

When recycling comes into play, it typically signifies that the product has reached its end of life and cannot be revalorized or repurposed through other means. Recycling then becomes the last resort to extract some value from the product and divert it from the landfill. Primarily, the concept of recycling aligns with the notion that a product, once it has exhausted its usability or functionality, should not be discarded or treated as waste. Instead, it should be seen as a reservoir of materials that could be repurposed or reintegrated into the production

cycle. Hence, recycling fundamentally focuses on the end-of-life stage of products, where it serves as an important strategy to recover materials and minimize waste.

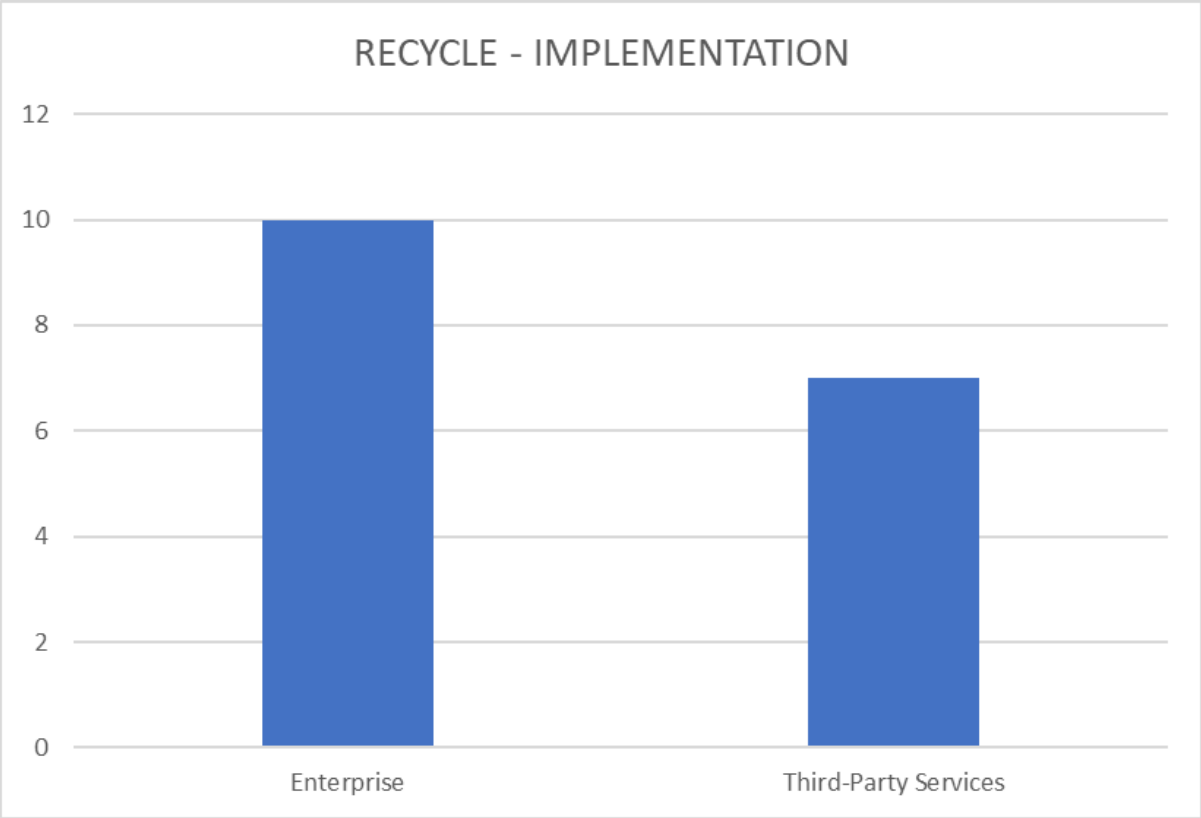


Figure 19: Recycle – Implementation

The implementation methods for recycling maintain a relative equilibrium. Given that the recycling process isn't as complex as sustainable revalorization, it's common to observe third-party services taking the lead in handling these recycling operations. This balanced approach often results from the widespread recognition of recycling's importance, combined with the technical expertise required to effectively recycle certain materials. By involving third-party services, companies can benefit from specialized knowledge and equipment, leading to more efficient and effective recycling processes. Moreover, entrusting recycling operations to third-party services allows businesses to focus on their core competencies while still contributing to sustainability goals. This collaborative approach reinforces the notion of shared responsibility in the pursuit of a circular economy, emphasizing the role each entrepreneur plays in maintaining the life cycle of materials and reducing environmental impact.

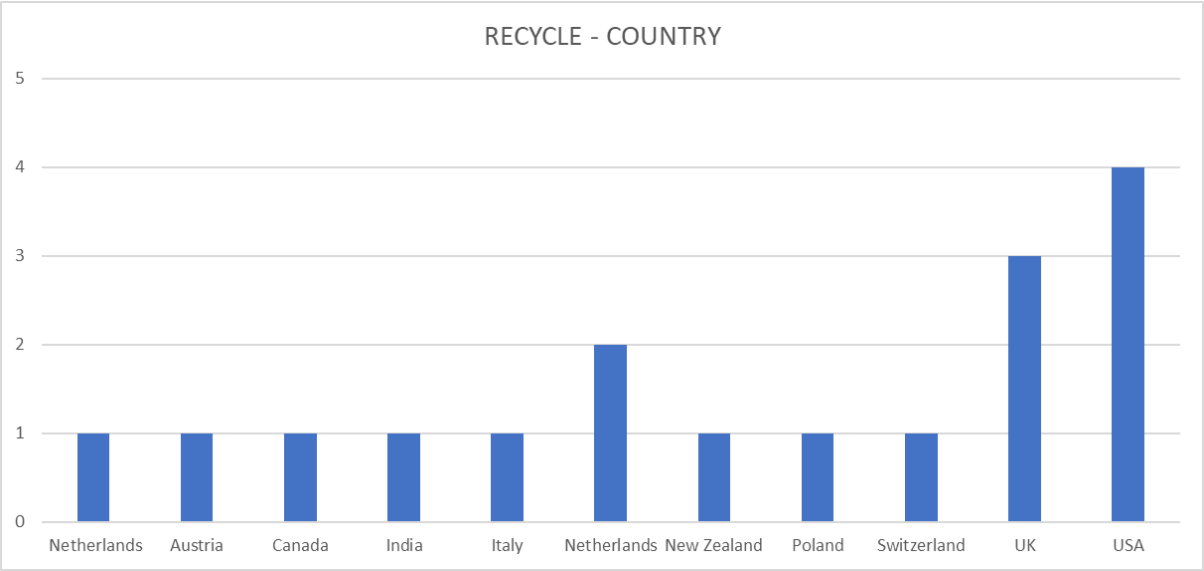


Figure 20: Recycle – Country

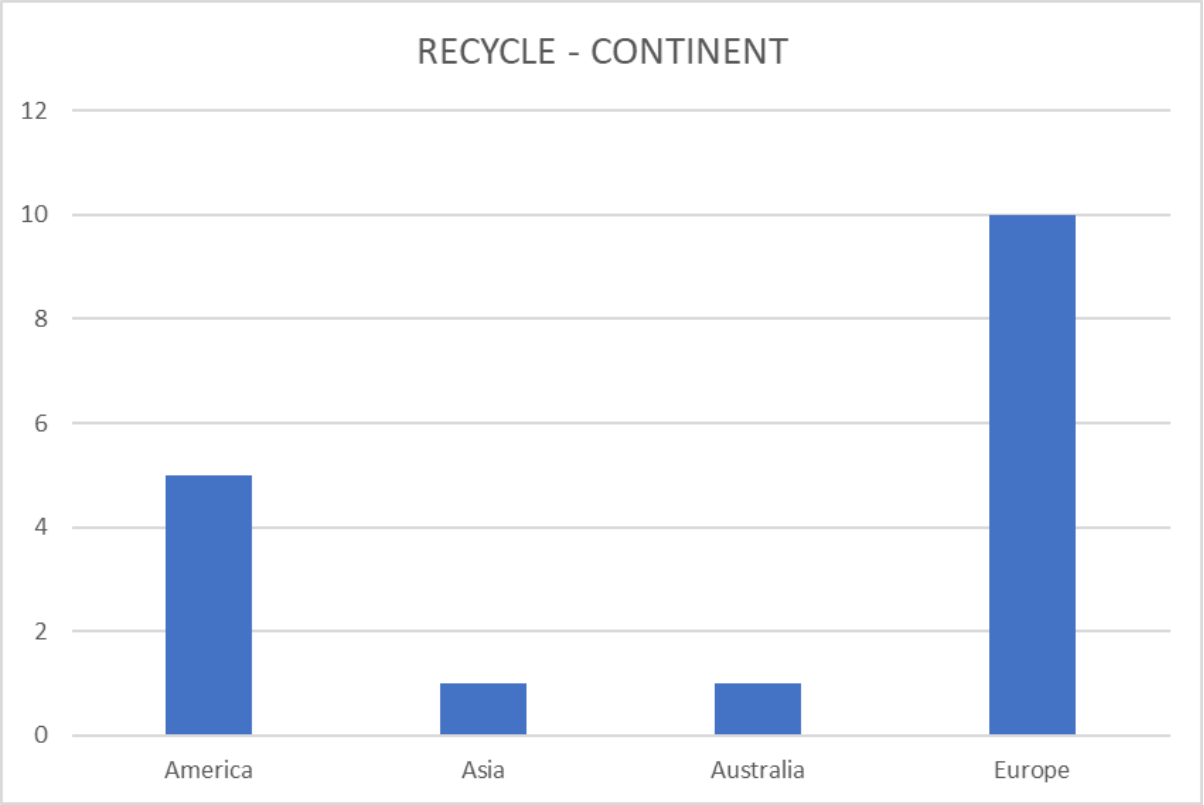


Figure 21: Recycle – Continent

A significant portion of recycling initiatives originates in the United States, with Europe leading the way when it comes to continental involvement. These areas have established a common market for recycling, with their well-developed waste management systems and

robust regulations supporting this practice. In Europe, waste is typically processed within national borders, leading to a high concentration of recycling initiatives in the region. This self-contained waste management strategy has accelerated innovative practices and positioned Europe as a global leader in recycling. Meanwhile, other regions like Australia and Asia are also entering the innovative recycling scene. Although their markets are still evolving, these regions show promising growth in adopting and developing advanced recycling techniques. Australia's robust environmental policies and Asia's rapid industrial growth, coupled with increasing environmental awareness, are fostering a conducive environment for innovative recycling practices. As these markets mature, they are expected to contribute more significantly to the global recycling landscape. Furthermore, as global awareness and urgency surrounding waste management continue to rise, it's anticipated that other regions will also follow suit, expanding the global reach and impact of innovative recycling techniques.

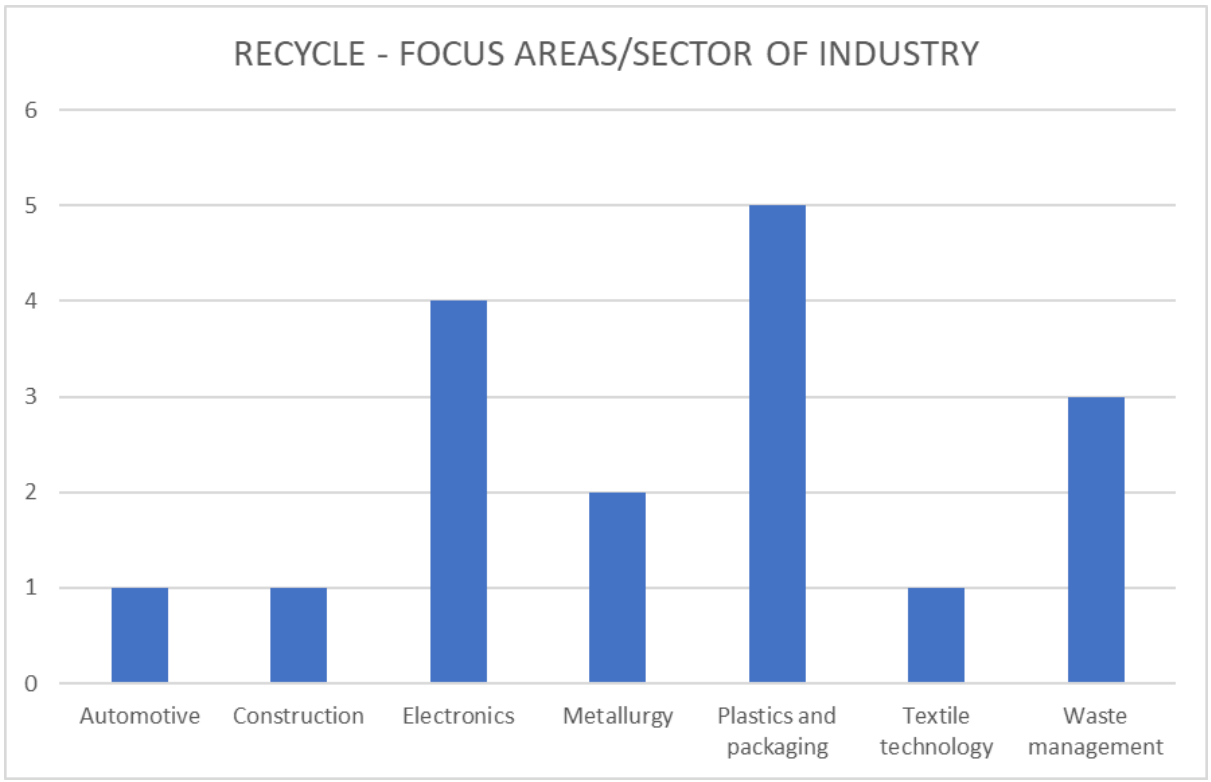


Figure 22: Recycle – Focus areas

Considerable opportunities exist primarily in the plastics and packaging sector when it comes to recycling. This sector represents a substantial market, and the material involved - plastic - is relatively straightforward to recycle. This ease of recycling, coupled with the enormous volume of plastic and packaging waste produced globally, creates significant potential for innovative recycling solutions. Following plastics, electronics or e-waste recycling presents the next significant opportunity. Notably, this sector offers the highest profit potential due to the value of certain metals and components found in electronic devices. As electronics become

increasingly pervasive, the volume of e-waste generated also continues to rise, reinforcing the necessity and potential profitability of e-waste recycling. General waste management and metallurgy provide substantial opportunities for recycling. Metallurgy holds central position in the recycling industry, given the immense volume and diversity of materials processed. Additionally, metals are relatively uncomplicated to recycle, and this process doesn't degrade the quality of the material. This maintains the value of recycled metals, further amplifying the recycling potential within the metallurgical sector. It's also important to highlight emerging sectors like textiles and construction. The recycling potential in these sectors is substantial, especially given the volume of waste they produce. Innovations in recycling technology could unlock new opportunities in these areas, potentially transforming waste streams into valuable resources and contributing to a more circular economy.

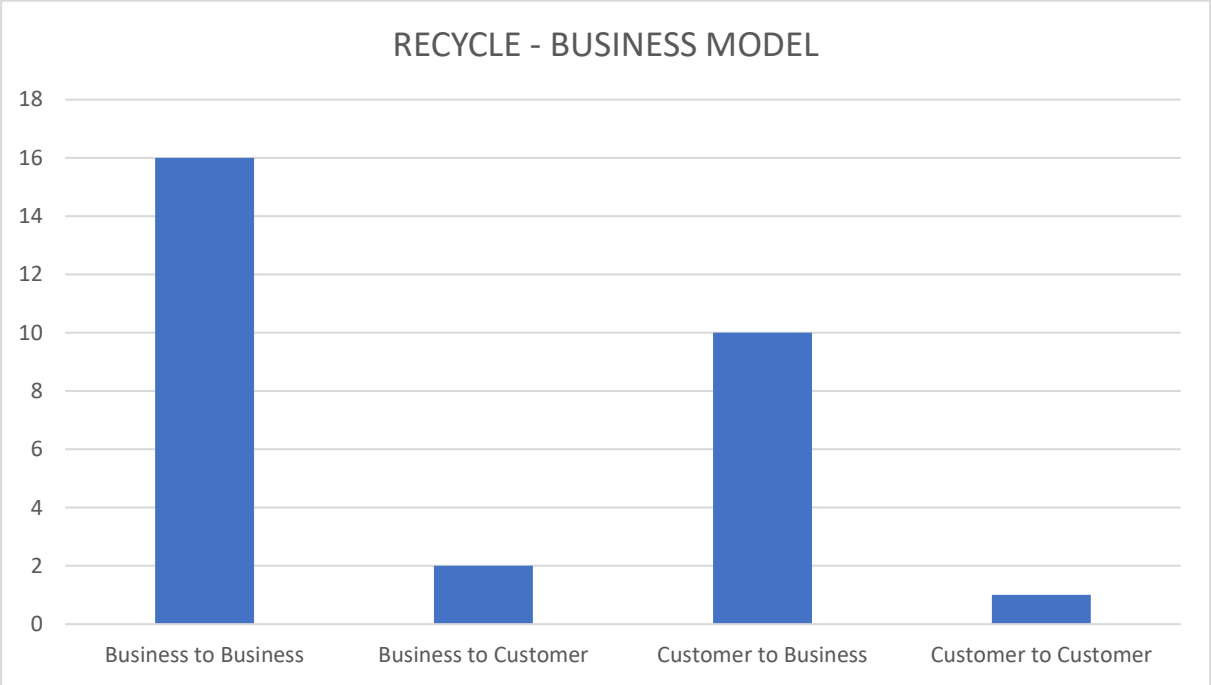


Figure 23: Recycle – Business model

Recycling initiatives are driven by both businesses and customers, with both playing a significant role in advancing efforts in this field. Participation from end customers, in the form of business-to-customer (B2C) or customer-to-customer (C2C) involvement, is not a widespread practice in the recycling sector. This is primarily because the recycling process is not a task easily undertaken by the average consumer. The complex nature of recycling requires specialized equipment and a considerable level of expertise. Furthermore, for recycling to be profitable and make a significant impact, it needs to be carried out on a large scale - a scale that usually surpasses the capabilities of individual consumers. However, customers can and do play a role in the initial stages of recycling - specifically in the collection process. For instance, individuals can help segregate waste, facilitate the collection of

recyclable materials, and participate in community recycling programs. However, even these efforts need to be organized on a sizable scale to align with the business scope of recycling initiatives. It's important to recognize that consumer participation in recycling is not just about the physical act of recycling. Consumer awareness, responsible consumption habits, and demand for recycled products significantly influence the market and can drive businesses towards more sustainable practices.

2.1.3.3.4 Sustainable production

This term refers to integrating sustainability in all stages of a product's lifecycle, from material sourcing to end-of-life disposal. It aims to minimize environmental impact while ensuring economic viability and meeting societal needs. By embracing these practices, businesses can contribute to a sustainable economy, aligning with consumers' growing demand for environmentally responsible products.

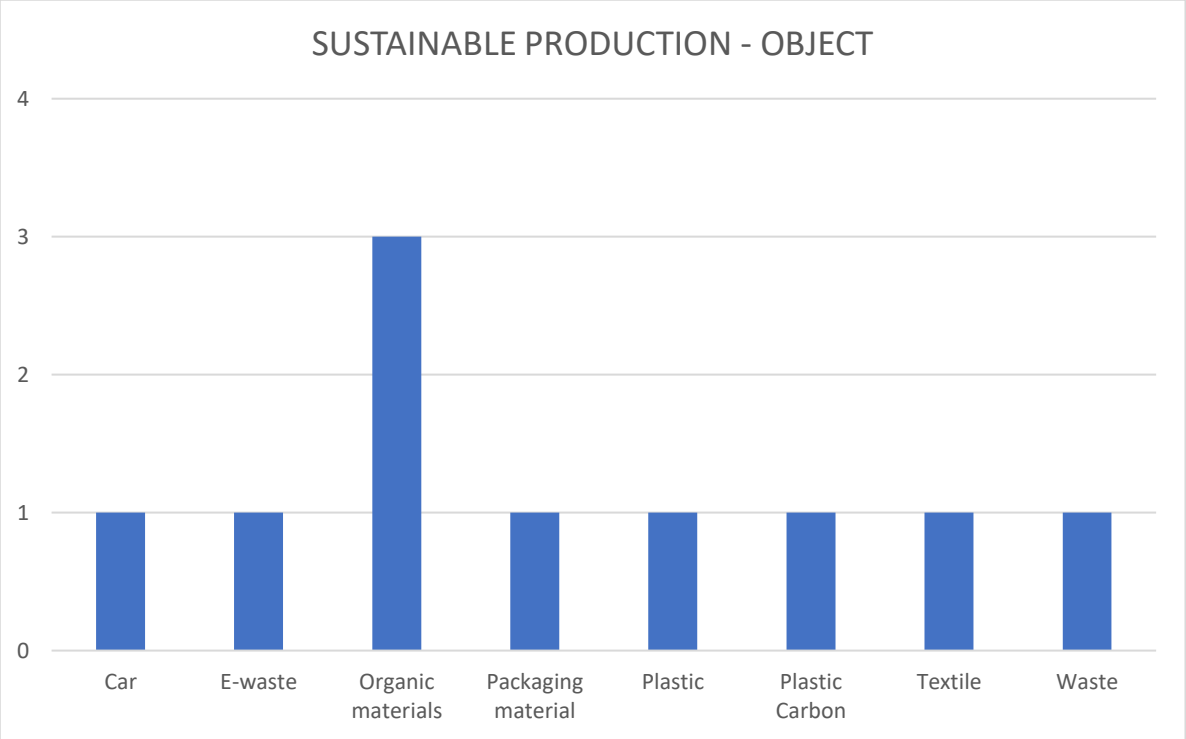


Figure 24: Sustainable production – Object

Organic materials make the majority in this context, primarily due to their widespread availability and unique properties that are still being explored for new applications. They are found all over the world and are integral to various industries. These materials possess a wide array of desirable qualities, such as being renewable, biodegradable, and versatile. This makes them an excellent choice for a host of applications, with the potential for new uses continually being discovered. Moreover, products made with organic materials are generally easier to recycle compared to their synthetic counterparts. The natural decomposition process of

organic materials is typically more straightforward, making it a more eco-friendly option. The biodegradability of these materials reduces the strain on waste management systems and contributes to a more sustainable circular economy. In addition to these benefits, the use of organic materials can potentially drive significant environmental benefits, such as reducing dependency on non-renewable resources, minimizing greenhouse gas emissions, and promoting biodiversity.

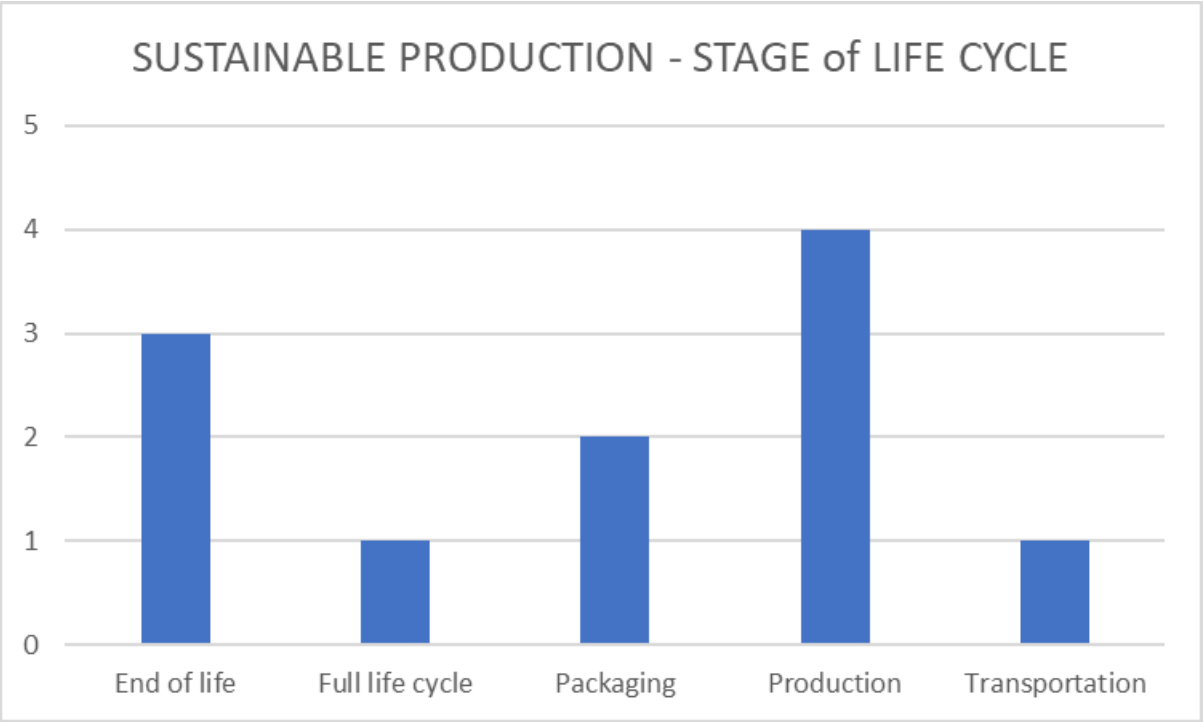


Figure 25: Sustainable production – Stage of life cycle

Sustainability includes all stages of a product's life cycle, with production as the core. However, supportive stages such as packaging and transportation are equally significant. Environment-friendly packaging options, efficient transport modes, and energy use can drastically impact a product's overall sustainability. Furthermore, stages like usage and end of life management, incorporating practices like recycling or responsible disposal, are crucial for a truly sustainable product lifecycle. The concept of end of life holds significant importance in this domain as it determines the ultimate destination of a product. When a product reaches its end of life, there is still an opportunity for it to be recycled, thereby contributing to sustainable production practices. Each phase provides an opportunity for enhancing sustainability, contributing to an eco-friendly production model.

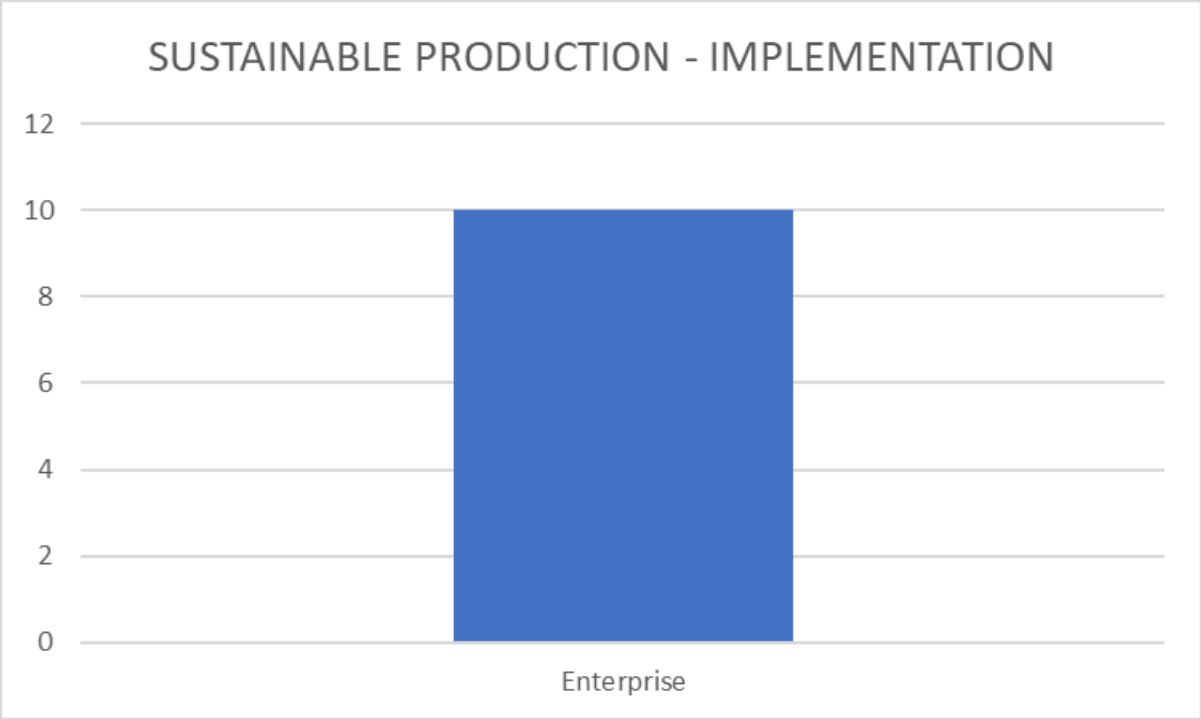


Figure 26: Sustainable production – Implementation

Implementing sustainable production practices is primarily the responsibility of the enterprise itself. Companies need to include these practices within their operational strategies, processes, and culture to make their production truly sustainable. The integration of eco-friendly technologies, efficient resource utilization, and responsible waste management is crucial for businesses. These measures not only reflect environmental responsibility but also position the company as progressive in the eyes of stakeholders. Moreover, such initiatives often lead to cost-effectiveness and enhanced efficiency, justifying the transition to sustainability.

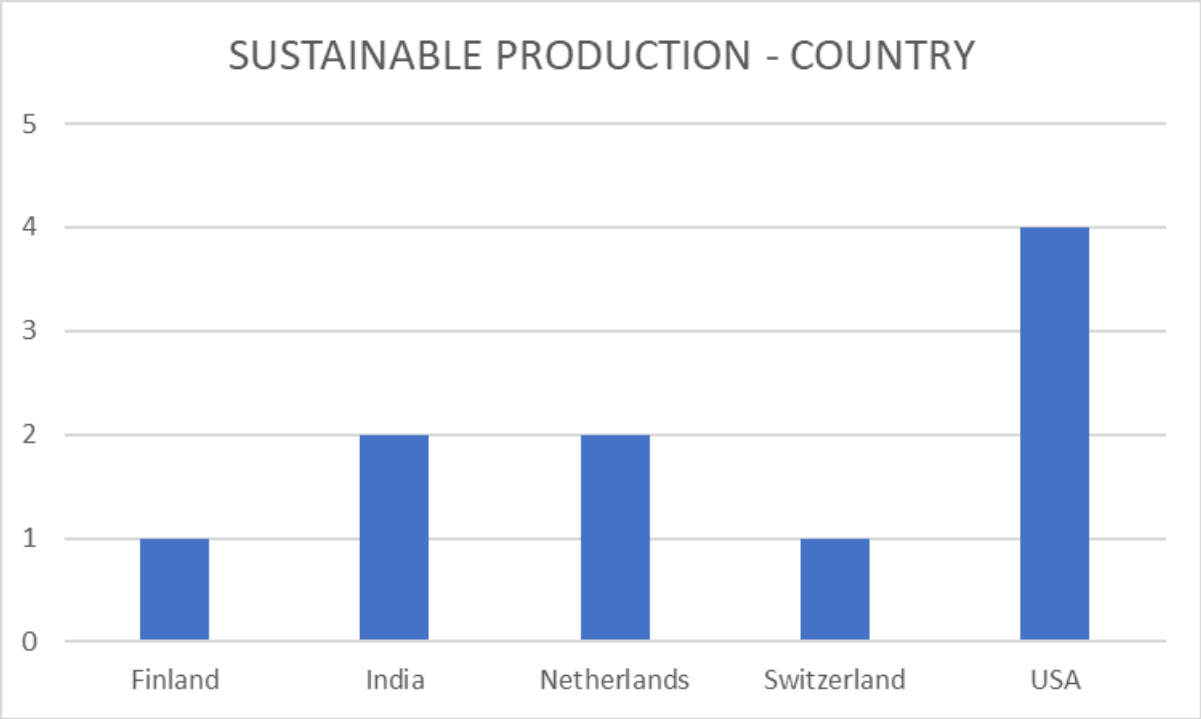


Figure 27: Sustainable production – Country

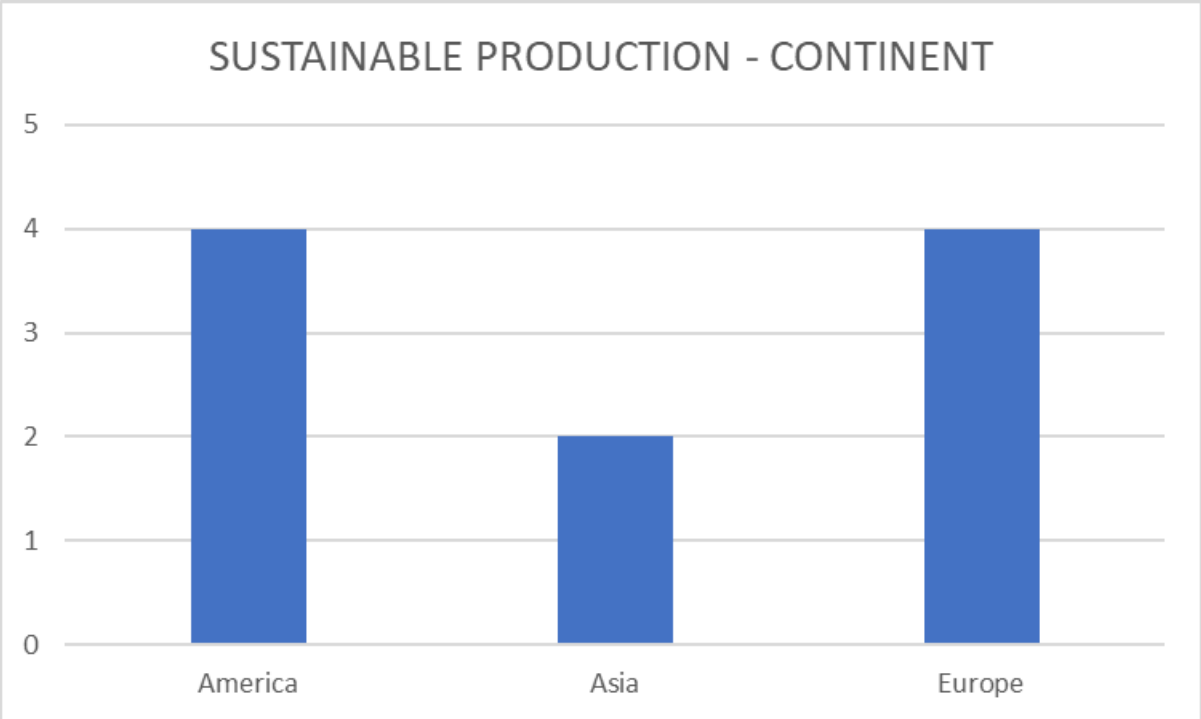


Figure 28: Sustainable production – Continent

Sustainable production has rapidly gained popularity worldwide and has become a fundamental shift in industrial processes. The geographic distribution of companies embracing sustainable production is evenly spread across continents, with America, Asia, and Europe leading the charge. It is increasingly becoming a global norm for businesses to align their operations with sustainability goals. Additionally, regulatory bodies globally are tightening legislation around sustainability, emphasizing the critical role of Circular Economy principles in business operations. This evolution isn't only driven by regulatory compliance but is also a strategic move in response to rising consumer awareness and demand for environmentally responsible products and services. Increasingly, sustainability is not just an add-on, but a core part of a company's value proposition and long-term strategic planning.

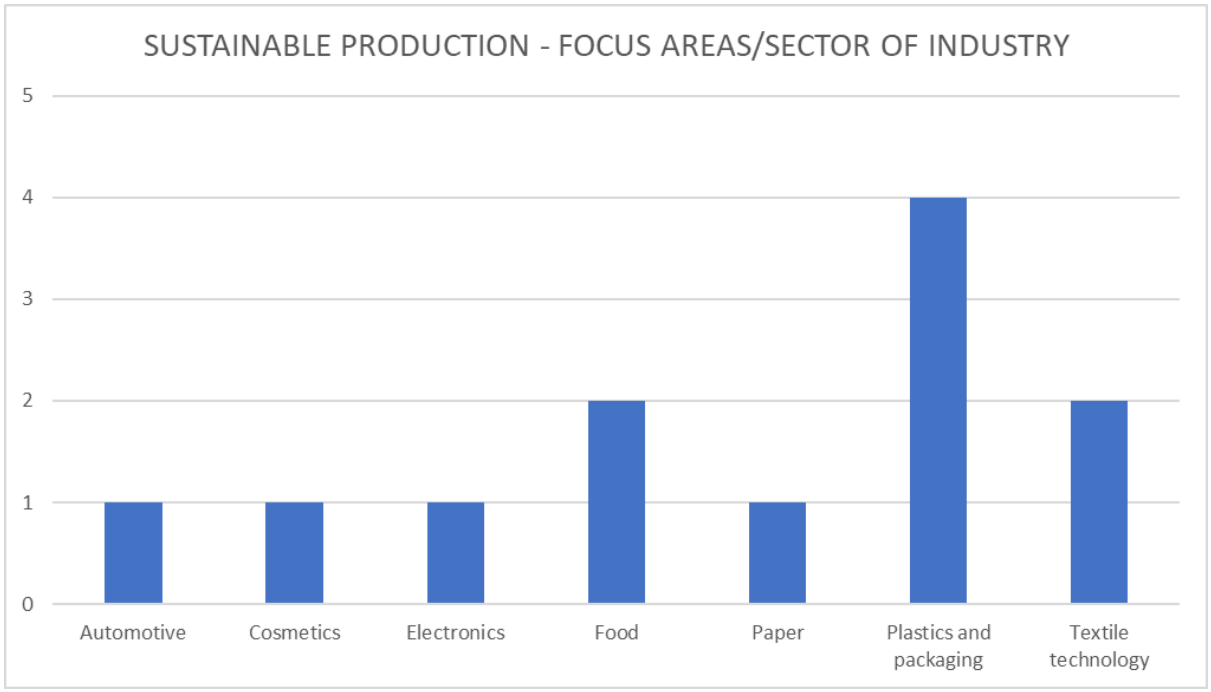


Figure 29: Sustainable production – Focus areas

Every industry sector is increasingly engaged in the transition towards sustainable production. The plastics industry, given its significant environmental impact, is at the forefront of this change, pioneering many innovative sustainability initiatives. However, other industries such as textiles and food processing are not far behind and are actively integrating circular economy principles into their operations. Emphasizing sustainability across all industry sectors is crucial due to their interconnectedness. For instance, waste or by-products from one sector could potentially be a valuable resource in another, thereby creating a closed-loop system that optimizes resource use and minimizes waste. Furthermore, sustainable products are well perceived across all categories, making it attractive for industries to adopt sustainable practices, irrespective of their sector.

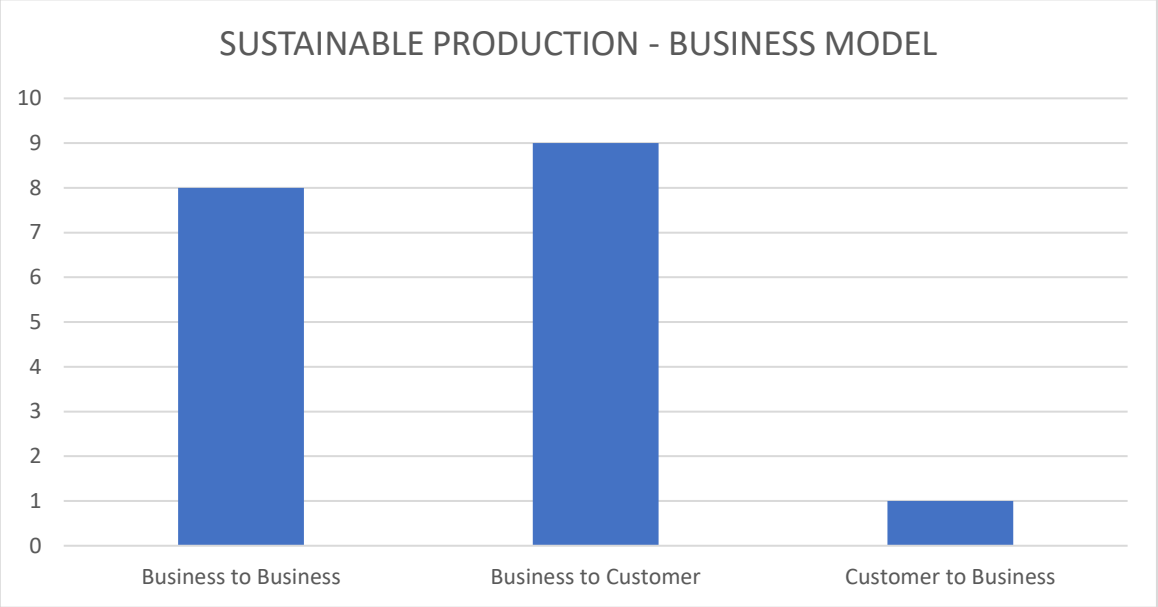


Figure 30: Sustainable production – Business model

The transition towards sustainable production is driven by businesses. While customers play a part, it's the businesses that sustain the most responsibility in ensuring sustainability in their production processes. They have the power to influence consumer behavior and promote a culture of sustainability through the products they manufacture. Ultimately, decisions made within the business structure are crucial in determining the sustainability of production systems.

2.1.3.3.5 Sustainability reports analysis

Sustainability reports, also known as Environmental, Social, and Governance (ESG) or Corporate Social Responsibility (CSR) reports, serve as valuable sources of information regarding Circular Economy practices. These reports provide insights into the efforts and initiatives undertaken by organizations to promote sustainability and address environmental, social, and governance issues

ESG is a type of report that measures a company's performance in these three key areas, thus assessing its sustainability and ethical impact. The environmental dimension covers the company's interaction with the natural world, including energy consumption, waste generation, pollution levels, conservation efforts and treatment of animals. Essentially, it provides an understanding of the company's environmental footprint. Social factors offer insights into the company's relationship with various stakeholders. It considers the company's engagement with employees, suppliers, customers and the communities in which it operates. It focuses on elements such as diversity, human rights, consumer protection and employee engagement. The governance aspect looks at how the company is managed and controlled. It includes the company’s leadership structure, executive compensation, audit processes,

internal controls, and the rights of shareholders. Additionally, it covers the company's business ethics and explores any potential conflicts of interest. Combined, these three elements offer a comprehensive picture of a company's long-term sustainability and ethical issues, providing valuable information to investors, consumers and other stakeholders. Companies that demonstrate good performance in their ESG reports are often seen as more resilient, forward-looking and better equipped to prosper in the long term [57].

A CSR report, short for Corporate Social Responsibility report, is a document produced by a company to share information about its performance in various social and environmental areas. The objective of the CSR report is to communicate a company's commitments and actions towards responsible and sustainable business practices to its stakeholders, which include investors, employees, customers, regulators, and the public. The report often covers a range of topics like environmental impact, including energy use, waste management, and carbon footprint; social responsibility, such as workforce diversity, employee health and safety, community involvement, human rights, and governance issues, including company ethics, accountability, and compliance with relevant laws and regulations. The CSR report often serves as an indicator of a company's values, showcasing how the organization integrates sustainability and social good into its operations. It's also a tool that allows stakeholders to hold the company accountable for its impacts on society and the environment. While the exact structure and content can vary, the overall goal is to provide a transparent account of the company's societal and environmental responsibilities and how it's performing against those commitments [58].

Corporate Social Responsibility (CSR) reports traditionally emphasize a company's philanthropic efforts and positive societal impacts, typically separate from core business operations. On the other hand, Environmental, Social, and Governance (ESG) reports reflect how a company integrates ESG factors into its strategy, operations, and decision-making process, focusing on risk management and long-term sustainability. Therefore, CSR is about societal contributions, while ESG represents sustainability's integration into business strategy.

Primary focus will be on ESG reports because they give a more complete picture of a company's practices. However, it's crucial to keep in mind that some companies might use both ESG and CSR reports to mislead the reader about their Circular Economy practices, when they might just be offering illusive commitments. So, it's important to critically evaluate these reports rather than taking them at face value.

2.1.3.3.5.1 Patagonia sustainability report

Patagonia is an American outdoor clothing and gear brand known for its strong commitment to environmental and social responsibility. Beyond its high-quality products, Patagonia is renowned for its sustainable business practices, environmental activism, and corporate philanthropy, often donating a percentage of its profits to environmental causes.

Over the years, the brand has become synonymous with both outdoor adventure and conservation efforts.

In the Patagonia 2021 Annual Benefit Corporation Report (CSR) [59], several strategies are outlined that contribute to the promotion of a circular economy. These include:

- Worn Wear Program: This is an initiative that encourages customers to trade in their used Patagonia items for store credit, which are then cleaned, repaired, and resold at a discounted price. This approach emphasizes the use phase of the product life cycle, and it reduces the demand for new products, leading to less resource consumption.
- Product Repair: Patagonia has one of the largest apparel repair facilities in North America. They repair tens of thousands of garments each year, which extends the lifespan of their products and keeps them out of the landfill.
- Sustainable Materials: The report highlights Patagonia's efforts to use organic cotton and recycled materials in their products, which decreases reliance on virgin materials and promotes recycling.

However, there may be aspects of the report that could potentially create an illusion of sustainability:

- Not All Materials are Sustainable: Despite the focus on sustainable materials, not all Patagonia's products are made from such materials.
- Carbon Neutrality Goal: Patagonia has a goal to become carbon neutral by 2025. However, the details of how they plan to achieve this goal are not fully laid out in the report. The use of offsetting to achieve this goal, for instance, can sometimes be viewed as a way for companies to continue their usual operations while seeming sustainable.
- Social Aspects: While the report mentions fair trade, there is little detailed information about the labor conditions in their supply chain. While not directly related to the circular economy, these social aspects are a key part of overall sustainability.

2.1.3.3.5.2 Interface sustainable report

Interface is a global commercial flooring company specializing in modular carpet tiles and resilient flooring. This American company is known for its commitment to sustainability and its mission to become a fully sustainable company, reducing its environmental footprint. Interface has been a pioneer in the industry in terms of eco-friendly production and the promotion of the circular economy. Over the years, Interface has been recognized for its innovative approaches to manufacturing and its dedication to environmental conservation.

Upon examining the 2021 ESG report for Interface [60], it can be found that the company is actively engaged in several initiatives to strengthen its circular economy practices. These include:

- Carbon Negative Products: Interface has launched a series of carbon negative products, which helps them reduce their overall carbon footprint. This contributes to the circular economy by emphasizing on reducing resource consumption and waste production.
- ReEntry and Cool Blue: Interface's ReEntry program and Cool Blu carpet backing aim to recycle or repurpose used carpet, preventing it from ending up in landfills and contributing to a circular economic model.
- Bio-based Materials: The company is trying to transition to bio-based materials to reduce reliance on finite resources.

However, an ESG report may present information in a way that can create an illusion of sustainability. For instance:

- Not all recycled or bio-based materials are created equal: The report doesn't detail the sources of these materials. Some sources may still have negative environmental impacts, even if they are technically renewable or recycled.
- Carbon Offsetting: The report mentions that Interface purchases carbon offsets, which while not inherently misleading, can sometimes be a way for companies to continue polluting while seeming sustainable. The specifics of these offsets are not provided, making it hard to determine their actual impact.
- Absence of Comprehensive Lifecycle Analysis: While Interface highlights certain aspects of its product lifecycle (like the use of recycled materials and end-of-life reclamation), the report does not provide a comprehensive lifecycle analysis of its products. This can make it difficult to fully assess the sustainability of their operations and can unintentionally give an illusion of sustainability.
- Limited Scope: The report's focus on a few select initiatives may overshadow other aspects of the company's operations that are not as sustainable. For instance, there is little mention of the energy efficiency of their manufacturing processes or the sustainability of their supply chains beyond the use of certain materials.

2.1.3.3.5.3 Forvia sustainable report

Forvia is a leading global automotive supplier, specializing in automotive seating, interior systems, and clean mobility solutions. The French company is known for its innovation and commitment to providing cutting-edge technology solutions to major automakers worldwide. With a strong emphasis on sustainability, Forvia is dedicated to creating eco-friendly and efficient products that meet the evolving demands of the automotive industry. Over its existence, Faurecia has established a strong reputation for its expertise in design and manufacturing, catering to numerous automakers across the globe.

Forvia, in their 2021-2022 Sustainability Report (CSR) [61], has outlined several initiatives that they are implementing to enhance their contribution to the circular economy:

- Eco-design: Forvia is focusing on the concept of "eco-design," designing products with consideration for the environmental impacts during the product's lifecycle.
- Recycling and Use of Recycled Materials: Forvia is actively recycling materials and increasing the usage of recycled materials in their products to minimize waste and dependence on virgin materials.
- Circular Economy Approach: Forvia is actively pursuing a circular economy approach to manage waste and resources within their operations. This includes practices like extending the life of their products through refurbishment and re-manufacturing.
- Carbon Neutrality: Forvia is working to become carbon neutral by 2030. They are investing in energy-efficient technologies and renewable energy sources to reduce their carbon footprint.
- Sustainable Procurement: Forvia follows sustainable procurement practices to ensure that their suppliers also adhere to the principles of sustainability and the circular economy.

Despite these positive efforts, the report does contain certain areas that could be potentially misleading or create an illusion of sustainability:

- Lack of Specifics: The report often discusses sustainability and circular economy efforts in general terms, without giving specific examples or concrete data to back up their claims. This can make it difficult for readers to fully understand the scope and effectiveness of their efforts.
- No Clear Targets: The report fails to provide clear targets and deadlines for most of their sustainability initiatives. Without clear goals and timelines, it's hard to gauge the seriousness and commitment of the company towards these initiatives.
- Focus on Intent Rather Than Actions: Much of the report discusses what the company intends to do rather than what they have already accomplished. While it's important to have plans, focusing mostly on intent can give the illusion of progress without providing evidence of real, measurable change.
- Absence of Third-Party Verification: The report does not mention any third-party verification of their claims. This lack of independent assessment may raise questions about the authenticity of the data and claims provided.

2.1.3.3.5.4 Whirlpool sustainable report

Whirlpool is an American manufacturer and marketer of home appliances. The company has become a household name, offering a wide range of products including refrigerators, washing machines, ovens, and more. Whirlpool is recognized for its commitment to innovation, quality, and sustainability in its products. Whirlpool has a significant international presence and operates in numerous countries around the world. Over the years, it has established itself as one of the leading brands in the home appliance industry.

In the Whirlpool 2022 Sustainability Report (ESG) [62], the company outlines various strategies that promote the principles of a circular economy. Here are some of them:

- Material Efficiency: Whirlpool is focusing on improving material efficiency in its products, including using more recycled materials and reducing waste in its manufacturing processes.
- Energy Efficiency: By making products more energy-efficient, Whirlpool extends the product lifecycle and reduces the environmental impact of the use-phase of its products.
- Product End-of-Life Management: Whirlpool has initiated various recycling programs for end-of-life appliances, aiming to recover materials that can be used in new products, thus promoting a closed-loop system.

Despite these positive steps, there are several aspects of the report that could potentially create an illusion of sustainability:

- Lack of Specific Targets: While the report details numerous initiatives, it often lacks specific targets or timelines for achieving them. Without such specifics, it can be hard to assess the company's commitment to these initiatives or to track their progress over time.
- Reliance on Efficiency: While energy and water efficiency are important aspects of sustainability, focusing primarily on efficiency can be misleading. Efficiency gains can sometimes be offset by increased overall consumption; a phenomenon known as the rebound effect [63].
- Limited Scope of Reporting: While the report provides information on some environmental and social aspects, it does not cover all aspects of Whirlpool's operations. This can create a skewed impression of the company's overall sustainability performance.

2.1.3.3.5.5 Electrolux sustainable report

Electrolux is a Swedish manufacturer of household appliances. Electrolux has established itself as a leading player in the industry. The company offers a diverse range of products, including refrigerators, washing machines, dishwashers, ovens, vacuum cleaners, and more. With a strong emphasis on innovation and quality, Electrolux continuously strives to improve the lives of consumers through their appliances. They are committed to sustainability and eco-friendly practices, aiming to provide efficient and environmentally conscious solutions.

In their 2022 Sustainability Report (ESG) [64], Electrolux has highlighted several steps they are taking to promote the circular economy:

- Commitment to climate-neutral manufacturing: Electrolux has mentioned its commitment towards achieving climate-neutral manufacturing. Yet, the lack of a concrete plan or specific timeline leaves room for uncertainty regarding the company's actual strides towards this goal.
- Use of recycled and renewable materials: The report indicates Electrolux's intention to increase its usage of recycled and renewable materials. However, without concrete data on their current utilization rates and specific future targets, it's challenging to gauge their progress in this regard.
- Product design based on circular principles: Electrolux aims to have all its products designed based on circular principles by 2030. While this is an ambitious goal, the absence of clear benchmarks or indicators of progress makes it difficult to assess the company's real-time movement towards this objective.

However, there are some elements in the report that could create a misleading impression of sustainability:

- Insufficient data on circular economy transition: The report seems to lack comprehensive data pertaining to Electrolux's transition towards a circular economy, leaving readers questioning the extent of their actual progress.
- Feasibility of climate-neutral manufacturing: While Electrolux's goals for climate-neutral manufacturing are commendable, the absence of a comprehensive action plan or timeline might raise doubts about the practicality of these goals.
- Lack of depth in sustainability details: Although the report mentions sustainability in Electrolux's product lifecycle, it doesn't offer an in-depth view or thorough understanding of the matter. This omission may limit the transparency of the company's overall sustainability efforts.

2.1.3.3.5.6 Sustainable reports conclusion

Companies like Patagonia and Interface, which have been deeply involved in the circular economy from their core, often present their sustainability reports as credible resources. These reports typically contain substantial information about their commitment to circular economy practices. On the other hand, companies such as Whirlpool, Electrolux and Forvia, which originated from a linear economy model, rarely provide solid evidence of stimulating or adopting circular economy initiatives. Their sustainability statements are often rooted more in intentions than concrete actions.

Considering these circumstances, a clear trend can be observed. Commercial entities that are primarily profit-driven and whose origins are not rooted in the principles of the circular economy are unlikely to make abrupt changes. The modifications they make to promote the principles of the circular economy are often relatively minimal, sufficient to comply with existing rules and regulations, but do not significantly disrupt their existing operations. The

main motivation of these corporations is still to maximize profits rather than care for the environment. Consequently, for these companies to seriously consider improving the sustainability of their products or production processes, they need to see tangible economic benefits from doing so, or they may need to enforce circular economy regulations more strictly.

In contrast, companies where sustainability is embedded in their core values demonstrate a genuine commitment to the transition to a circular economy. These companies see sustainability not just as a regulatory obligation or a public relations strategy, but as a fundamental part of their mission and operational strategy. As such, they actively engage in practices that promote resource efficiency, waste reduction and recycling, recognizing the long-term environmental, social and economic benefits of such approaches. This clear divide in corporate attitudes highlights the important role of corporate culture and leadership in driving sustainable business practices.

2.1.3.4 Non-patent literature conclusion

In summary, the table serves as a valuable snapshot of organizations that are leading the way in transitioning to a circular economy. These organizations are pioneers, challenging traditional linear economic models and establishing new benchmarks for others to follow. Success stories of Circular Economy initiatives can be found all around the world, indicating a global trend towards addressing this important topic. While regions like Europe and North America are leading the way with their abundant resources for such initiatives, the movement can be observed on a global scale. It is heartening to see that the problem of sustainability is being tackled worldwide, with varying degrees of effectiveness. Whether it's a significant step or a smaller effort, the response to the challenge of creating a more sustainable future can be witnessed in different corners of the globe. An intriguing trend that has emerged is the broadening scope of the circular economy concept. While plastic pollution has rightfully received significant attention, it is encouraging to see that sustainability initiatives are now exploring and addressing a wide range of objects and waste materials. This inclusive approach recognizes that the challenges of sustainability extend beyond plastics and encompasses various types of products. By considering and investigating different objects, the circular economy movement aims to create holistic solutions that tackle multiple environmental issues simultaneously. By showcasing successful examples of circular economy practices, the table inspires and motivates other entities to adopt similar strategies and embrace the principles of sustainability. It highlights the importance of breaking away from the linear model and emphasizes the potential for positive change that can be achieved through circular economic approaches. The table not only provides valuable insights into the strategies and successes of these organizations but also serves as a catalyst for driving broader adoption of circular economy principles across industries and sectors.

2.1.4 Guidelines requirements

After establishing the foundational inputs that form the basis for the development of guidelines on knowledge and good practices, it is crucial to outline the structural framework of the thesis. This entails defining the requirements for the organization and adaptability of the content. By doing so, the thesis can be structured in a manner that ensures coherence and flexibility, allowing for effective communication of the intended information and facilitating ease of navigation for readers.

The guidelines should be written in clear, simple language that can be easily understood by the intended audience. The guidelines should be written in clear, simple language that can be easily understood by the intended audience. Information should be logically arranged, with a clear flow from one section to the next. Incorporating tools like a table of contents or graphical representation allows for easy navigation, enabling users to track required steps. While accuracy is important, compactness ensures that readers can quickly grasp key points [65]. The significance of these elements lies in maximizing the guideline's utility and ensuring that the audience can both access and apply the information effectively.

Guidelines should be adaptable to various contexts or situations where stakeholders might apply them. This flexibility ensures broader applicability and relevance. They should be based on credible sources and research. There should be a way for users to provide feedback on the guidelines, ensuring continuous improvement based on real-world application [66]. Incorporating a mechanism for users to share feedback facilitates an iterative refinement process. Additionally, presenting real-world examples or case studies offers the illustrations of the guidelines' practical utility. Such examples serve as clarifying agents, helping stakeholders visualize and comprehend the guidelines' real-life implications.

Guidelines should not just provide information but clear steps or actions that stakeholders can take based on the guidance. Consideration should be given to any training or support stakeholders might need to effectively utilize the guidelines. Incorporate diagrams, charts, and other visual aids to enhance understanding and retention of information.

2.1.6 PESTEL in guidelines development

The utilization of the PESTEL analysis (Table *1*: PESTEL analysis of Circular Economy and Leveraging Patents) was important in developing the strategies for patent search guidelines within the context of the CE. By systematically breaking down external factors into Political, Economic, Environmental, Social, Technological, and Legal realms, this analysis shed light on the complex interactions between IP and the CE. Each of these elements brought attention to unique strategies. For instance, the political dimension emphasized the importance of aligning with eco-friendly government initiatives, while the technological aspect highlighted the need to stay informed about emerging innovations.

Through the application of the PESTEL framework, a comprehensive strategy for conducting patent searches was developed, enabling meaningful insights within the macro-environmental context of the Circular Economy. This analysis not only determined the key areas of focus for the searches but also influenced the strategic utilization of the findings, considering all factors identified in the Pestel analysis. As a result, the patent search efforts were aligned with the broader context and considerations outlined in the PESTEL analysis, ensuring their relevance and applicability in real-world scenarios.

2.2 Testing of the guidelines

The testing of the guidelines for boosting CE involves the establishment of a testing protocol, which aims to collect feedback from users regarding the usefulness and usability of the guidelines. This process allows for the evaluation of the guidelines' effectiveness and their practicality in real-world scenarios.

The developed guidelines are aimed to be tested in different circular economy scenarios, involving members of organizations within a industry context. The focus was on assessing the versatility and adaptability of the guidelines through multiple case studies, aiming to understand the visible benefits and potential challenges of implementing them in real-world industrial settings.

The objectives of testing the guidelines for patent search are multifaceted. First and foremost, the aim is to assess the accuracy, comprehensiveness, and relevance of the content to the domain of patent searching. This process also seeks to determine the usability and clarity of the guidelines for a range of users, identify any content gaps or ambiguities, evaluate their effectiveness in facilitating successful patent searches and verifying whether opportunities to enhance the CE were identified. Feedback will be collected to highlight potential areas for improvement and to gauge user satisfaction. Furthermore, the testing will check the alignment with current industry practices and explore the guidelines' general applicability across different sectors and regions.

2.2.1 Participant selection

To ensure the validity and practicality of the guidelines, structured interviews and surveys were designed and conducted with users of the guidelines. The objective was to collect direct feedback from stakeholders in the industry sector. The emphasis was placed on involving organization members who possess experience in intellectual property or circular economy. Their feedback would be valuable in assessing the usefulness of the developed guidelines [67]. However, to ensure unbiased feedback regarding the usability of the guidelines, members without such experience were also included in the testing process.

In the search for testers, the focus was on professionals within organizations who have experience with products that the company is responsible for. Additionally, it was important for the testers to have a connection to circular economy or intellectual property rights. The

process involved reaching out to individuals in the companies and leveraging external contacts to find and engage the testers. Testers were encouraged to participate by emphasizing the potential benefits of the guidelines, which could help enhance circular economy practices within their organization.

The emphasis was placed on involving organization members who possess experience in intellectual property or circular economy. Their feedback would be valuable in assessing the usefulness of the developed guidelines. However, to ensure unbiased feedback regarding the usability of the guidelines, members without such experience were also included in the testing process.

2.2.2 Testing process

A combination of interviews and questionnaires has been proposed as a method to collect feedback on the usability and usefulness of the guidelines. This approach allows for a more comprehensive understanding of the feedback. Interviews offer advantages over self-completion questionnaires, as interviewers can provide clarification and ask for further elaboration on responses. Respondents often find the interview process more rewarding than filling out a form, leading to higher participation rates and more in-depth questioning. However, interviews can be time-consuming for researchers and may introduce interviewer bias. On the other hand, self-completion questionnaires are cost-effective and better suited for issues with a limited number of clear and simple questions. They are particularly useful for surveying geographically dispersed individuals. By combining both methods, researchers can gather detailed and accurate feedback from a larger group of people while minimizing potential biases and limitations [68].

It is important to emphasize that this study is of an exploratory nature, aiming to delve into the subject matter and gain a deeper understanding. As such, the initial data collection conducted serves as a foundational step in the process of refining and fine-tuning the guidelines. This preliminary data gathering provides valuable insights and serves as a starting point for further analysis and development of the guidelines.

By recognizing the exploratory nature of the study, it becomes evident that the guidelines are not set in stone but are subject to refinement based on additional research, feedback, and practical implementation. The initial data collection serves as a crucial foundation that informs subsequent iterations of the guidelines. As more information becomes available and as the guidelines are tested and implemented in real-world scenarios, adjustments and improvements can be made to ensure their effectiveness and relevance.

2.2.3. Feedback collection

The guidelines were distributed to prospective users through email correspondence (Appendix B.11). Accompanying the guidelines was an introductory note that elaborated on the central theme and objectives of the thesis. Furthermore, to provide clarity and context, a

concise overview was provided detailing the purpose of these guidelines and outlining the specific feedback and actions expected from the users. This approach was taken to ensure that recipients had a clear understanding of the guidelines' significance and their role in its evaluation and improvement.

2.2.4 Data analysis

Upon conducting structured interviews and surveys with the selected participants, the gathered feedback was subjected to a systematic analysis to gauge the guidelines' efficiency and applicability. The primary objective was to derive insights from the data concerning the guidelines' accuracy, comprehensiveness, and relevance within the realm of patent searching. Detailed evaluations of user responses from both interviews and self-completed questionnaires allowed for a nuanced understanding of the guidelines' usability, clarity, and potential content gaps. The purpose of the structured interview is to gather general feedback regarding the implementation of the guidelines and to gain a deeper understanding of the user's profile and their research area.

The foundational logic of quantitatively testing guidelines for patent search lies in assessing their efficacy, general applicability, and user-friendliness. Firstly, it is crucial that these guidelines consistently yield relevant results, demonstrating their efficacy. Furthermore, the guidelines need to be versatile enough for application across diverse contexts, underscoring their broad applicability. Lastly, for these guidelines to gain widespread acceptance, they must be intuitive and user-friendly, enabling stakeholders, even those with minimal patent experience, to leverage them effectively.

Metrics serve as measurable indicators to evaluate the success of guidelines. An important metric is the search rate, which shows whether relevant patents were retrieved during the process. Additionally, user satisfaction rates (useability), gathered through feedback forms or post-search surveys, provide insights into the guidelines' user-friendliness and overall effectiveness. Another set of metrics included is the Task Load Index which is crucial because it provides insights into the perceived strain and demands of a task from the user's perspective. When applied in the context of testing guidelines, it can indicate areas where a process or system might be overly complicated, time-consuming, or frustrating, thus pointing out potential avenues for improvement. Metrics for evaluating the guidelines encompass various dimensions of utility and applicability. They gauge the perceived value usefulness and ensure the guidelines' objectives. Completeness is verified by assessing areas users find insufficient, while concerns are identified by pinpointing sections users find complex. Relevance measures how closely the guidelines align with users' specific needs. Users' experience with other guidelines offers a comparative perspective, and the real-world effects of guideline adherence are captured through inserting outcomes. An open-ended section for recommendations and final thoughts ensures a holistic understanding of user experience.

Furthermore, the data interpret the guidelines' alignment with modern industry practices and their adaptability across various sectors. The feedback from experienced professionals in the fields of intellectual property and circular economy provide deep insights into the practical application and value of the guidelines. Simultaneously, input from those unfamiliar with these domains was crucial in determining the guidelines' intuitiveness and general accessibility. The blend of diverse feedback paved the way for the iterative refinement of the guidelines, ensuring their robustness and utility in real-world industrial contexts [69].

2.3 Methodology conclusion

By employing a range of methodologies, each tailored to address specific aspects of the research question, this study aims to achieve a comprehensive, grounded, and actionable exploration of the relationship between intellectual property and the circular economy in an industrial context. The approach adopted seeks to demonstrate the pivotal role of IP in advancing sustainable development and the CE.

The focus in methodology was on assessing the versatility and adaptability of the guidelines through multiple case studies, aiming to understand the visible benefits and potential challenges of implementing them in real-world industrial settings.

Methodology act as the bridge connecting patent searching and the circular economy. By opting for specific research methodologies that prioritize the identification of innovative, sustainable, and circular technologies or methods within patents, researchers can highlight the direct contributions of intellectual property to circular economy principles. Moreover, structured guidelines and evaluation criteria ensure that the patent search is focused on key attributes that align with circular economy goals. By combining traditional patent searching techniques with criteria tailored to the circular economy, the methodology reveals patents that not only offer novel solutions but also promote sustainable and circular practices.

In wrapping up the methodology, it can be observed that a systematic and comprehensive approach was employed to fuse the complexities of patent searching with the principles of the circular economy. The complexities of patent searching were addressed and the principles of the circular economy were incorporated through exhaustive research and clear guidelines. This approach ensured that the findings not only aligned with the nuances of patent information but also reflected the objectives of sustainability and circularity. As the focus shifts from the methodologies employed, the upcoming results section will showcase the tangible outcomes of this process, shedding light on the intricate relationship between patent search insights and their implications in the realm of the circular economy.

3. Results

The guidelines for patent search were evaluated in the context of the circular economy, and several findings were obtained. In this chapter, sections of the guidelines are presented in a brief manner to give users an understanding of the eventual result of the development of the guidelines. Data from case studies, interviews, and questionnaires were collected and are presented in this section. Feedback from both participants familiar and unfamiliar with intellectual property was considered. The results show the benefits, opportunities, and challenges faced when using the guidelines in different industries.

3.1 Guidelines structure

To give the sensation of the guideline structure, the brief description of each section of the guidelines is presented in the thesis, nevertheless the full paper of "guidelines for patent search" is attached as an Appendix B.

3.1.1 Introduction

The Introduction emphasize the role of patent searches in improving Circular Economy practices and identifying resource-sharing opportunities between sectors. Intellectual property rights facilitate the spread of environmentally friendly knowledge and innovation across industries. To conduct an effective search, organizations should have clear objectives and focus on specific areas of the Circular Economy, such as sustainable production, waste management, and global resilience.

In addition to the evolving landscape of patent searches, there is also a growing recognition of the potential benefits of patents within the context of the circular economy. As businesses and industries strive for more sustainable practices, patents can play a crucial role in protecting and incentivizing innovative solutions that promote circularity, resource efficiency, and waste reduction.

To navigate the patent search process effectively, a visual representation can be a valuable tool. An Appendix B.1 provides a step-by-step process map, outlining the various stages and tasks involved in conducting a comprehensive search. This visual representation helps searchers stay organized, ensuring that all necessary steps are followed, and important aspects are not overlooked. The graphical representation utilized in this study draws its foundation from the Business Process Model and Notation (BPMN). BPMN, a widely recognized standard, provides businesses with a clear, visual means of mapping out their internal processes in a structured manner. By adopting the conventions and symbols of BPMN, the representation ensures clarity, consistency, and comprehensibility, enabling stakeholders to easily interpret and follow the processes depicted. This choice aids in bridging the gap between business process design and implementation, fostering enhanced communication and understanding among various participants [70].

Additionally, an execution form (Appendix B.2) can be utilized to record the progress of the search. This form serves as a checklist, allowing searchers to track their actions, record relevant information, and note any challenges or insights encountered along the way. By using an execution form, searchers can maintain a systematic and well-documented approach to the search process, facilitating future reference and evaluation.

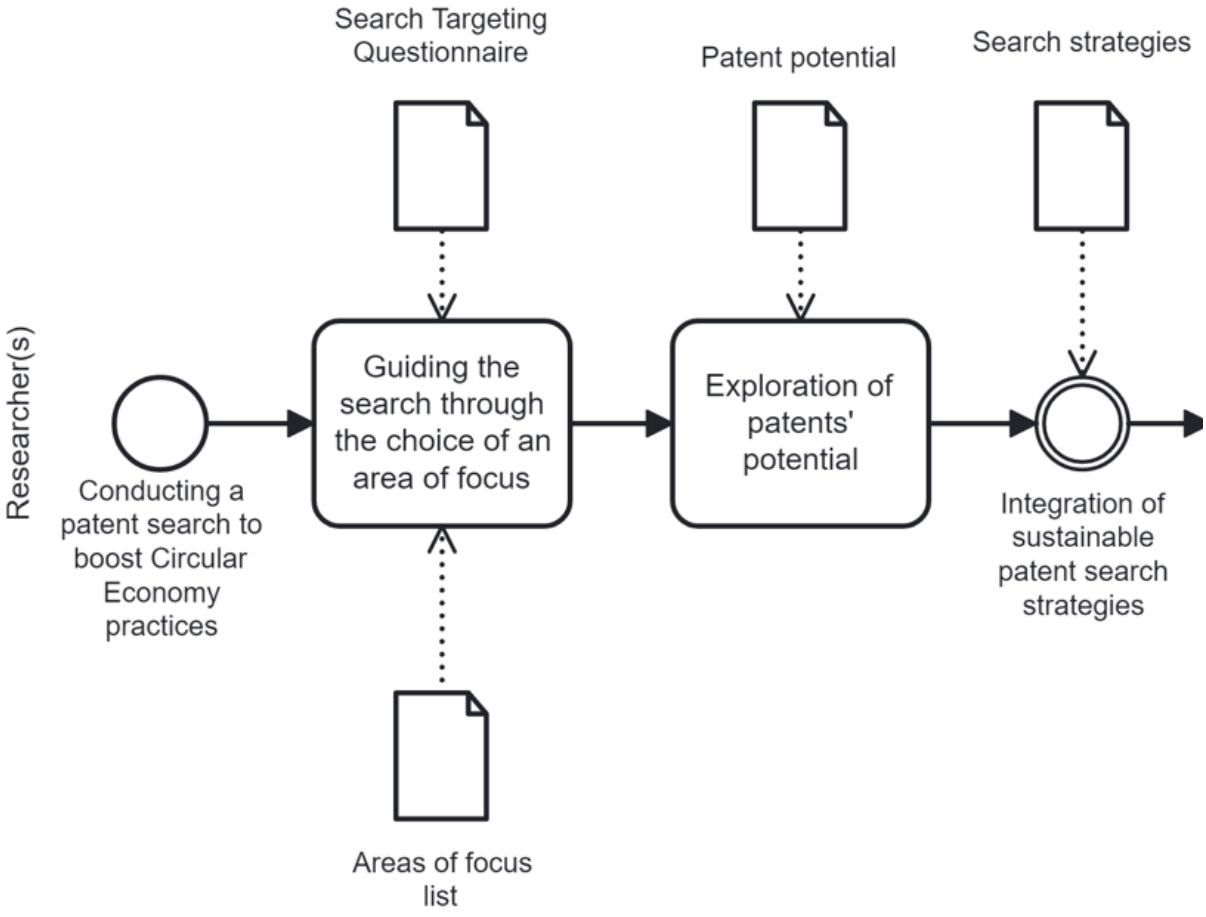


Figure 31: Graphical representation of the introduction and non-patent literature

Overall, incorporating visual representations (Figure *31*: Graphical representation of the introduction and non-patent literature) and execution forms into the patent search process can enhance efficiency, organization, and documentation. These tools provide a structured framework for searchers to follow, ensuring that all necessary steps are completed, and progress is effectively recorded. By utilizing such resources, searchers can streamline their efforts and maximize the chances of uncovering valuable patent information within the context of the circular economy.

3.1.2 Non patent literature

Before diving into patent searches (Figure *31*: Graphical representation of the introduction and non-patent literature), researchers should familiarize themselves with the circular economy's core concepts using non-patent literature. For the guidelines' effectiveness, strategies for patent searches have been outlined to enhance the process and guide users on areas to focus on, potentially elevating circular economy practices during their search. The strategies presented in the guidelines are based on the analysis of success stories and serve as a connection between the circular economy and patent search.

3.1.2.1 Non patent literature strategies on patent search

The non-patent literature analysis of success stories has revealed several highly significant findings. This component of the guideline plays a vital role in assisting users in exploring various targets. These strategies provide substantial support in formulating effective keywords for patent search, which is crucial for successful outcomes.

Selected areas of focus for Circular Economy strategies that have been derived from non-patent literature are listed in the following sections.

3.1.2.2 Production and Consumption

Production and Consumption, in their broadest terms, refer to the creation of goods and their subsequent use by consumers. The strategies listed, such as Integrating Circular Principles and Design for Recyclability, directly influence how products are made and utilized, emphasizing sustainability. Using Organic Materials and employing Advanced Manufacturing Techniques ensure products are not only green but also efficiently produced. Product Lifecycle Management and Integration of Sustainability ensure the entire journey of a product, from creation to disposal, is considered. Lastly, Customer Engagement reflects the final, crucial link between product creation and its end user, ensuring a holistic approach to sustainable production and consumption, the core tenets of a circular economy.

1. **Internal Integration of Circular Principles**: Efforts should be made to integrate circular principles into existing processes and operations. Overall operational sustainability can be improved by examining patents for systems that integrate circular economy principles, such as waste reduction or recycling.
2. **Design for Recyclability**: Products that are durable, functional, and recyclable once they reach the end of their lifespan should be created. Future product designs can be inspired by patents on product designs that facilitate easier disassembly and recycling, such as modular smartphone designs.
3. **Use of Organic Materials**: Organic materials should be prioritized due to their widespread availability, renewability, and biodegradability. A valuable resource could be found in patents related to the production of bio-based products or materials.

4. **Product Lifecycle Management**: Each stage of a product's lifecycle needs to be understood and managed to support sustainable practices. Valuable insights into improving sustainability at each stage of the product lifecycle can be gained by reviewing patents for manufacturing processes that reduce waste or energy usage.
5. **Advanced Manufacturing Techniques**: Advanced manufacturing techniques should be adopted to reduce energy usage, minimize waste, and improve product quality. Patents that detail advanced manufacturing techniques, such as additive manufacturing (3D printing) or precision machining, could offer key insights.
6. **Integration of Sustainability**: Sustainability should be integrated into all stages of a product's lifecycle to minimize environmental impact and meet societal needs. Patents illustrating complete lifecycle sustainability, such as production methods that use less energy, create less waste, or use renewable materials, could be a crucial part of integrating sustainability into operations.
7. **Customer Engagement**: Circular Economy practices among customers should be encouraged by reintroducing the revalorized products back to them. Customer engagement for a circular economy can be shaped by patents that address systems for customer feedback and customer-driven improvements.

3.1.2.3 Waste Management

Waste Management pertains to the practices and processes of handling and disposing of products and materials at the end of their useful life. The strategies listed inherently align with this concept. Comprehensive Waste Management and Emphasis on Waste Reduction concentrate on holistic and efficient disposal methods, ensuring minimal environmental harm. Operational Autonomy and Mechanization of the Recycling Process prioritize streamlining and mechanizing these disposal techniques, ensuring they're not only eco-friendly but also efficient and productive. By focusing on the End-of-life Stage, the strategies pinpoint a critical juncture where waste can be most effectively reduced and resources recaptured, exemplifying the very essence of waste management in a circular economy.

1. **Comprehensive Waste Management**: A comprehensive approach to waste management should be adopted to manage products that have reached the end of their lifecycle effectively. Efficient ways to manage waste can be identified by examining patents for waste management processes or recycling techniques, thus minimizing the company's environmental footprint.
2. **Operational Autonomy**: Control over the revalorization process should be maintained to make necessary adjustments and optimizations. Operational efficiency in waste management can be enhanced by patents on the automation of recycling processes.
3. **Mechanization of Recycling Process**: Machinery should be used to accelerate the recycling process, reduce manual labor, and enhance overall productivity. The

enhancement of the recycling process can be aided by patents related to machines or robots that can sort and process recyclables more efficiently.

4. **Emphasis on Waste Reduction**: The focus should be put on waste reduction to lessen environmental impact. Patents on technologies or systems that reduce waste at all stages of production and consumption could provide crucial insights into reducing a company's environmental footprint.
5. **Focus on End-of-life Stage**: The end-of-life stage of products, where significant opportunities for resource recovery and waste reduction exist, should be emphasized. For companies in the electric vehicle industry, invaluable insights could be provided by patents that address the recycling or safe disposal of electric vehicle batteries.

3.1.2.4 Secondary Raw Materials

Secondary Raw Materials focus on the reuse, repurposing, and reintegration of previously used materials into new products or processes. The strategies outlined resonate with this idea. Versatility in Raw Materials and Innovation in Recycling emphasize broadening the array of reusable materials and refining recycling methods, harnessing the full potential of previously used resources. Modular Design allows for the easier breakdown of products, enabling the efficient extraction and reuse of materials. Sustainable Revalorization ensures that even if a product isn't broken down, its value is restored and prolonged. Lastly, Intelligent Resource Management ensures that when these secondary raw materials are reintegrated, it's done in a manner that's efficient and waste-minimizing, ensuring a circular approach to resource use.

1. **Versatility in Raw Materials**: The capacity to work with a wide range of materials should be developed. Insights into how to manage a wide range of materials, including complex waste, can be provided by patents related to plastic recycling or biodegradable plastic alternatives.
2. **Innovation in Recycling**: Innovative recycling techniques that align with the principles of the Circular Economy should be continually developed and implemented. Inspiration for innovative recycling techniques can be provided by patents presenting novel technologies for recycling specific types of waste, like e-waste or single-use plastics.
3. **Modular Design**: Products should be designed in a modular manner to facilitate their disassembly, repair, upgrading, or recycling. Inspiration can be drawn from patents on modular design principles that enable products to be more easily disassembled or upgraded.
4. **Sustainable Revalorization**: The possibility of restoring the value of the product without dismantling it should be supported. Insights into how to reclaim value from products without dismantling them can be gained, for example, from patents on refurbishing used electronics.

5. **Intelligent Resource Management**: Intelligent resource management should be implemented to optimize resource usage and minimize waste. Patents on technologies that improve resource efficiency, such as smart grids or efficient irrigation systems, could provide valuable insights

3.1.2.5 Competitiveness and Innovation

Competitiveness and Innovation emphasize the need for companies to be agile, forward-thinking, and committed to sustainable growth in today's rapidly evolving business landscape. Openness to Innovation calls for companies to explore and harness new technological advances, recognizing the plethora of untapped possibilities available. Sustainability Metrics provides firms with the tools to measure and, consequently, improve their sustainability efforts, promoting transparent accountability. Innovation in Supply Chain Management offers a pathway to refine operational processes, ensuring efficiency and reduced resource waste. Third-party Support highlights the significance of external collaborations in enhancing operational excellence, with the example of Clarivate accentuating the value of eco-innovative patent analytics. Lastly, Sustainable Business Models pivot businesses towards practices that are not just profit-driven but also environmentally conscious, underlining that sustainability and profitability can, and should, go hand in hand.

1. **Openness to Innovation**: Untapped potential in different sectors should be recognized, and the development of new revalorization strategies should be open. New revalorization strategies can be explored by patents presenting innovative approaches, like using algae to create biodegradable plastic.
2. **Sustainability Metrics**: Metrics for tracking sustainability should be developed and utilized to gauge the success of sustainability efforts. Patents on systems or technologies for tracking sustainability metrics, such as carbon footprint calculators or waste tracking systems, could provide crucial tools for measuring a company's sustainability progress.
3. **Innovation in Supply Chain Management**: Innovation in supply chain management should be encouraged to optimize resource usage and reduce waste. Patents on technologies or systems that improve supply chain efficiency and sustainability, such as real-time tracking systems or optimized logistics, could provide valuable insights.
4. **Third-party Support**: The adoption of the Circular Economy within operations can be fostered by leveraging the support of third-party service providers. The patent search process can be significantly accelerated, and higher quality results can be yielded by using patent search services like Clarivate. Clarivate enhances sustainability through eco-innovative patent analytics.

5. **Sustainable Business Models**: Business models that prioritize sustainability should be embraced. Patents on systems or technologies that support sustainable business models, such as systems for tracking and reducing carbon footprints, could help shape the direction of a company's sustainability efforts.

3.1.2.6 Global Sustainability and Resilience

Global Sustainability and Resilience underscore the importance of a holistic, worldwide approach to sustainable practices, ensuring that businesses are equipped to face global challenges and fluctuations. Geographical Consideration prompts businesses to position their operations in regions with advanced economies and stringent environmental regulations, leveraging their strong foundation in sustainable practices. Engagement across Sectors highlights the potential of tapping into a variety of industries, which when coupled with sustainable practices, can yield opportunities for revalorization, as exemplified by the textile industry's strides in sustainable fabrics. Regulatory Compliance emphasizes the imperative of adhering to environmental laws, ensuring businesses operate sustainably and responsibly. Collaboration with Stakeholders stresses the value of partnerships and transparent communication in driving sustainability goals forward. Finally, the Promotion of Renewable Energy propels companies towards energy solutions that are not only sustainable but also vital in combating global climate challenges, underlining the vast potential of innovative energy-harnessing technologies.

1. **Geographical Consideration**: Regions with advanced economies, strong institutional frameworks, and heightened environmental consciousness should be considered for operation. Sustainable technologies that have been validated in a rigorous regulatory environment can be identified by prioritizing patents filed in regions with strong environmental regulations, such as EU or US.
2. **Engagement across Sectors**: Diverse industries that generate large amounts of waste and discarded products should be involved to offer potential for revalorization. For instance, opportunities for revalorization in the textile industry can be provided by patents related to sustainable fabrics and recycling of textile waste.
3. **Regulatory Compliance**: Compliance with environmental regulations should be maintained to ensure sustainable operations. Patents that deal with technologies or systems for regulatory compliance, such as emission tracking systems or waste disposal technologies, could provide crucial insights into maintaining compliance while promoting sustainability.
4. **Collaboration with Stakeholders**: Collaboration with stakeholders should be facilitated to support sustainable practices. Patents on collaborative systems or technologies that improve stakeholder engagement and feedback could help foster a more sustainable corporate culture.

5. **Promotion of Renewable Energy**: The use of renewable energy sources should be promoted to reduce greenhouse gas emissions. Patents on new technologies for harnessing wind, solar, hydro, or other renewable energy sources can provide valuable insights.

3.1.3 Keyword formulation

The insights from the prior chapter guide the keyword formulation crucial for effective patent searches. It's essential to create a list of keywords, considering synonyms, relevant to the circular economy area of interest (Figure *32*: Graphical representation of keywords formulation). For areas concerning production, waste management, and raw materials, exploring a company's Bill of Materials (BOM) helps track related patents and optimize resources, while for competitiveness and global sustainability, delving into Circular Economy terminology aids in achieving innovation and sustainability goals.

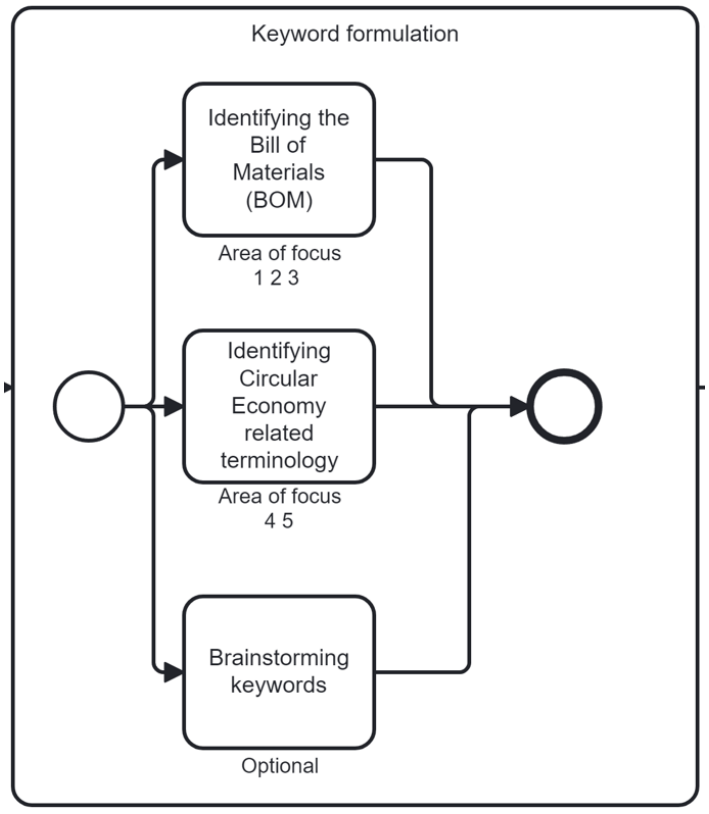


Figure 32: Graphical representation of keywords formulation

3.1.4 Patent databases

This chapter is essential as it provides researchers with the fundamental knowledge necessary to navigate and utilize patent databases effectively (Figure *33*: Graphical representation of Patent databases & Patent classification system). Considering the vastness and complexities of the patent landscape, being able to identify the appropriate database and

optimize its capabilities can significantly impact the accuracy, efficiency, and relevance of search results. By comprehending the specific features and advantages of each database, researchers can customize their search strategies, enabling a thorough and focused exploration of patents. Ultimately, this supports informed decision-making and facilitates the generation of actionable insights.

3.1.5 Patent classification system

The Patent Classification Systems, specifically CPC and IPC codes, serve as a methodical framework to categorize patents based on their technological attributes (Figure *33*: Graphical representation of Patent databases & Patent classification system). Utilizing these systems in patent searches ensures a focused and efficient exploration of specific technological sectors. When targeting areas like sustainability or waste management, these codes streamline the search by pointing directly to related patents. This organized approach is controlling the vast array of patents, ensuring that researchers only focus on the most pertinent and relevant ones.

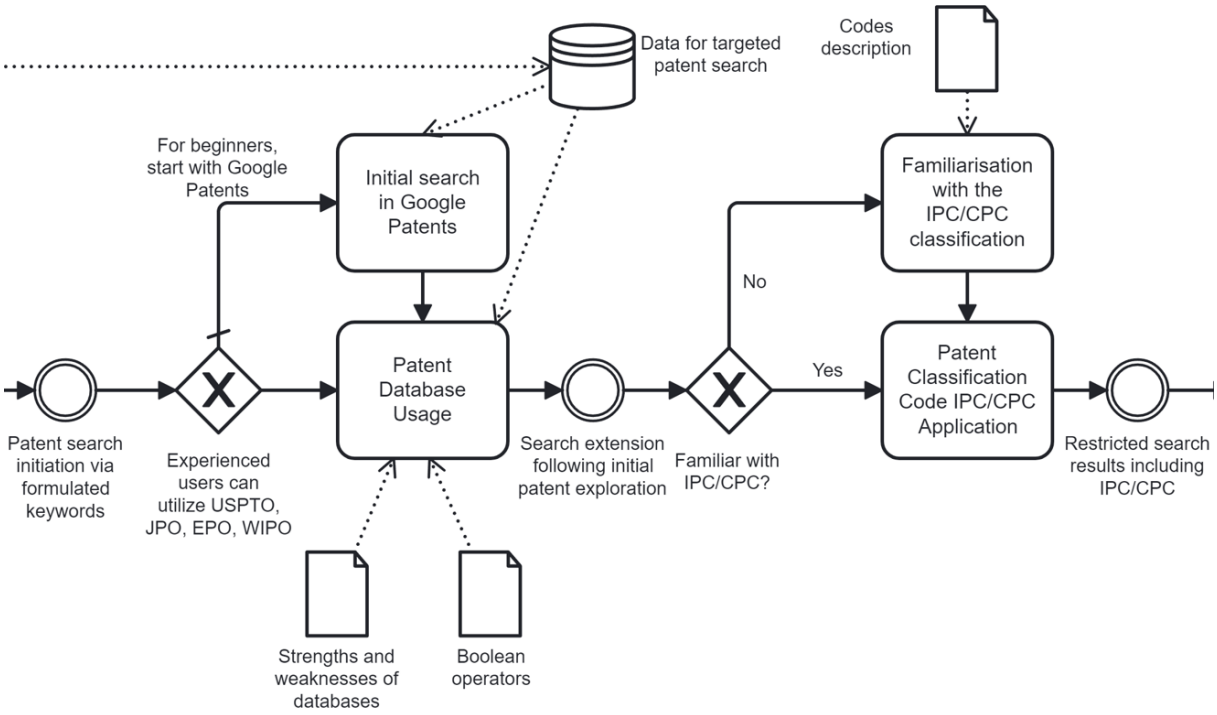


Figure 33: Graphical representation of Patent databases & Patent classification system

3.1.6 Patent analysis

The chapter on "Patent Analysis" provides a systematic approach to understanding and extracting value from selected patents, with a particular focus on the circular economy (Figure *34*: Graphical representation of patent analysis).

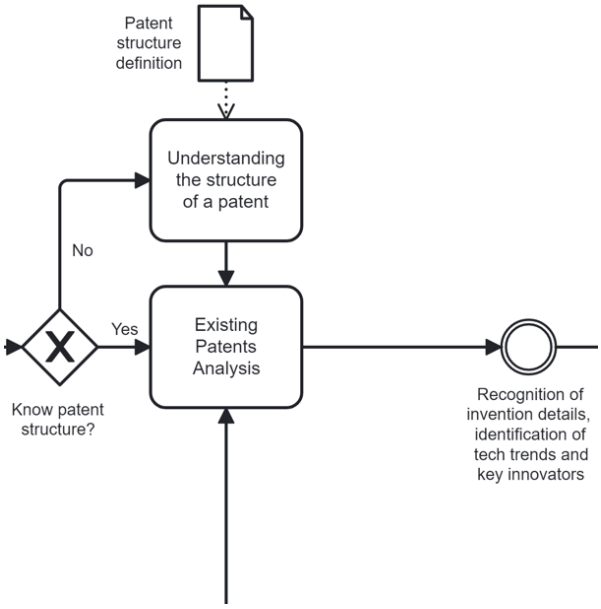


Figure 34: Graphical representation of patent analysis

It explores key components of patents, such as abstracts, claims, and technical solutions, within specific focal areas related to production practices and global sustainability. This analysis allows for the identification of prevailing technological trends, key industry players, and areas where technological advancements are needed. The chapter also delves into the legal aspects of patents, highlighting the importance of patent claims, validity, geographical scope, and methods to ensure non-infringement. The ultimate objective is to offer a comprehensive perspective on patent activity, providing valuable insights for strategic decision-making and potential innovations in the field.

3.1.7 Legal expert consultation

This chapter underscores the potential value of seeking guidance from patent attorneys or legal experts, especially when interpreting complex patent claims, assessing patent validity, and navigating potential infringements (Figure *35*: Graphical representation of Legal expert consultation & Strategic application of findings). While their expertise can enhance precision and provide strategic insights in various patent-related areas, their involvement remains optional. Researchers can still undertake patent searches and analysis independently if they possess a robust understanding of the patent process and are comfortable doing so. However, the depth and accuracy that a legal expert brings to the table can be invaluable in critical decision-making contexts.

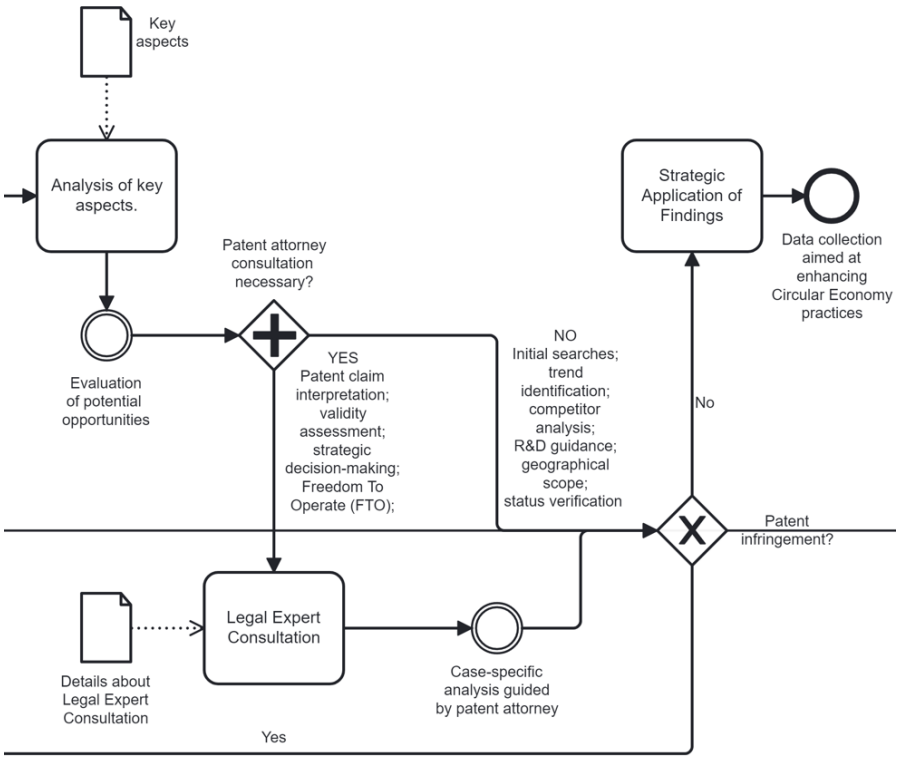


Figure 35: Graphical representation of Legal expert consultation & Strategic application of findings

3.1.8 Strategic application of findings

The chapter on "Strategic Application of Findings" highlights the significance of utilizing insights derived from patent analyses to drive strategic decision-making across various domains (Figure *35*: Graphical representation of Legal expert consultation & Strategic application of findings). These insights play a crucial role in shaping research and development trajectories by identifying market gaps and directing competitive analysis through understanding competitors' research focus. They also contribute to effective risk management by helping organizations avoid potential patent infringements. Additionally, these findings guide investment or acquisition strategies by leveraging a company's patent strengths. Understanding the patent landscape is also instrumental in devising legal strategies, such as patenting novel innovations or navigating licensing agreements. By astutely applying these patent insights, organizations can enhance their position within the circular economy, navigate legal challenges, and align their efforts with the most promising opportunities.

3.2 Guidelines feedback

The dynamic between patents and the CE reveals both synergy and discord, with patents protecting and motivating innovations, but also potentially restricting access to essential CE knowledge. Innovation in the CE domain has greatly benefited from patent

protections, particularly in sustainable technologies, eco-designs, and recycling methods. Protecting intellectual property while promoting sustainability presents significant challenges, including policy gaps and potential patent infringements in sustainable processes. There is a research gap in comprehensive studies on the intersection of CE and IP, particularly leveraging patent information.

The insights and comments provided by users who have engaged with and implemented the guidelines are examined. These guidelines, which were developed to navigate the complex interplay between patent searching and the principles of the circular economy, underwent rigorous research and iterations. Their effectiveness and relevance, however, can truly be assessed only when evaluated in real-world scenarios. Through feedback, both strengths to be maintained and areas in need of improvement are identified. Within this chapter, the varied feedback received is systematically analysed, with themes identified and conclusions drawn in the following chapter. A holistic understanding of this feedback will shape future versions of the guidelines, highlighting the importance of user feedback in the iterative development of impactful resources (Appendix C).

3.2.1 Quantitative analysis

Feedback on the usability of the guidelines for patent search is examined. Quantitative methods were employed to evaluate users' opinions. While the guidelines were designed to assist in the complicated task of patent searching, their effectiveness in real-world scenarios was assessed. Through the feedback obtained, the strengths and areas for improvement of the guidelines were identified. This analysis will serve as a foundation for potential refinements, ensuring that the guidelines can be optimally beneficial to a wider audience.

A set of ten multiple-choice questions was created (Appendix B.3) to quickly collect feedback on the general usability of the guidelines, particularly in areas like clarity of data organization, ease of use, and overall user confidence. Respondents were asked to rank their responses on a scale where '1' represented 'Strongly Disagree' and '5' indicated 'Strongly Agree'.

Based on the feedback collected, it became evident that every respondent found the guidelines to be user-friendly and intuitive (Figure *36*: Guidelines' easiness of use). This positive reception underscores the guidelines' effectiveness in offering clear direction, suggesting that their design aligns well with the needs and expectations of the intended audience. Such a result affirms the clarity and accessibility of the content.

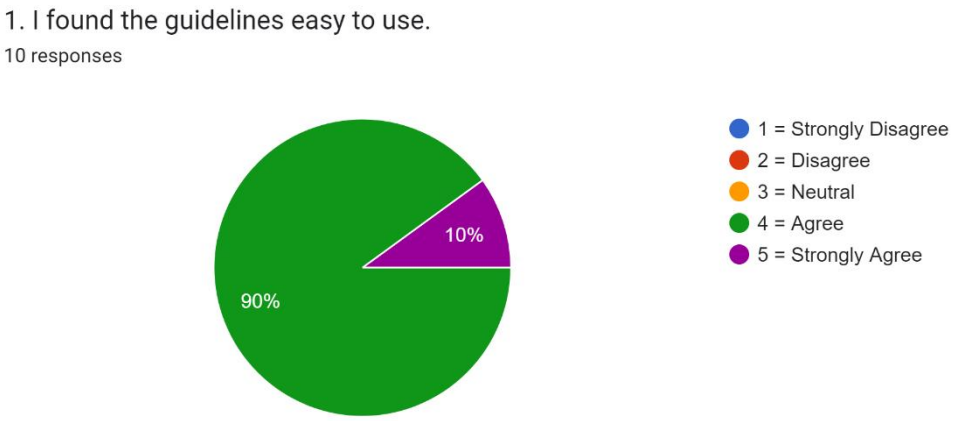


Figure 36: Guidelines' easiness of use

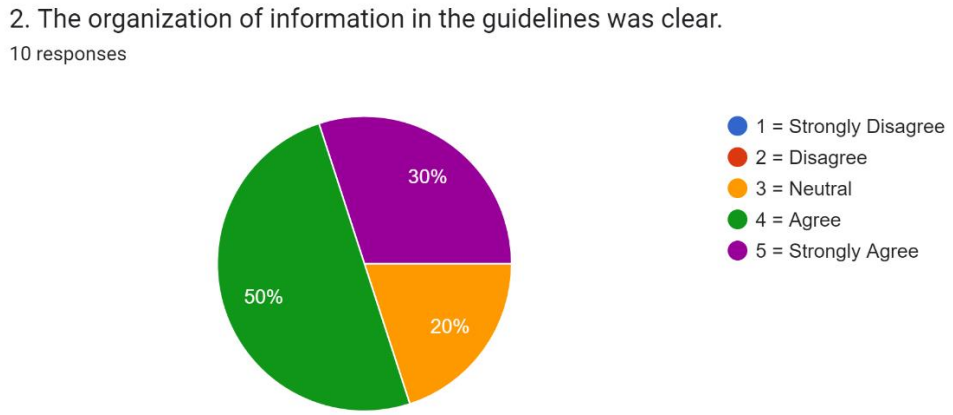


Figure 37: Guidelines' organization

The vast majority of respondents expressed a positive perception, noting that the information was methodically organized and presented (Figure *37*: Guidelines' organization). However, a modest segment of participants maintained a neutral stance concerning the clarity of the data, suggesting potential areas for refinement.

Similarly, the positive feedback persisted as participants expressed their confidence in navigating the guidelines. The majority of participants felt empowered and believed that they did not require external assistance or guidance (Figure *38*: Confidence while using guidelines). However, it is worth mentioning that 20% of the respondents had a more cautious perspective, indicating neither strong confidence nor significant doubt.

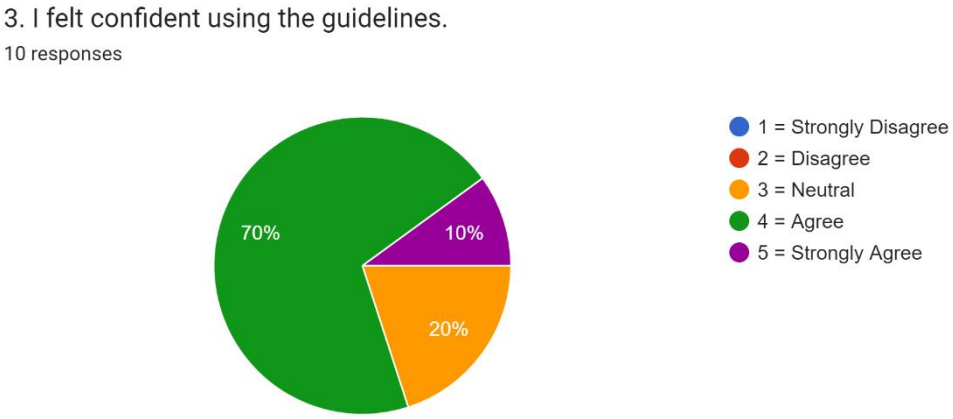


Figure 38: Confidence while using guidelines

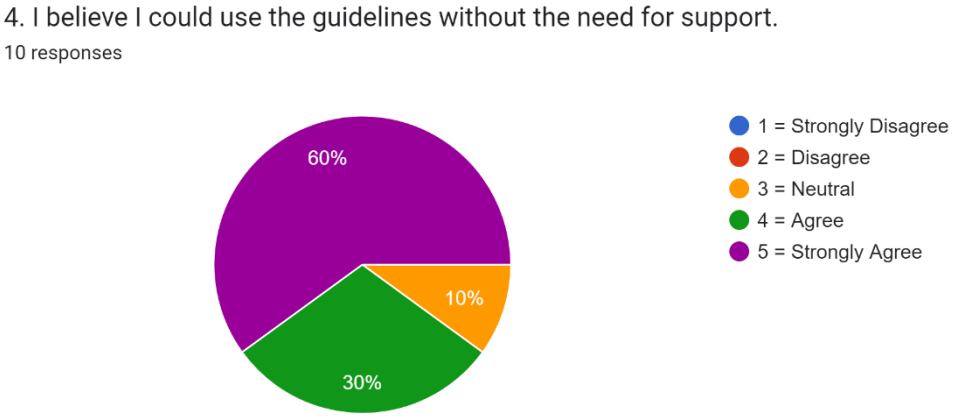


Figure 39: Need for support to use guidelines

The majority of participants found the guidelines to be self-explanatory and user-friendly, indicating that the material was well-structured and intuitive (Figure *39*: Need for support to use guidelines). They felt confident navigating through the content without seeking external assistance. However, a solitary respondent opted for a more measured response, indicating neither complete self-sufficiency nor the explicit need for external support. This feedback suggests the importance of ensuring that guidelines remain accessible to a diverse range of users, as well as considering the potential need for supplementary resources or clarifications in specific areas.

When delving into the content of the guidelines, a commanding majority of 80% found the material to be intuitive and easy to comprehend (Figure *40*: Guidelines' understanding). They felt that the content was articulated in a manner that resonated with their prior knowledge and experience. On the other hand, 20% of respondents remained on the fence, expressing a neutral opinion. This suggests that, while they didn't find the content particularly challenging, there might be areas that could benefit from further clarification or refinement to cater to a broader audience.

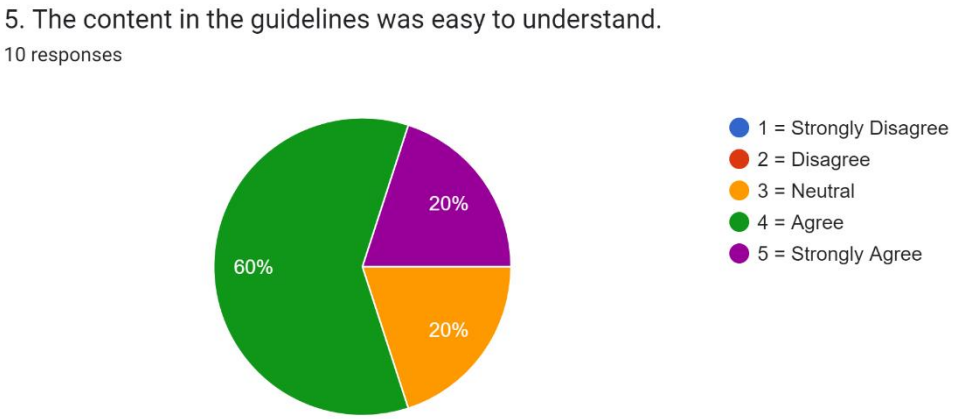


Figure 40: Guidelines' understanding

The feedback from respondents regarding how the guidelines aligned with their initial expectations showed a range of reactions (Figure *41*: Expectations towards guidelines). A substantial 60% maintained a neutral stance, indicating neither dissatisfaction nor particular commendation. This suggests that while they didn't find any significant issues, there may have been certain aspects that could be improved upon or explored in more depth. On the contrary, the remaining 40% expressed positive feedback, confirming that the guidelines not only met but potentially exceeded their initial expectations. This positive endorsement highlights the value and relevance of the guidelines for a significant portion of the user base.

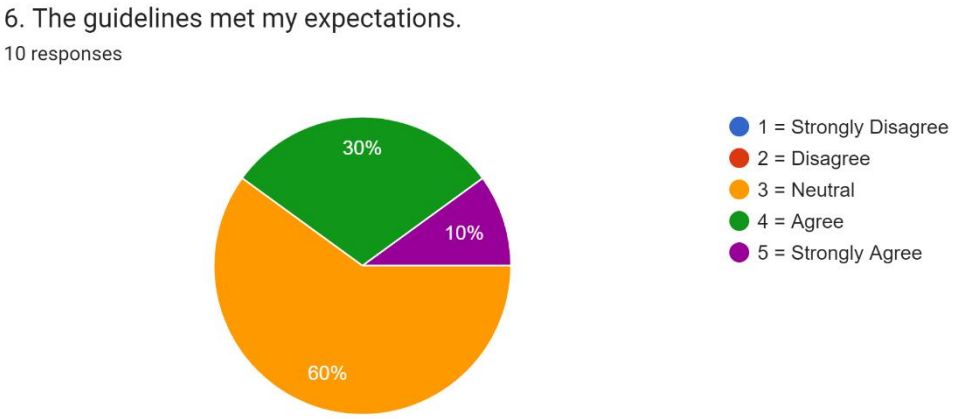


Figure 41: Expectations towards guidelines

The perspectives of users regarding the learning process for using the guidelines were diverse (Figure 42: Learning the guidelines). Among the respondents, 30% had a neutral opinion, indicating neither agreement nor disagreement with the ease of learning. On the other hand, 40% of the users agreed that learning to use the guidelines was a manageable task. They found it relatively straightforward and comprehensible. Furthermore, an additional 30% of the users strongly agreed that learning to use the guidelines was effortless. They found the guidelines intuitive and user-friendly, which facilitated their understanding and utilization. These positive responses demonstrate that a significant proportion of users found the guidelines to be accessible and easy to grasp.

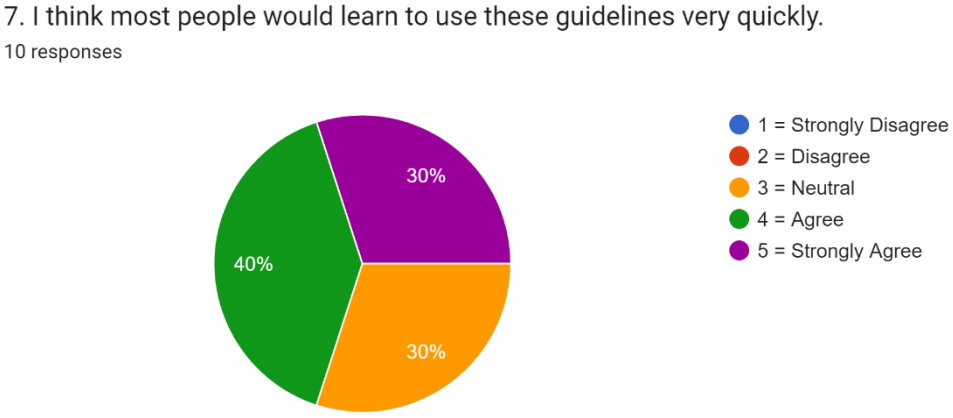


Figure 42: Learning the guidelines

None of the respondents perceived the guidelines as overly complex (Figure *43*: Guidelines' complexity). A majority of 60% disagreed with the notion of complexity, indicating that they found the guidelines to be straightforward and manageable. They did not encounter any significant difficulties in understanding or implementing them. Additionally, 40% of the respondents maintained a neutral stance regarding the complexity of the guidelines. This suggests that while they did not find the guidelines particularly complex, they also did not express strong agreement with the ease of understanding. Overall, these findings indicate that the guidelines were generally perceived as clear and comprehensible, with a lack of significant complexity reported by the respondents.

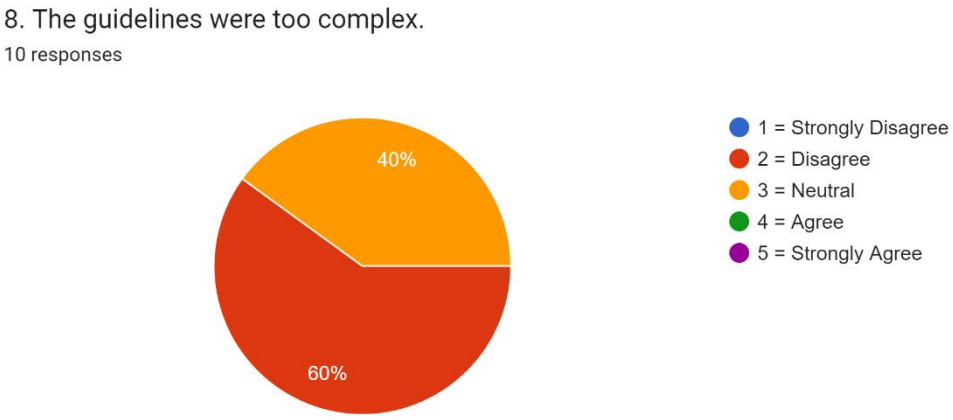


Figure 43: Guidelines' complexity

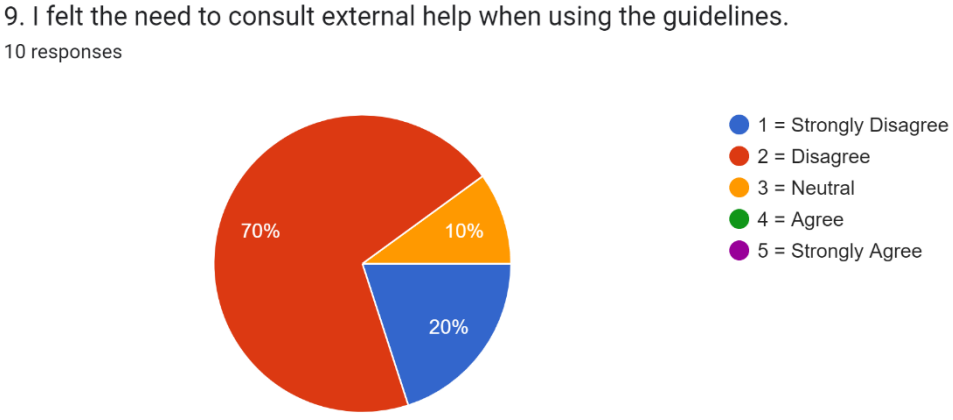


Figure 44: Need for external help then using guidelines

When it came to seeking external consultation, most of the participants expressed a sense of self-sufficiency (Figure *44*: Need for external help then using guidelines). They believed that they had enough resources and knowledge to navigate the situation without the need for outside assistance. This majority group felt confident in their abilities and did not see the necessity of seeking external consultation or support. However, it is worth noting that one individual remained undecided on the matter. This person had mixed feelings and was unsure whether they should rely solely on their own judgment or consider seeking external input. This hesitation highlights that even within the majority, there can still be individuals who have reservations or uncertainties about their self-sufficiency.

In conclusion, the majority of participants, accounting for 90% of the respondents, expressed a belief that the guidelines were comprehensive (Figure *45*: Information in the guidelines). They found the guidelines to be thorough and inclusive, covering all the necessary information and providing a comprehensive framework for their needs. This positive sentiment indicates that the guidelines were well-received and met the expectations of a significant portion of the users. However, it is worth noting that one participant remained neutral on this aspect. This individual neither strongly agreed nor disagreed with the comprehensiveness of the guidelines. Their neutral stance suggests that they may have had a different perspective or had reservations about certain aspects of the guidelines. Despite this, the overwhelming majority's belief in the comprehensiveness of the guidelines highlights their effectiveness in addressing the needs and expectations of the users.

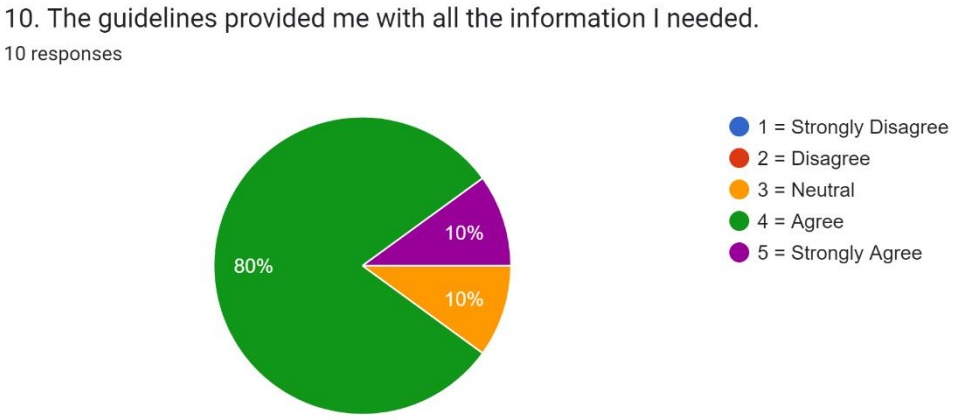


Figure 45: Information in the guidelines

Based on the gathered feedback, it is evident that the majority of users found the guidelines user-friendly and well-organized. While most respondents expressed confidence in using the guidelines and understanding its content, a notable portion remained neutral on various aspects, suggesting potential areas for refinement. Overall, the guidelines appear to fulfil their purpose effectively for most users, though there's a clear indication for potential improvements to address the concerns of those who held neutral views.

3.2.2 Qualitative analysis

The feedback received on the guidelines for patent search, particularly in relation to the circular economy, has yielded valuable insights into users' perceptions and experiences. Through qualitative analysis, a comprehensive understanding of users' sensations has been gained, allowing for a deeper exploration of the strengths of the guidelines, areas that may require improvement, and specific user needs. The following analysis provides an overview of users' responses, offering a detailed examination of their experiences and identifying potential opportunities for refinement. To gather feedback on the usefulness of the guidelines, a set of ten open-ended questions was formulated. These questions were designed to encourage respondents to provide their insights and opinions on various aspects of the guidelines, allowing for a comprehensive evaluation of their effectiveness. The open questions aimed to capture valuable feedback and generate meaningful discussions that can contribute to further improvements and refinements of the guidelines.

The guidelines are perceived by the majority as tools that advance both the circular economy and innovation. While they are generally seen as a positive step, there is a perception that they may be too detailed or complicated for some users (*Instructions were complex. For some searches it might be too much, but it would help in other searches*). Many users appreciate the depth and comprehensiveness of the guidelines. However, there is a noticeable demand for enhancing the visual elements, suggesting a preference for intuitive, graphical explanations over textual descriptions (*More details at the beginning of graphical guidelines.*). In terms of clarity, a significant number of users find the guidelines to be clear. However, scattered feedback about specific sections being convoluted indicates the need for a more streamlined structure or explanatory notes in certain areas (*Some parts are complex and require a focus when reading*.). While the relevance of the guidelines is widely acknowledged, some users imply that they could navigate patent searches without this additional aid (*"The guidelines were specific and helpful in finding and completing the next steps of the guide"*). This raises questions about whether the guidelines' unique advantages are adequately highlighted. In practical terms, the guidelines are considered actionable by most users. However, recurring mentions of difficulties related to keyword selection and identifying relevant results highlight the importance of improving this component ("*Main challenge is to use specific keywords to find best suited results.*"). Opinions regarding the guidelines vary. Some users appreciate the profound insights they offer, while others find them to be more complex ("I*t is more complex that normal patent search guideline.*").

When it comes to outcomes, there is a predominant positive trend regarding the efficiency of searches. However, issues related to navigating the guidelines and filtering out irrelevant results indicate areas that require attention ("*I went through couple of patents that were irrelevant, but I found a proper one eventually."*). The feedback emphasizes the importance of visual aids. While current illustrations are well-received underscoring their significance in the context of patent searches (*"Graphical representation helped go through the process."*). Users' recommendations are valuable and point towards potential enhancements such as improved visuals, increased conciseness, and a more intuitive navigation design (*"I would try to make it more simple to go through but keep the level of details. Maybe the format could change."*). The reception of the guidelines fluctuates between admiration for their innovative approach and scepticism regarding their necessity. This highlights the need for a clearer articulation of the guidelines' unique value proposition.

During the testing phase, it was observed that industry-related organizations were the primary users of the guidelines. However, challenges arose when these users displayed gaps in their sustainability or patent search knowledge, emphasizing the importance of having a foundational understanding for optimal utilization of the guidelines.

The feedback received through qualitative analysis highlights the generally positive reception of the guidelines, along with constructive criticism aimed at improvement. By addressing the identified areas for enhancement and leveraging the existing strengths, the guidelines can be further refined to create a more user-centric and effective tool for conducting patent searches within the context of the circular economy. This iterative process of incorporating feedback will ultimately contribute to the continued evolution and optimization of the guidelines.

3.2.3 Task Load Index

NASA Task Load Index (TLX) is a subjective workload assessment tool developed by NASA for evaluating perceived workload during task performance. It provides a multi-dimensional rating based on six subscales: Mental Demand, Physical Demand, Temporal Demand, Performance, Effort, and Frustration. By evaluating these subscales, researchers and professionals can understand how various factors influence an individual's task workload. This tool is extensively utilized across different fields to gauge workload and decipher its impact on performance [71].

The responses on the Task Load Index were reviewed to study the general workload on the task. The scale was ranged from 1 to 7, with 1 being low and 7 being high, and the neutral score was represented by number 4.

The mental demand was found to be slightly high, indicating that the process of going through the guidelines was mentally demanding (Figure *46*: Mental demand). This outcome was expected, as patent searching is typically a demanding task even for experienced users.

The physical demand was generally perceived as low, as the task did not require physical activity, but rather focused on mental engagement (Figure *47*: Physical demand).

The temporal demand was perceived as neutral to low, suggesting that the task was not excessively long but still required a certain amount of time to complete (Figure *48*: Temporal demand).

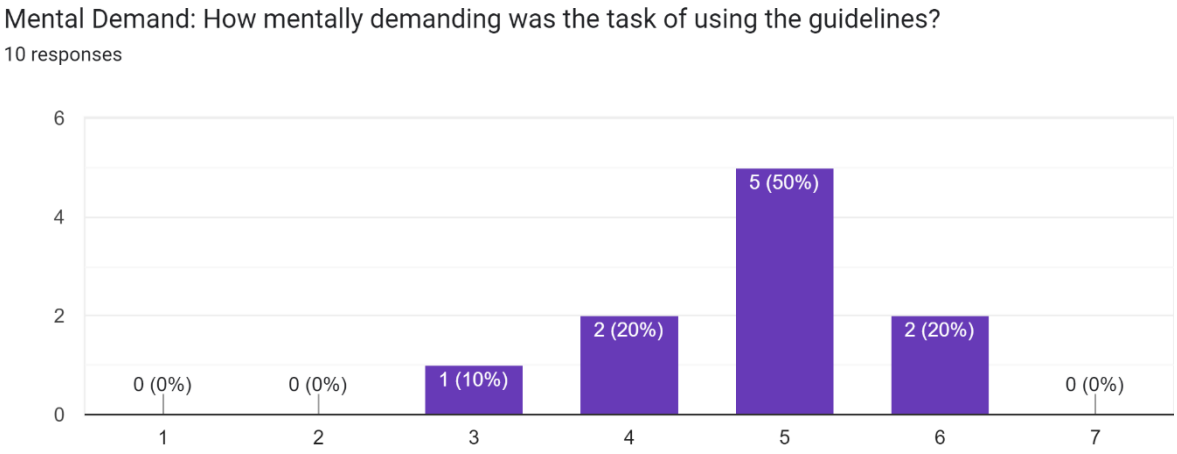


Figure 46: Mental demand

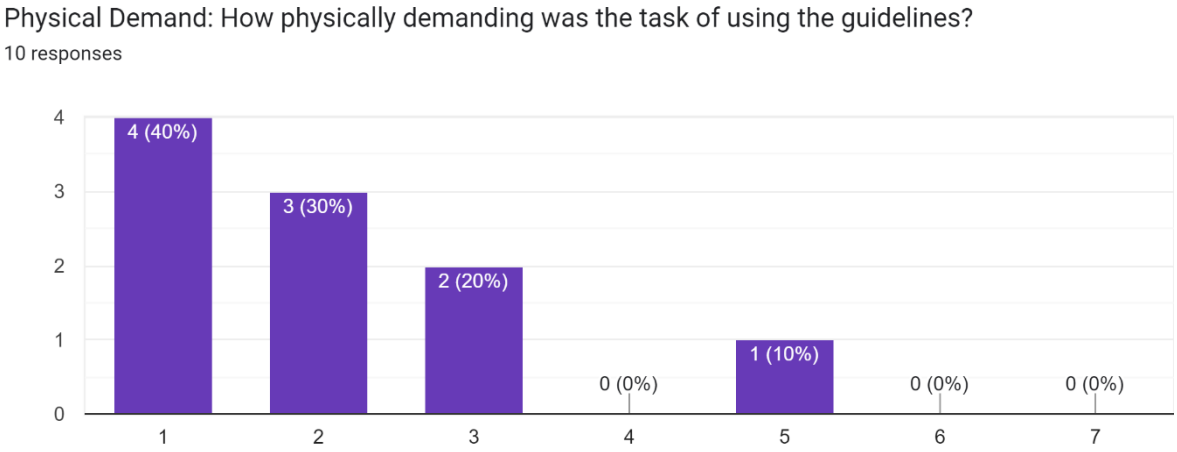


Figure 47: Physical demand

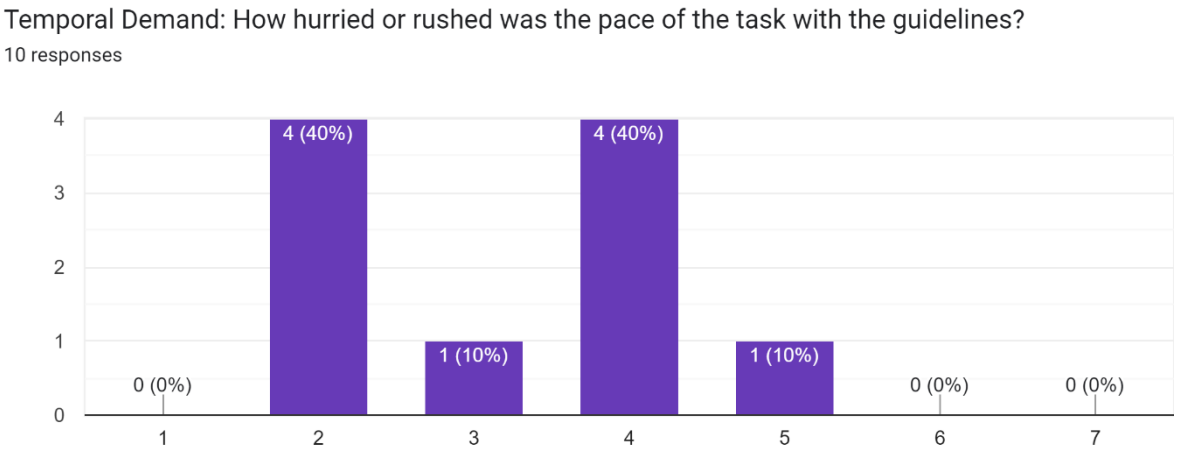


Figure 48: Temporal demand

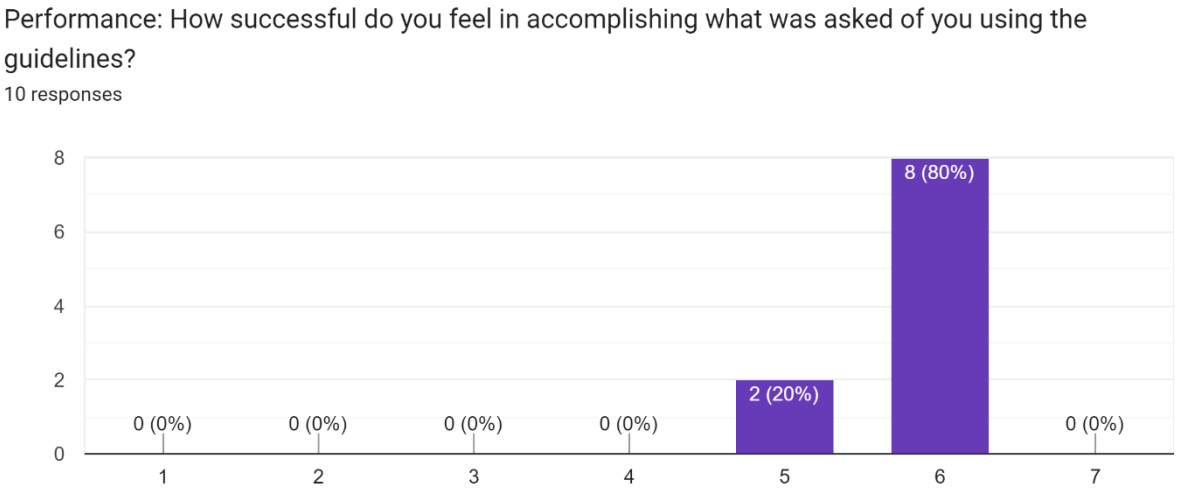


Figure 49: Performance

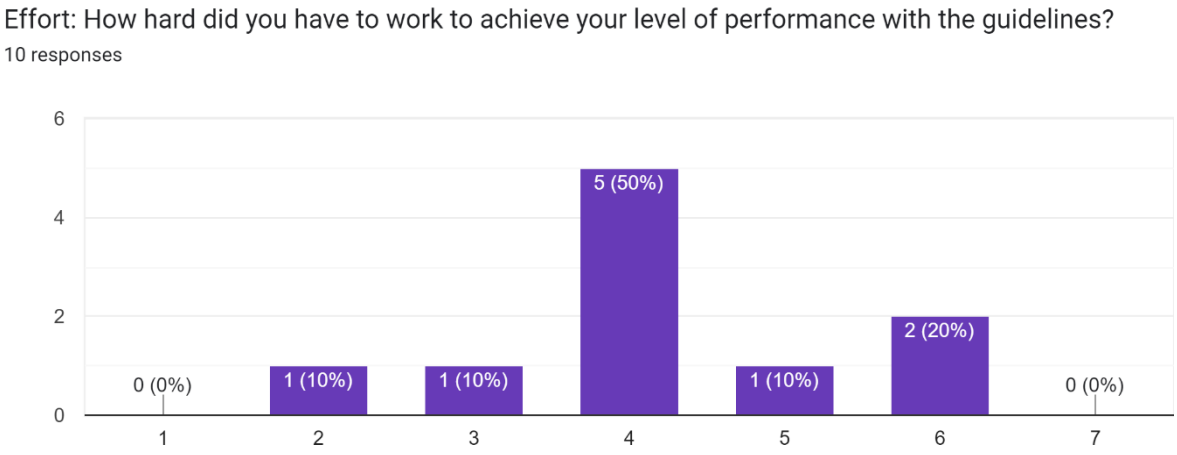


Figure 50: Effort

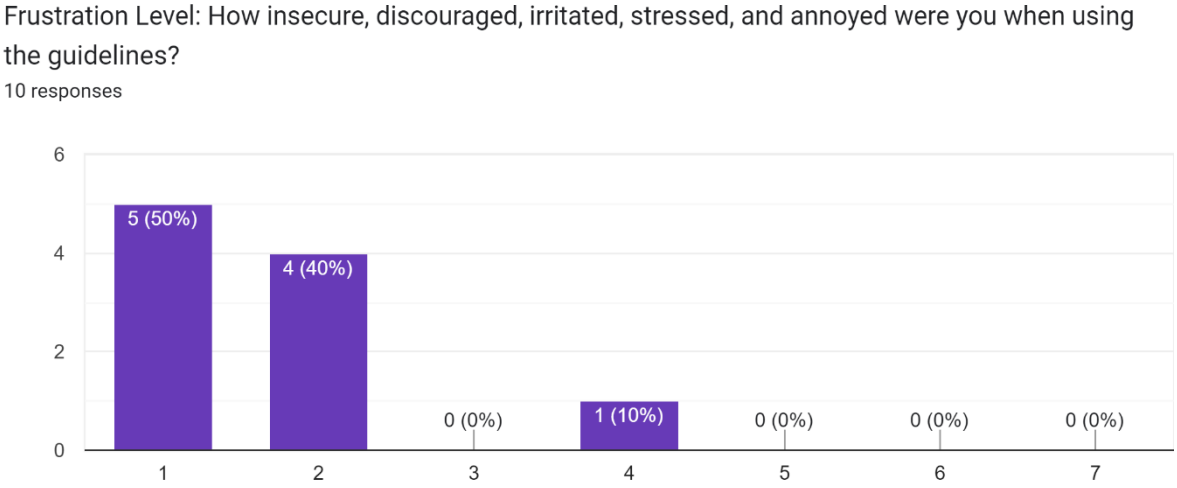


Figure 51: Frustration level

The performance was rated positively, indicating that the users were satisfied with the process they experienced (*Figure 49: Performance*).

The question regarding the effort elicited diverse responses, ranging from neutral to both low and high. This indicates that the task presented varying levels of difficulty based on the users' profiles (Figure *50*: Effort).

The frustration level was perceived as low, indicating that the guidelines did not pose a significant challenge in terms of patience (Figure *51*: Frustration level).

3.3 Outcomes of guidelines testing

The interplay between patent protections and the Circular Economy has both propelled innovation in sustainable technologies and eco-designs while also posing potential barriers to accessing crucial CE knowledge. Balancing the preservation of intellectual property rights

with the promotion of sustainability is a key challenge in this domain. Despite the significant role patents play in the Circular Economy, there is a notable research gap at the intersection of patents and the exploitation of patent data.

These guidelines have undergone meticulous research and iterations, but their true effectiveness lies in their real-world applications. Feedback from users plays a crucial role in unveiling the strengths of the guidelines as well as areas that require further improvement. Through quantitative analysis, it was determined that a majority of users found the guidelines to be intuitive and well-organized. However, there was a segment of users who expressed neutrality on certain aspects, indicating potential areas for refinement.

The qualitative analysis provides a detailed understanding of user experiences, revealing that while the guidelines are generally appreciated for their depth, there is a call for enhanced visual components and streamlined structures in certain sections. While recognized as valuable tools, some users question the necessity of the guidelines, highlighting the need for clearer communication of their unique value proposition. Additionally, feedback underscores the demand for improved visual aids and a more explicit presentation of the benefits that the guidelines offer.

In conclusion, this chapter emphasizes the iterative nature of refining the guidelines based on consistent feedback. By addressing the areas highlighted by users, the guidelines can remain relevant and effective for patent searches within the context of the Circular Economy. The aim is to strike a balance between intellectual property protection and the promotion of sustainability, ensuring that these guidelines continue to support innovation and contribute to the advancement of the Circular Economy.

4. Discussion

In the discussion section of this thesis, a critical link is established, where findings from earlier sections related to patent search guidelines and the circular economy are synthesized. Through this section, quantitative and qualitative feedback are combined, and their broader implications for patent search efficiency and the promotion of the circular economy are examined. By summarizing these findings with existing literature, the unique contributions of the guidelines are underscored and contextualized within established industry norms. Furthermore, challenges observed among industry-related organizations are highlighted, pointing to areas for refinement and future exploration. As a result, the complexities of the study's outcomes and their potential significance in the broader narrative of innovation, efficiency, and sustainability are addressed.

4.1 Conclusion on quantitative feedback

The approach of users in navigating the multifaceted terrains of patent exploration has been profoundly reshaped by the introduction of patent search guidelines. This

transformation is evidenced by the positive feedback, which is perceived not only as a testament to the efficacy of the guidelines but also as an indication of their ability to simplify a complicated process. The genesis of these guidelines was believed to have been rooted in a desire to demystify the patent search journey. Based on the quantitative data gathered, it can be concluded that this goal has been largely met, though it is acknowledged that the journey towards perfection remains continuous.

Neutral feedback has been recognized as a rich source of opportunities for further refinement. Such feedback is often indicative of subtleties that might be omitted from the guidelines or nuances that could be misunderstood. The reasons behind this feedback are deemed essential for understanding. Assumptions are made that these neutral perspectives might stem from users whose unique needs or preferences haven't been fully covered. By dissecting these comments, areas for potential enhancement can be pinpointed, offering a roadmap to elevate the guidelines.

Central to the patent search journey, as derived from user feedback, are the dual concepts of content comprehension and user autonomy. Analysis indicates that users greatly value the capacity to independently interpret content and conduct patent searches without external intervention. This preference sheds light on the indispensable nature of clarity and accessibility within the construction of the guidelines. Delivering content in an intuitive, streamlined, and devoid of jargon format emerges as a paramount requirement, especially to prevent users from feeling daunted or overwhelmed. The rationale behind emphasizing such clarity and accessibility is rooted in the perspective that a user, when equipped with clear guidelines, stands a better chance at executing a thorough and effective patent search. Nevertheless, the inherent complexity of the patent domain meant that certain terminologies were indispensable. To address potential ambiguities and bridge comprehension gaps, a glossary was thoughtfully integrated into the guidelines. This inclusion, as feedback suggests, was met with significant approval from the user base.

It has been recognized that the patent domain is in a state of constant evolution. This dynamic landscape, marked by the introduction of ground-breaking technologies and frequent updates in terminologies and classifications, necessitates a keen awareness of ongoing shifts. Primarily, guidelines that fall behind the current state of the industry can lead to suboptimal searches, potentially overlooking pivotal patent opportunities. This not only impacts the efficiency of the search but also the value derived from it. Consequently, the imperative to regularly revisit, review, and revamp the guidelines stands out. By doing so, they can consistently reflect the latest advancements, methodologies, and tools, ensuring users are always equipped with cutting-edge insights for their patent search endeavours.

The fostering of a sense of community and collaboration among users has been viewed as more than just a user experience enhancer. By creating platforms for users to engage, an ecosystem

that is self-sustaining is believed to have been established. The potential of such an ecosystem to act as a real-time feedback loop has been recognized, suggesting that guideline improvements can be more adaptive to the actual challenges faced by users.

In technologically progressive era, the importance of being at the cutting edge in the patent domain has been highlighted. The potential of artificial intelligence and machine learning to redefine the efficiency of patent searches when integrated has been acknowledged. The necessity of such integration is clear: the automation and enhancement of search processes can be made more precise and adaptive to user needs. However, the importance of guiding users on harnessing these tools is equally stressed, ensuring the guidelines remain universally applicable.

In summary, while many gaps have been successfully bridged by the patent search guidelines, a commitment to ongoing evolution, understanding, and innovation ensures their position as an indispensable tool in the patent exploration landscape.

4.2 Conclusion on qualitative feedback

From the qualitative feedback gathered regarding the guidelines for patent searches concerning the circular economy, several tangible patterns and takeaways emerge. The guidelines were predominantly recognized as catalysts in furthering both the circular economy and innovation. This suggests that the underlying principles and methodologies they incorporate have been tailored to resonate with the broader goals of a sustainable and innovative future.

However, it is evident that the depth and detail of the guidelines, while appreciated by many, present a double-edged sword. On one hand, they offer comprehensive guidance, but on the other, they may seem daunting or intricate for some users. This complexity necessitates a balance between detailed information and user-friendly presentation, especially when considering the evident preference for visual explanations. Such preferences emphasize the growing trend in user experience which leans towards graphical representation of data, underscoring the importance of integrating more intuitive and visually appealing components.

Interestingly, the reception of the guidelines' clarity is predominantly positive, but the sporadic feedback on certain sections' convoluted nature signifies a need for revisiting these areas. This might involve simplifying language, restructuring content, or adding explanatory notes to ensure broader comprehensibility.

Feedback received indicates that users predominantly view the guidelines as both practical and directly applicable to real-world patent searches. The majority seem pleased with how the guidelines function, emphasizing their hands-on approach and the actionable steps provided. However, a recurring issue flagged by users pertains to the difficulties encountered during the

keyword selection phase. This continuous mention not only highlights the integral role of keyword selection in the patent search process but also shines a light on the various challenges and intricacies that users face.

Keyword selection stands out as a fundamental aspect of these guidelines, given their reliance on keyword-based searching. Recognizing the right keywords becomes an art in itself, often taking time and experience to hone. It is essential for users to differentiate between generic keywords, which yield an overwhelming number of results, and more specific keywords that can direct them to a set of patents most pertinent to their needs. Ensuring successful searches hinges on the ability to strike a balance between these keyword types. Addressing this challenge directly in the guidelines, perhaps by providing a more detailed section on keyword strategies, examples, and common pitfalls, could greatly enhance their usability and effectiveness.

It's interesting to note the diverse perceptions regarding the necessity of the guidelines. A significant number of users deem them indispensable, while a subset believes they can efficiently navigate the patent search process without them. Such feedback provides a valuable chance to enhance the presentation and communication of the guidelines' unique advantages, ensuring that users can fully recognize and value the distinct benefits they provide.

This feedback disparity likely stems from the specific nature of some searches. Although the guidelines are designed to align with a broad spectrum of research areas, there might be instances where a topic is so niche that the guidelines struggle to provide targeted assistance. In such cases, the guidelines could sometimes yield a larger set of results than what's available in patent databases. This highlights the potential for refining the guidelines to cater more effectively to both broad and highly specialized searches, ensuring all users find tangible value irrespective of their search scope.

When considering how the guidelines are applied, it's evident that industry-related organizations are the primary users, shedding light on the intended audience. However, the hurdles encountered by these users, stemming from a lack of foundational understanding, suggest a potential area for enhancement. Introducing an initial section that offers a concise primer on both sustainability and the basics of patent searching could bridge this knowledge gap. This direction is coherent, given that the guidelines are primarily tailored to support users in advancing their grasp on sustainability, rather than introducing them to its elementary concepts. Incorporating this foundational knowledge could ensure a smoother and more informed experience for all users, regardless of their prior exposure to sustainability.

In essence, the qualitative feedback not only praise the innovative approach of the guidelines but also offers constructive critique for their refinement. The diverse responses indicate that while the guidelines have made commendable strides in aiding patent searches within the circular economy context, there exists a promising path of evolution ahead. By continuously

integrating such invaluable feedback, there is immense potential for the guidelines to shift into a universally recognized tool, bolstering the efficiency and effectiveness of patent searches in the realm of the circular economy.

4.4 Optimization of patent search

In the nuanced world of patent searches, the interaction of accuracy, precision, and recall serves as the cornerstone metrics in information retrieval. These metrics gain even more significance when combined with the Cooperative Patent Classification (CPC) and International Patent Classification (IPC) systems. These systems are designed to systematically categorize patent documents. By utilizing specific codes, the precision and accuracy of searches can be greatly improved. However, in cases where a broader search is desired, using a wider range of codes may enhance recall but potentially reduce precision.

Keywords play a crucial role in patent searches, serving a dual purpose. Broad keywords ensure high recall by retrieving a large number of results. However, they may lack the ability to capture specific nuances, resulting in lower precision. On the other hand, detailed keywords provide high precision by focusing on specific aspects but may overlook broader relevant patents, leading to reduced recall. The optimal approach often involves combining keywords with CPC/IPC codes to achieve a synergistic enhancement of both precision and recall.

In addition to codes and keywords, the overall accuracy of a search reflects the proportion of retrieved patents that are relevant and properly classified. For example, if a search yields 100 patents with 90 aligning with the searcher's interest, the accuracy rate would be 90%. Precision narrows down this metric by considering only the fraction of retrieved patents that are relevant. For instance, if out of 10 fetched patents, 9 are relevant, the precision would be 90%. Recall, on the other hand, captures the spectrum of all relevant patents successfully retrieved in a search.

Guidelines play a crucial role in guiding patent searches, providing a structured and systematic approach. Their strategic importance lies in increasing the likelihood of discovering relevant documents. They contribute to efficiency by eliminating unnecessary steps, saving time, and ensuring the reproducibility of searches. If another researcher follows the same guidelines in a consistent patent landscape, they can expect similar results. These guidelines act as gatekeepers, preventing the search quality from falling below a certain threshold and minimizing the risk of overlooking essential patents.

The landscape of patent searches is constantly evolving, driven by continuous learning and updates. The dynamic nature of the CPC and IPC systems requires searchers to be agile and adapt to their modifications. As emerging technologies shape the terrain, new terms and concepts emerge that searchers need to stay informed about. Additionally, the context of each search is crucial. Whether it's a patentability search, freedom-to-operate assessment, or any other type, understanding the objective determines the depth and breadth of the search.

Geographical considerations further complicate the landscape, as patents are not universally filed, necessitating a focus on specific regions based on requirements.

Collaboration plays a significant role in enhancing the search journey. Another perspective can uncover overlooked elements or validate the relevance of the chosen path. Furthermore, conducting a post-search evaluation act as a guiding light for future endeavours. Reflecting on the outcomes, understanding the successes and failures, and adjusting for the future is invaluable.

In essence, while metrics like accuracy, precision, and recall, along with classification systems and keywords, provide the foundation for patent searches, the true success lies in the delicate balance between continuous learning, contextual understanding, collaboration, and iterative feedback. Navigating this intricate map effectively ensures a streamlined approach to patent searches, maximizing the discovery of relevant literature while minimizing distractions.

5. Conclusion

In the conclusion chapter of this thesis, reflections are drawn upon the multifaceted insights gathered regarding patent search guidelines in the context of the circular economy. Here, the collective findings from both the quantitative and qualitative assessments are harmonized, presenting a comprehensive review of their implications. This chapter not only encapsulates the perceived strengths and areas of potential refinement of the guidelines but also reiterates their relevance and necessity within the industry. By revisiting challenges and successes, a cohesive understanding of the research journey is rendered, providing clear takeaways and suggestions for future endeavours. The culmination of this chapter serves to crystallize the broader vision of the research, elucidating its significance in driving innovation and sustainability in patent searches.

5.1 Summary of key findings

The relationship between intellectual property, particularly patents, and the Circular Economy necessitates a delicate balance between protection and collaboration. To advance the cause of sustainable innovation, it is essential to address policy ambiguities and adopt appropriate patenting strategies that align with the principles of the Circular Economy. This conclusion highlights the need for further exploration and transformative insights at the intersection of intellectual property and the Circular Economy to drive sustainable development and technological innovation.

The feedback received regarding the patent search guidelines indicates that while they are recognized as valuable tools for the Circular Economy, there is room for improvement in terms of conciseness and user-friendliness. While the guidelines are generally comprehensive and detailed, there is a consensus that enhancements in visual aids and overall structure would further enhance their effectiveness.

Their relevance and practicality in the context of the Circular Economy suggest that while the guidelines are useful, there is an opportunity to emphasize their unique benefits and provide additional guidance on effective search strategies. Furthermore, comparing these guidelines to others reveals that their focus on sustainability is a notable strength, although this depth of focus may introduce added complexity for some users.

The positive outcomes stemming from the utilization of the guidelines underscore their utility, but there is a collective call for refining the navigation and structure to enhance user experience. This mix of positive feedback and constructive suggestions presents an opportunity to fine-tune the guidelines, emphasizing their unique value, particularly in the realm of sustainability and the Circular Economy.

Expanding the utilization of the guidelines to include a dedicated team with specialized knowledge in intellectual property and the Circular Economy is crucial for a successful patent search process. This team should possess the necessary expertise and authority to make informed decisions and set strategies that align with the company's goals and objectives.

In conclusion, nurturing the synergy between patents, the Circular Economy, and sustainable innovation requires continuous refinement and adaptation. By addressing user feedback, enhancing the guidelines' user-friendliness, emphasizing their unique value proposition, and establishing a dedicated team, can effectively harness the power of intellectual property to drive sustainable development and innovation in the Circular Economy.

5.2 Address the objectives

The central aim of this thesis revolves around a comprehensive examination of the role of intellectual property within the Circular Economy framework. This entails delving into the essence and relevance of the Circular Economy, analyzing the prevailing IP structures, highlighting noteworthy case studies, dissecting the potential hurdles and obstacles, formulating strategies to harness IP optimally, gauging the consequent economic and environmental repercussions, heightening public consciousness, offering actionable guidance, and enriching the discourse on the strategic alignment of IP in facilitating a shift towards a more circular economic model.

Upon reviewing the final findings and considering the objectives set forth, it is clear that the guidelines effectively address a notable gap in the existing literature that was identified during the research phase of this work. This thesis not only sheds light on the specialized area of patent searching, with a focus on the circular economy, but it does so in a unique and comprehensive manner. The introduction of these guidelines demonstrates the recognition of the identified need, but it is only the initial step in an ongoing process. Although the Circular Economy is gaining increasing attention as a globally significant topic, the practical implementation of its principles in real-world contexts reveals that there is still a considerable

distance to be covered in the journey from a predominantly Linear Economy to a truly Circular one.

5.3 Significance of the research

The adoption of IP can significantly contribute to the advancement of Circular Economy practices. While IP is not commonly utilized by everyday customers, it serves as a powerful tool for stakeholders who play a crucial role in shaping our daily lives and carry a great responsibility for the environment. Stakeholders have the ability to leverage IP to influence public awareness regarding sustainability, which is a common practice. However, continuous learning and education are necessary to emphasize the importance of Circular Economy at the core of customers' values.

Moreover, stakeholders must embrace the Circular Economy within their own actions and intentions, rather than solely focusing on organizational image or meeting sustainability goals mandated by regulations. The change must originate from within. Although awareness surrounding the Circular Economy has been increasing as a trend in recent years, implementing the necessary changes is not an easy task. It requires substantial effort at the core, including a shift in approach that often involves breaking old habits deeply rooted in traditional practices.

Guidelines, such as the one presented in this thesis, aim to promote the Circular Economy from the unique perspective of Intellectual Property. They strive to support and encourage Circular Economy activities in general. While initiatives like this thesis may seem small in scale, they represent a step forward in supporting sustainability. The shift towards a Circular Economy is desired from every customer and stakeholder. It necessitates collective efforts, as the concept of the Circular Economy emphasizes the interconnectedness of various industries and the need for mutual support. Every individual should be aware of this important process of transitioning to a Circular Economy.

Both guidelines and intellectual property serve to support relevant sectors of the industry and foster awareness. They encourage the initiation of similar initiatives and demonstrate that everyone has a responsibility to protect and enhance sustainability practices.

5.4 Recommendations for future research

As the patent search guidelines continue to evolve, there are several key recommendations for future research that can further enhance their effectiveness and maximize their impact. While the guidelines have undergone multiple iterations and internal testing, engaging external companies for comprehensive real-world trials remains a significant challenge. To overcome this hurdle, it is crucial to establish partnerships and collaborations with external organizations to conduct thorough testing using diverse real-world examples. Such trials will provide valuable insights and ensure the guidelines' applicability across different industries and contexts. However, it is important to acknowledge that achieving

tangible outcomes and meaningful findings from these trials requires substantial time and funding investment.

The initial tests of the guidelines have yielded promising results, with users reporting positive outcomes and valuable insights from their implementation. However, user feedback has highlighted the need for further refinements, particularly in terms of usability and relevance. Therefore, future research should prioritize addressing these areas of improvement. Enhancing the usability of the guidelines can involve simplifying complex language, streamlining the structure, and incorporating user-friendly visual aids. Making the guidelines more relevant can be achieved by tailoring them to specific industries or sectors, providing targeted guidance on emerging technologies, and addressing the unique challenges faced by different user groups.

It is crucial to recognize that patent searching is inherently complex and requires specialized knowledge. To make the process more accessible and intuitive for users, future research should focus on developing intuitive interfaces, leveraging artificial intelligence and machine learning technologies to automate certain aspects of the search process, and providing comprehensive educational resources to enhance users' understanding of patent terminology and procedures. By simplifying the intricacies of patent search, the guidelines can become more user-friendly and empower a broader range of individuals to navigate the patent landscape with confidence.

In conclusion, future research endeavours should prioritize external testing, refine the guidelines based on user feedback, and focus on enhancing usability and accessibility. By establishing partnerships, investing in comprehensive trials, and addressing the complexities of patent searching, the guidelines can be further optimized to provide valuable insights and support to users across various industries. The goal is to ensure the wide dissemination and adoption of the guidelines in real business scenarios, fostering innovation and driving sustainable development in the intellectual property landscape.

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ENEA	Cyrkl	ENTERPRISE
Energy and waste management	Waste and recycling management	ACTIVITY
National Agency for New Technologies, Energy and Sustainable Economic Development ENEA has advanced knowledge and expertise in the development and management of circular economy tools, technologies and services, for efficient use and management of resources, ranging from design to the production of goods and services and closure of loops, nalized to achieve the highest possible value for resources, thus reducing their consumption.	Cyrkl is a marketplace in which it is possible to sell or buy industrial waste, by-products, secondary raw materials or used materials. Cyrkl is an international technology and consulting company specialising in circular waste management. Thanks to advanced technological solutions, Cyrkl helps companies turn waste into resources and thus into revenue with Europe's largest digital marketplace for waste and residuals.	DESCRIPTION
Management	Management	AREA
Synergy	Waste	OBJECT
Full life cycle	End of life	STAGE of LIFE CYCLE
Business to Business	Business to Business	BUSINESS MODEL
Regulatory compliance Business model and financial viability	Quality of input materials Access to raw materials	FACTORS
Scientific and technological advancements Environmental protection Economic development National security	Stable stream of secondary materials between companies Reuse or close the loop recycling 15 - 45 % savings on yearly waste costs	BENEFITS and OPPORTUNITIES
Integration	Integration	FOCUS AREAS/SECTOR OF INDUSTRY
Italy	Czech Republic	COUNTRY
Europe	Europe	CONTINENT
Third-Party Services	Third-Party Services	IMPLEMENTATION
ENEA conducts research and provides knowledge and technology transfer to support the transition towards a more sustainable and circular economy	Cyrkl can help increase the efficiency of resource use and reduce waste generation, contributing to a more circular economy.	EXTENT OF CIRCULARITY
Limited resources Bureaucracy Funding	Distance between companies Technology barriers Reliance on data	LIMITATIONS

ByFusion	Rubicon	Metaloop
Repurpose plastic	Waste and recycling management	Metal scrap management
ByFusion repurposes plastic waste into building material. ByFusion is a recycling technology company that has developed a machine that can convert plastic waste into building blocks that can be used in construction.	Rubicon is the leading digital marketplace for waste and recycling and a provider of innovative software-based solutions for businesses and governments worldwide.	Metaloop provides a platform that makes metal recycling easier and more accessible by supporting logistics, trading, contracting.
Repurpose	Management	Recycle
Plastic	Waste	Metal
End of life	Full life cycle	End of life
Business to Customer	Business to Business	Business to Business
Availability of plastic waste Proximity to the source of waste Adequate funding Regulatory compliance Market demand	A willingness to embrace new technology An understanding of waste management practices Adequate waste generation Access to Rubicon's services Budget considerations	Quality of input materials Access to raw materials Technological expertise Market demand Regulatory compliance Financial resources
Divert plastic from oceans and landfills; Reduce the depletion of resources that are necessary to produce traditional building materials; 83% less CO2 emissions than concrete blocks; Versatile product; Cost-effective;	Reduced Costs Environmental Benefits	Process optimization Cost savings Revenue Optimization (Increase of scrap revenue by up to 30% benefiting from the best prices on the market) Environmental sustainability Virgin materials conservation Reduced carbon footprint
Plastics and packaging	Integration	Metallurgy
USA	USA	Austria
America	America	Europe
Enterprise	Third-Party Services	Third-Party Services
ByFusion's RePlast due to variations in the types of plastic waste used, the company claims that their technology has the potential to create a closed-loop system where plastic waste is recycled into building materials that can be reused and recycled again at the end of their life.	Rubicon claims to be working towards a circular economy and provides waste management and recycling services.	Amount of metal scrap it recycles and the proportion of recycled metal that is used to produce new products.
Market acceptance Quality concerns Limited scalability	Cost Dependence on Technology Limited Geographic Coverage	Distance between companies Limited availability of metal scrap Competition from other recyclers

AdrianMartinus	Syntoil S.A.	Sims Lifecycle Services
Repurpose skateboards	Recycle tyres	Refurbish and recycle electronics
AdrianMartinus is a company that uses old skateboards to make furniture.	SYNTOIL transform contaminated soot from batch pyrolysis process into tailor-made recovered Carbon Black. Syntoil is recovering valuable resources and limiting the usage of fossil fuels, waste and carbon dioxide emission.	SLS offers IT asset disposition (ITAD) and e-waste recycling solutions for businesses.
Repurpose	Recycle	Refurbish
Skateboards	Tyres	E-waste
End of life	End of life	End of life
Customer to Business	Business to Business	Business to Business
Availability of skateboard waste Skilled labor Market demand Sustainable business practices	Syntoil S.A. generates revenue from the sale of the oil generated by the pyrolysis process. The company can also collect fees for accepting waste tyres and plastics for processing from other companies or municipalities. In addition, Syntoil S.A. can license its technology to other companies interested in using the pyrolysis process to convert waste into oil.	Proper planning and management Compliance with regulations Access to technology and equipment Skilled workforce
Repurposing skateboards which are difficult to recycle; Sustainable Unique designs Local production	Recovered carbon black obtained in a process of recycling used tires; Recovered carbon black is sustainable; The emissions are x6 less than in virgin carbon black; Can be reused to produce rubber goods again; Revenue on tyres; Scalability	Precious Metal Refining - no need to exploit virgin materials; Electronics Recycling; Refurbishing and remarketing electronics; Sustainable practices Compliance with regulations Global presence
Furniture	Automotive	Electronics
USA	Poland	USA
America	Europe	America
Enterprise	Third-Party Services	Enterprise
AdrianMartinus is a company that upcycles materials into furniture and other products. As a result, the extent of circularity of AdrianMartinus depends on the materials they are using and how much waste they are diverting from the linear economy.	-	Sims Lifecycle Services promotes circularity by refurbishing and reusing IT assets, as well as recycling electronic waste to extract valuable materials that can be used to create new products.
Low capacity Limited material source Limited market appeal	Technical challenges Availability of raw materials Market acceptance	Handling and recycling electronics is a big challange - it requires skilled workers and facilities; High costs

MINT INNOVATION	RePurpose Energy	Synchor
Recycle metal	Reuse batteries	Recycle asphalt
Mint is using a city-scale metal recovery clean technology to reduce reliance on mining, while providing green metals to accelerate circular supply. Using a proprietary clean technology, Mint recovers metals from urban waste, where the waste is produced, and returns them to the local economy. Old phones can become jewellery, ash municipal incinerators can be turned into bronze propellers.	RePurpose Energy is focused on reusing EV batteries to create reliable, low-cost “ second-life” energy storage systems.	Synchor Recycling develops RaZphalt, a proprietary product that is repurposed from recycled asphalt, wood, and asphalt shingles.
Recycle	Repurpose	Recycle
Metal	E-waste	Asphalt
End of life	End of life	End of life
Business to Business	Business to Business	Business to Business
Access to a steady supply of electronic waste Proper sorting and collection of electronic waste Awareness and education Investment in Mint Innovation's technology Collaboration and partnership	Access to waste resources Infrastructure Technological expertise Funding and government support Regulatory compliance	Access to waste asphalt Adequate infrastructure Regulations Market demand Technology and innovation
Reduced reliance on mining Reduced environmental impact Increased circularity Localized processing Green metals	Transform EV battery waste into value Sell repurposed batteries at low cost Lithium-ion batteries contain many valuable materials worth recovering and saving from a landfill Local energy production	Recycle asphalt and wood products; 100% recycled product with a negative carbon footprint Cost savings High-quality recycled asphalt Scalability
Metallurgy	Automotive	Construction
New Zealand	USA	Canada
Australia	America	America
Third-Party Services	Enterprise	Enterprise
Mint's technology provides a significant extent of circularity by recovering metals from urban waste streams and returning them to the local economy for reuse.	RePurpose Energy's business model is focused on creating a circular economy for batteries by reusing and recycling them. By doing so, they are able to reduce waste and promote sustainability.	Synchor's recycling of asphalt into RaZphalt could be considered a circular practice as it diverts waste material from landfills and gives it a new life as a valuable resource.
Limited availability of feedstock High capital costs Energy consumption	Technical challenges Costs Limited applications	Technical challenges Regulatory challenges Market acceptance

TerraCycle	Renew One	Greyparrot
Recycle waste	Recycle plastic	Sort waste
TerraCycle is a global waste management company that specializes in recycling hard-to-recycle waste, such as cigarette butts, coffee capsules, and plastic packaging.	Renew One is a waste-to-energy company that specializes in converting non-recyclable plastic waste into valuable commodities through a process called chemical recycling. The company's technology breaks down plastic waste into smaller molecules, which can then be used to create new plastic products, fuels, or chemicals.	Greyparrot has created an AI-powered waste recognition software that can identify and sort waste materials in real-time. Their solution supports efficient and accurate waste management in the industrial sector.
Recycle	Recycle	Sort
Waste	Plastic	Waste
End of life	End of life	End of life
Business to Business	Business to Business	Business to Business
Participation Education and awareness Accessibility Funding Partnerships Technology	Converts soft plastics - plastic bags, wrappers, pouches, and other scraps - into diesel fuel.	Proper waste collection and segregation Reliable data connectivity Trained personnel Appropriate waste management infrastructure Compatibility with existing waste management processes
Recycling hard-to-recycle waste Partnering with major brands Creating new products from recyded waste Raising awareness about waste reduction Supporting local communities	Sustainable waste management Resource conservation Economic benefits	Increased efficiency Increased accuracy Data collection Environmental impact
Waste management	Plastics and packaging	Waste management
Italy	USA	UK
Europe	America	Europe
Enterprise	Third-Party Services	Third-Party Services
TerraCycle claims to have a high level of circularity as they aim to recycle as much waste as possible and keep materials in use for as long as possible.	Measured by the percentage of plastic waste they are able to convert into new, usable products through their chemical recycling process.	Greyparrot offers AI-powered waste recognition and analysis technology for sorting and tracking waste materials.
Limited program availability High costs Potential for greenwashing	Scale-up challenges Energy requirements Market demand	Costs Limited application Complexity

Worn Again Technologies	RePack	Circulor
Recycling clothing	Logistics management	Supply Chain management
Worn Again Technologies is a UK-based technology company that focuses on developing circular recycling processes for the textile industry. They have developed a technology that can separate and extract polyester and cotton from end-of-use textiles and convert them into new fibers, which can be used to make new textiles, creating a closed-loop recycling system.	RePack is a reusable packaging service for online retailers. When customers place an order with a participating retailer, they have the option to choose RePack packaging for an additional fee. The product is then shipped to the customer in a durable and reusable bag or box that they can return to a nearby collection point or through the mail.	Circulor is a British technology company that provides traceability and transparency solutions for the sustainable sourcing and recycling of raw materials in industries such as automotive, electronics, and aerospace.
Recycle	Sustainable production	Supply Chain
Textile	Packaging material	Synergy
End of life	Transportation	Transportation
Business to Business	Business to Business	Business to Business
Availability of suitable feedstock materials Adequate funding and investment support Collaborative partnerships with industry stakeholders Access to advanced technologies for chemical recycling processes Government policies and regulations supporting the adoption of circular economy principles.	Utilizing reusable packaging Partnering with retailers Minimizing waste and promoting material reuse Implementing effective logistics and supply chain management to ensure seamless collection and redistribution Educating and incentivizing consumers to participate in the closed-loop system	Access to accurate and comprehensive data Commitment to transparency Collaboration with supply chain partners Compliance with regulations Investment in technology Willingness to change business models
Reduction of textile waste Resource conservation Cost savings	Reduced waste Cost savings Positive brand image	Increased transparency Improved sustainability Enhanced brand reputation Compliance with regulations
Textile technology	Plastics and packaging	Transport
UK	Finland	UK
Europe	Europe	Europe
Enterprise	Enterprise	Third-Party Services
Worn Again Technologies aims to achieve a high level of circularity by recovering raw materials from end-of-use textiles and plastics and reintroducing them into the supply chain as valuable resources.	RePack's extent of circularity is high as they operate a closed-loop system where their reusable packaging is collected, cleaned, and redistributed to their partner retailers.	Circulor's technology supports the circular economy by enabling companies to close the loop and increase the amount of materials that can be reused or recycled.
Scale limitations Limited range of materials Regulatory barriers	Cost Limited availability Transportation impact	Cost Technical expertise Limited reach

PolyStyreneLoop	DyeCoo	Piëch Automotive
Recycle plastic	Sustainable Textile Dyeing	Sustainable Car Production
PolyStyreneLoop is an initiative that aims to develop a circular solution for the recycling of polystyrene, which is commonly known as Styrofoam. Polystyrene is a widely used material in packaging, insulation, and other applications, but its recycling can be challenging due to its low density and bulky nature.	DyeCoo is a company that specializes in providing sustainable textile dyeing solutions. Their technology eliminates the need for water in the dyeing process, resulting in significant water savings compared to traditional textile dyeing methods. It also reduces energy consumption as the drying step is eliminated. DyeCoo's process avoids the use of chemicals commonly used in conventional textile dyeing, leading to a reduction in chemical usage and environmental impact.	Piëch Automotive is an electric vehicle (EV) manufacturer that aims to produce innovative, sustainable, and high-performance EVs. The benefits of Piëch Automotive include their focus on sustainable materials, energy-efficient manufacturing processes, and advanced EV technologies.
Recycle	Sustainable production	Sustainable production
Plastic	Textile	Car
End of life	Production	Production
Business to Business	Business to Business	Business to Customer
Collection and sorting infrastructure Recycling technology Market demand Stakeholder engagement Scalability and feasibility Regulatory and policy support Environmental and social impact	Adequate Investment Proper Training Material Compatibility Market Demand	Financial feasibility Manufacturing capabilities Supply chain management Innovation and technology Regulatory compliance
Promotes circular economy Reduces waste Resource conservation	Water and Energy Savings Chemical Reduction Cost and Time Savings Sustainability Scalability	Sustainability Innovation Contribution to Electric Mobility
Plastics and packaging	Textile technology	Automotive
Netherlands	Netherlands	Switzerland
Europe	Europe	Europe
Third-Party Services	Enterprise	Enterprise
PolyStyreneLoop is focused on the recycling and circular economy of polystyrene waste, specifically post-consumer expanded polystyrene (EPS) foam, commonly known as Styrofoam.	DyeCoo's technology can contribute to circularity in the textile industry through reduced water consumption, chemical reduction, and potential energy savings, leading to more sustainable and environmentally friendly dyeing processes.	The extent of circularity of Piëch Automotive would depend on their efforts in using sustainable materials, recycling and repurposing of end-of-life EV components, and minimizing waste and emissions throughout their production.
Limited scale Technical challenges Economic viability	Initial Investment Application Limitations Market Adoption	Cost and affordability of EVs Market demand for premium EVs Competition in the EV industry.

Loop Rocks	Kaffe Bueno	Circle Economy
Upcycling building materials	Upcycling coffee waste	Waste and recycling management
Loop Rocks revolutionize the construction industry by offering a circular economy solution for the use of natural stone waste. The company collects and processes waste from the stone processing industry, such as leftover stone slabs, and turns them into sustainable products for construction, landscaping, and interior design applications.	Kaffe Bueno is a company that specializes in upcycling coffee waste into valuable and sustainable products. They utilize coffee grounds, which are typically considered as waste after coffee brewing, to create a range of high-quality, natural ingredients for the food, cosmetics, and nutraceutical industries. Kaffe Bueno's innovative approach aims to reduce coffee waste and create circular value chains by transforming coffee grounds into valuable ingredients that can be used in various applications, thereby promoting sustainability and resource efficiency.	Circle Economy is a non-profit organization, that focuses on accelerating the transition to a circular economy. Circle Economy works with businesses, governments, and other stakeholders to promote circular economy principles, develop circular business models, and facilitate collaboration and knowledge-sharing among circular economy stakeholders.
Repurpose	Repurpose	Management
Building materials	Organic materials	Synergy
End of life	End of life	Full life cycle
Business to Business	Business to Business	Business to Business
Raw material availability. Advanced processing technology. Market demand. Compliance with regulations. Stakeholder collaborations. Viable business model. Efficient value chain management.	Access to coffee waste Technology and expertise Market demand Partnerships and collaborations Sustainability and circularity mindset Regulatory compliance Business model and financial viability	Leadership and commitment Collaboration and partnerships Circular design and innovation Resource efficiency and waste reduction Business models and incentives Stakeholder engagement and education
Resource conservation through recycling. Reduction of environmental impact and waste. Contribution to a circular economy. Potential cost savings through resource optimization. Creation of new business opportunities and markets.	Waste reduction Resource optimization Circular economy Environmental benefits	Expertise in Circular Economy Collaborative Approach Innovation and Solutions-oriented Global Reach
Construction	Food	Integration
Finland	Denmark	Netherlands
Europe	Europe	Europe
Enterprise	Enterprise	Third-Party Services
Loop Rocks aims to contribute to a circular economy by recycling waste materials and reducing environmental impact through resource conservation.	Kaffe Bueno's extent of circularity can be considered high, as they focus on upcycling coffee waste into valuable bioactive compounds and natural ingredients.	Circle Economy's extent of circularity can be measured by their initiatives, projects, and activities aimed at advancing circular economy principles.
Limited availability of suitable waste feedstock. Dependence on market demand and pricing. Technological and operational challenges.	Raw material availability Market demand Technology and expertise	Resource Constraints Influence and Enforcement Regulatory and Institutional Barriers

Closing the Loop	DePoly	Fairphone
Recycling mobile phones and e-waste	Advanced recycling of polyesters	Sustainable Smartphones Production
Closing the Loop is a social enterprise that operates as a global circular economy company, focusing on the responsible collection and recycling of end-of-life mobile phones and other electronic waste (e-waste) from Africa and other emerging markets. The organization's mission is to reduce e-waste, promote sustainable resource management, and create employment opportunities for local communities in developing countries.	DePoly is a company that has developed a chemical recycling technology to efficiently depolymerize and recycle polyester waste into high-quality raw materials for producing new polyester products, reducing plastic waste and promoting circularity in the textile and packaging industries.	Fairphone is a social enterprise and consumer electronics company that produces and sells smartphones with a focus on ethical and sustainable principles. The company's mission is to create smartphones that are designed to be fair to people, the environment, and the economy. Fairphone aims to address issues in the electronics industry, such as human rights abuses, conflict minerals, and electronic waste, by producing smartphones that are made with ethically sourced materials, designed for longevity, and produced under fair labor
Recycle	Recycle	Sustainable production
E-waste	Plastic	E-waste
End of life	End of life	Full life cycle
Customer to Business	Business to Business	Business to Customer
Effective collection system Certified recycling facilities Environmental and social awareness Local partnerships and community engagement Proper regulatory compliance Market demand and viability Monitoring and reporting	Feedstock quality Process optimization Environmental considerations Product quality and market demand Regulatory and certification compliance Cost considerations Collaboration and partnerships	Responsible use and disposal Community engagement Support for Fairphone's mission
Responsible e-waste management Social impact Employment opportunities Circular economy Environmental and social awareness	Plastic waste reduction Circular economy promotion Resource conservation Market demand for recycled materials	Ethical and sustainable sourcing Repairability and upgradability Circular economy principles Software updates and support
Electronics	Plastics and packaging	Electronics
Netherlands	UK	Netherlands
Europe	Europe	Europe
Enterprise	Enterprise	Enterprise
Closing the Loop is a social enterprise that collects and responsibly recycles end-of-life mobile phones from Africa and other emerging markets, promoting circularity through material recovery, reuse of mobile phones, and social impact.	The extent of circularity achieved through depolymerization depends on various factors, including the efficiency of the depolymerization process, the quality of the recycled output, the market demand for recycled materials.	Fairphone's extent of circularity is based on designing for durability and repairability, ethical and sustainable sourcing, recycling and resource recovery, software updates and support, and community engagement.
Scale and scope Regulatory challenges Market demand and viability	Technical challenges Feedstock limitations Environmental considerations	Cost Limited availability Limited features

Ecovative Design	Bureo	Reflow
Sustainable packaging	Recycling fishing nets	Upcycling textile waste
Ecovative Design focuses on developing and manufacturing sustainable packaging materials and building products using mycelium, which is the root structure of mushrooms. They aim to provide a natural and renewable alternative to traditional materials, promoting circularity and sustainability in packaging and construction industries.	Bureo collects and upcycles discarded fishing nets into skateboards and other products. They aim to address marine pollution caused by abandoned fishing nets, also known as ghost nets, and promote circularity in the fishing industry by transforming this waste into useful products.	Reflow focuses on upcycling textile waste into new, high-quality textile fibers for use in the fashion industry.
Sustainable production	Repurpose	Repurpose
Organic materials	Plastic	Textile
Packaging	End of life	End of life
Business to Business	Business to Business	Business to Business
Understanding the material properties Proper handling and storage Design considerations Testing and prototyping Environmental impact assessment Compliance with regulations and standards Collaboration with Ecovative	Collection Infrastructure Quality and Quantity of Waste Materials Processing Technology Market Demand Supply Chain Integration Environmental Regulations Social Impact	Access to textile waste Technology and infrastructure Quality of end product Market demand and supply chain integration Environmental and economic viability Stakeholder collaboration Regulatory compliance Education and awareness
Sustainability Versatility Performance Innovation	Marine pollution reduction Circular economy promotion Awareness raising	Reduced reliance on virgin materials Waste reduction and resource conservation Sustainable textile production High-quality end product
Plastics and packaging	Plastics and packaging	Textile technology
USA	USA	Netherlands
America	America	Europe
Enterprise	Enterprise	Enterprise
Ecovative's products are highly circular, utilizing renewable resources, minimizing waste in production, and providing compostable and biodegradable end-of-life options. Their sustainable materials are designed to replace traditional materials and contribute to a circular economy by closing the material loop through partnerships and collaborations with other organizations.	Bureo's extent of circularity can be seen in their efforts to collect and upcycle discarded fishing nets into new products, creating a closed-loop system that repurposes waste materials into valuable products. By transforming discarded fishing nets into products like skateboards, sunglasses, and other items, Bureo promotes circular economy principles by reducing the reliance on virgin materials, diverting waste from landfills or the ocean, and	Reflow's upcycling approach promotes circularity in the textile industry by converting textile waste into new, high-quality textile fibers, which can be used in the fashion industry as a substitute for virgin materials. By diverting textile waste from landfill, reducing reliance on virgin materials, and contributing to waste reduction and resource conservation, Reflow's upcycling process aligns with principles of circular economy and sustainability.
Cost Availability Performance Variability	Limited availability and quality of waste materials Market demand and economic viability Supply chain integration challenges	Scale and availability of textile waste: Technology and infrastructure requirements Market demand and supply chain integration

Closed Loop Partners	Recyclebank	Orange Fiber
Circular Economy management	Circular Economy management	Sustainable textile
Closed Loop Partners is an investment firm that specializes in funding and supporting circular economy startups. They provide capital and resources to innovative businesses that are working towards circular solutions, with the aim of promoting circularity in various industries and sectors.	Recyclebank is a rewards program that encourages and incentivizes individuals and communities to adopt sustainable waste management practices, such as recycling, reducing waste, and conserving resources. The program operates in partnership with local communities, waste haulers, and recycling facilities to track and reward individuals for their environmentally-friendly behaviors.	Orange Fiber specializes in producing sustainable textile fibers from citrus juice by-products, with the aim of promoting circularity and waste reduction in the textile and fashion industries. Orange Fiber utilizes the waste materials generated from citrus juice production, such as orange peels, which are typically discarded as waste or used as animal feed. Through a proprietary process, Orange Fiber extracts cellulose from the citrus peels and transforms it into a high-quality, eco-friendly textile fiber.
Management	Management	Repurpose
Synergy	Synergy	Organic materials
Full life cycle	Full life cycle	End of life
Business to Business	Business to Business	Business to Business
Alignment with Circular Economy Principles Innovative Circular Solutions Scalability and Market Potential Team and Expertise Financial Viability Social and Environmental Impact Collaboration and Partnership	Participation Awareness and Education Community Engagement Sustainable Behaviors Technology Adoption Business Partnerships Consistency and Long-term Commitment	Sustainability and Circular Economy Material Properties Quality and Performance Supply Chain Management Market Demand and Brand Positioning Innovation and Collaboration Compliance and Certification
Financial Support Resource Assistance Circular Economy Promotion	Incentivizing Sustainable Behavior Community Engagement Education and Awareness Local Business Support	Sustainability Renewable and Biodegradable Unique Properties Innovation and Differentiation Social Impact
Integration	Waste management	Textile technology
USA	USA	Italy
America	America	Europe
Third-Party Services	Third-Party Services	Enterprise
Closed Loop Partners promotes circularity by providing funding and resources to circular economy startups, reflecting their mission to advance circular solutions in various industries and sectors. The extent of circularity achieved depends on the success of the startups they support in implementing circular business models and practices.	Recyclebank promotes circularity by incentivizing users to recycle, reduce waste, and conserve resources through its online platform. While the extent of circularity achieved through Recyclebank can vary depending on factors such as user engagement and local recycling infrastructure, its programs and partnerships contribute to advancing sustainability in waste management and resource conservation.	The circularity of Orange Fiber, as a sustainable textile fiber made from citrus waste, is significant, but not complete. While it repurposes waste materials and uses environmentally friendly production methods, there are still limitations related to energy usage, water consumption, and raw material availability that need to be addressed to further enhance its circularity in the textile and fashion industries.
Selective Investment Criteria Limited Capacity: Market Risks	Geographic Limitations Participation Challenges Dependence on Business Partnerships	Limited Supply Processing Challenges Performance Limitations

Ocean Bottle	Recyclex	Zero Waste Scotland
Recycling of ocean waste	Recycling of lead, zinc and polypropylene.	Circular Economy management
Ocean Bottle is a social impact-driven company that produces reusable water bottles made from recycled plastic and stainless steel. They aim to tackle ocean plastic pollution by incentivizing plastic collection and supporting recycling initiatives, while also providing access to clean water in developing communities.	Recyclex is a company that specializes in the development and manufacturing of sustainable plastic materials using post-consumer and post-industrial waste as feedstock. They aim to promote circular economy principles by utilizing waste materials to create new plastic materials, thus reducing the demand for virgin plastic and minimizing environmental impact.	Zero Waste Scotland is an environmental organization based in Scotland that aims to accelerate Scotland's transition towards a circular economy and reduce its waste generation. It is a non-profit organization funded by the Scottish Government and European Regional Development Funds, and it works with businesses, communities, and individuals to promote waste reduction, resource efficiency, and sustainable resource management practices.
Repurpose	Repurpose	Management
Plastic	E-waste	Synergy
End of life	End of life	Full life cycle
Business to Customer	Business to Business	Business to Business
Commitment to reusability Durability and functionality Awareness and engagement Education and communication Access to clean water sources Community engagement	Quality of feedstock Technology and processes Product specifications Market demand and value proposition Supply chain and partnerships Regulatory compliance Education and awareness	Leadership and Commitment Collaboration and Partnerships Education and Awareness Tailored Solutions Infrastructure and Technology Monitoring and Evaluation Regulatory and Policy Support Community Engagement
Reducing plastic pollution Providing access to clean water Durability and functionality Raising awareness	Resource conservation Waste reduction Greenhouse gas reduction Circular economy promotion Brand reputation and customer demand	Environmental Impact Economic Opportunities Sustainable Communities Innovation and Collaboration
Plastics and packaging	Plastics and packaging	Integration
UK	France	Scotland
Europe	Europe	Europe
Enterprise	Enterprise	Third-Party Services
Ocean Bottle's circularity extent includes the use of recycled materials, social impact initiatives, a circular business model, durable product design, and education and awareness efforts. They are based in the UK and promote circular economy principles by reducing plastic waste, supporting recycling, and addressing social and environmental issues associated with plastic pollution.	Recyclex specializes in trecycling of lead, zinc and polypropylene, which aligns with circular economy principles of reducing waste and promoting resource efficiency.	Zero Waste Scotland focuses on waste prevention, resource efficiency, recycling and resource recovery, circular business models, collaboration and innovation, and education and awareness to promote circular economy principles and practices. The extent of circularity achieved may vary depending on initiatives, regions, stakeholders, and sectors, requiring ongoing evaluation and collaboration for maximum circularity in Scotland's waste and
Initial cost Maintenance and care: Access to clean water sources	Quality and performance variability Contamination and impurities: Limited availability and consistency of feedstock	Complex Challenges Implementation Challenges Limited Scope

Precious Plastic	Ocean Sole	Repurpose Global
Plastic recycling	Upcycling filp-flops	Sustainable packaging
Precious Plastic is a global community-driven project that aims to promote the recycling of plastic waste through an open-source platform. The project provides blueprints and instructions on how to build the machines, which include a shredder, an extruder, an injection molder, and a compression molder. These machines can be built using basic tools and materials, and they allow people to recycle plastic waste into products such as phone cases, keychains, and even furniture.	Ocean Sole is a Kenyan social enterprise that creates art sculptures and other products from discarded flip-flops that have washed up on the shores of Kenya and other African countries.	Repurpose global is global platform for reducing plastic waste. Repurpose Global is a company that provides a range of sustainable, single-use products made from plant-based materials. Their focus is on offering compostable alternatives to traditional disposable items, promoting circularity by reducing waste and providing environmentally-friendly solutions.
Recycle	Repurpose	Sustainable production
Plastic	Plastic	Organic materials
End of life	End of life	End of life
Business to Business	Customer to Business	Business to Business
Access to plastic waste Adequate space and resources Technical expertise Knowledge of plastic types Market for recycled products	Consumer awareness and education Market demand Sustainable production and distribution Innovation and diversification Collaboration and partnerships	Understanding of composting Compliance with local regulations Education and awareness Proper waste segregation Availability of composting infrastructure Communication and engagement
Plastic recycling Localized production Open-source platform	Environmental impact Social impact Artistic and creative products	Environmental sustainability Circular economy promotion
Plastics and packaging	Plastics and packaging	Plastics and packaging
Netherlands	Kenya	USA
Europe	Africa	America
Third-Party Services	Enterprise	Enterprise
Precious Plastic aims to achieve circularity by transforming plastic waste into new products through an open-source platform. However, the extent of circularity achieved depends on several factors, including the efficiency of the recycling process, the end-use of the recycled products, and the availability of plastic waste.	Ocean Sole's circularity extends to both their production process and the products they create. Their production process involves collecting discarded flip-flops from the ocean and coastlines, cleaning them, and transforming them into colorful sculptures and other products. By using a waste material that would otherwise end up in landfills or polluting the ocean, they are reducing waste and contributing to a more circular economy.	Repurpose Global promotes circularity by offering single-use products made from plant-based materials that are designed to be compostable, potentially contributing to a circular economy by reducing waste and promoting composting.
Limited capacity Technical expertise Material limitations	Scale Production limitations Limited product range	Limited availability Cost considerations

Rheaply	Plastic Bank	Superuse Studios
Facilitates resource sharing	Recycling and collecting plastic	Upcycling building materials
Rheaply is a technology company that provides a cloud-based platform for organizations to manage and exchange their surplus assets. The platform enables organizations to track and manage their assets, identify surplus items that can be repurposed or sold, and connect with other organizations to facilitate asset sharing and collaboration. Rheaply's mission is to promote sustainability and reduce waste by creating a more circular economy.	The Plastic Bank is a social enterprise that aims to reduce plastic waste in the ocean while creating social impact. The organization works by establishing plastic collection centers in developing countries and paying individuals to collect and recycle plastic waste. The collected plastic waste is then sold as a raw material to companies for use in new products, creating a circular economy and reducing the amount of plastic waste that ends up in the ocean.	Superuse Studios is a global architecture firm that focuses on sustainable design practices and the use of recycled materials in their projects. The firm is known for its innovative approach to design, which involves repurposing existing materials and structures to create new buildings and spaces.
Management	Management	Repurpose
Synergy	Plastic	Building materials
Full life cycle	End of life	End of life
Business to Business	Customer to Business	Business to Business
Leadership support User engagement Clear guidelines and policies Integration with existing systems Network size and diversity Measuring impact	Access to Plastic Waste Financial Sustainability Fair and Transparent Compensation Corporate Partnerships Community Engagement Scalability	Alignment with sustainable values Clear communication Flexibility and openness to innovation Collaborative approach Budget and timeline considerations
Resource optimization Cost savings Sustainability Data insights Collaboration	Reduction of Plastic Waste Promotion of Circular Economy Social Impact Environmental Education Corporate Partnerships	Sustainable design practices Innovative approach to design International presence
Integration	Plastics and packaging	Construction
USA	Canada	Netherlands
America	America	Europe
Third-Party Services	Enterprise	Enterprise
Rheaply's platform enables circular economy practices by promoting resource sharing and reuse within organizations, thus reducing waste and increasing resource utilization. While Rheaply's extent of circularity is limited to the activities that take place within its network, the platform is a valuable tool for promoting circularity and supporting sustainability goals.	The Plastic Bank's model promotes circularity by creating a market for recycled plastic and reducing the amount of plastic waste that ends up in the ocean. By collecting and recycling plastic waste, the organization helps to create a circular economy by reducing the demand for new plastic production and promoting the use of recycled plastic in new products.	Superuse Studios is strongly committed to circular design principles, which aim to create a closed-loop system in which waste is minimized and materials are reused or repurposed. They achieve circularity through the use of recycled materials, repurposing existing materials and structures, design for disassembly, and collaboration with the local community and stakeholders.
Adoption Integration Security	Limited impact Inequities Economic sustainability	Limited scope Resource availability Complexity

LanzaTech	Ecolife Recycling	Bioelektra Group
Carbon conversion technology.	Promote recycling and sustainability	Waste management
LanzaTech is a global biotechnology company that specializes in carbon capture and conversion. The company has developed a proprietary gas fermentation technology that can convert waste carbon gases, such as those emitted by industrial processes, into sustainable fuels and chemicals.	Ecolife Recycling is a non-profit organization that promotes sustainable living and environmental conservation through community engagement and education. They offer programs and services such as waste assessments, educational workshops, community events, and recycling initiatives for businesses and residents, as well as operate an eco-store that sells sustainable products.	Bioelektra Group is a Polish company that focuses on environmental protection and renewable energy. It specializes in waste management and recycling, and generates electricity and heat from renewable sources like biogas, biomass, and photovoltaics. The company offers services such as waste collection and management, waste treatment plant construction and operation, compost and fertilizer production, and renewable energy generation.
Repurpose	Management	Management
Carbon	Waste	Waste
Production	End of life	Full life cycle
Business to Business	Business to Business	Business to Business
Waste carbon sources Funding/resources Business/government collaborations Regulatory support/incentives Public awareness/support.	Community engagement/participation Adequate funding/resources Collaborations/partnerships Infrastructure/facilities availability Effective education/outreach	Good infrastructure Access to resources Supportive policies Sufficient funding Public awareness
Reduces carbon emissions Supports circular economy Converts waste into valuable products	Promotes sustainability Offers education programs Conducts waste assessments Operates eco-store	Reduces pollution Promotes sustainability Generates clean energy Creates jobs
Energy	Integration	Energy
USA	USA	Poland
America	America	Europe
Enterprise	Enterprise	Third-Party Services
LanzaTech's carbon conversion technology promotes circularity by capturing and recycling waste carbon gases from industrial processes, which would otherwise be emitted into the atmosphere as greenhouse gases. By converting these waste gases into sustainable fuels and chemicals, LanzaTech supports the circular economy by reducing carbon emissions and promoting the use of recycled materials.	As a recycling and waste reduction organization, Ecolife Recycling promotes circularity by diverting waste from landfills and encouraging the use of recycled materials. They also operate an eco-store that offers sustainable products, further promoting circularity by supporting the use of environmentally-friendly and reusable items.	Bioelektra Group operates with a high level of circularity, as its waste management and recycling services aim to reduce waste and promote the reuse of materials. The company's use of renewable energy sources like biogas and biomass further demonstrates a commitment to circularity by utilizing organic waste and other resources to generate energy.
Scalability challenges Relies on the availability of waste carbon sources Competition from other carbon capture and conversion technologies	Localized outreach Funding dependence Behavior change challenges	High capital costs Complex processes Expertise

DePoly	Banyan Nation	The Bulb Cycle
Chemical recycling process	Recycling plastic waste.	Recycling light bulbs
DePoly is a company that uses a chemical recycling process to convert post-consumer PET waste into high-quality plastics, promoting circularity and reducing plastic waste. Their technology can depolymerize PET waste into its constituent monomers, which can be purified and repolymerized into new high-performance plastics.	Banyan Nation is a Hyderabad-based waste management company that specializes in the collection and recycling of plastic waste, with a focus on using technology to promote circularity and sustainability.	The Bulb Cycle is a company that specializes in the recycling and refurbishing of fluorescent light bulbs. The company's mission is to reduce hazardous waste and promote sustainable lighting solutions by recovering and reusing valuable materials from discarded bulbs.
Recycle	Recycle	Recycle
Plastic	E-waste	E-waste
End of life	End of life	End of life
Business to Business	Business to Business	Business to Business
PET waste supply Chemical recycling process Quality standards	Reliable waste collection infrastructure Strong partnerships with businesses and governments Consumer awareness and support for sustainable waste management practices	Access to waste bulbs Commitment to sustainability Willingness to participate in recycling program Potential cost savings from recycling over disposal
Reduces plastic waste Promotes circularity High-quality plastics	Promotes circular economy Reduces plastic waste Supports local communities	Reduces hazardous waste Promotes sustainable lighting Recovers valuable materials Diverts waste from landfills Reduces environmental impact
Plastics and packaging	Waste management	Electronics
Switzerland	India	USA
Europe	Asia	America
Enterprise	Enterprise	Enterprise
DePoly's chemical recyding process for PET plastic waste is a highly circular solution that diverts post-consumer plastic waste from landfills and incineration, reducing the environmental impact of plastic waste.	Banyan Nation's extent of circularity involves collecting, processing, and recycling plastic waste into new products, which reduces waste and promotes a circular economy.	The Bulb Cycle's efforts promote circularity by minimizing waste sent to landfills, reducing the need for virgin materials, and creating value from materials that would otherwise be discarded.
Costly process Limited scalability Energy-intensive process	Limited processing capacity Need for government support High costs of technology implementation	Limited scope Access to waste Competition

The Retyrement Plan	Newlight Technologies	Renewi
Upcycle discarded tires	Biodegradable plastic production	Waste-to-product
The Retyrement Plan is a social enterprise that upcycles discarded tires into unique and innovative furniture and home decor items. The enterprise promotes sustainable design and reduces waste by transforming tires into durable and long-lasting products, such as chairs, tables, lamps, and planters. The Retyrement Plan employs local artisans and promotes eco-friendly living by using traditional crafting techniques to create functional and aesthetically pleasing products.	Newlight Technologies is a company that is focused on addressing the global plastic pollution crisis by developing and manufacturing a biodegradable plastic called AirCarbon. AirCarbon is created using a proprietary process that captures methane and other greenhouse gases from various sources, such as landfills and wastewater treatment plants, and converts them into a high-performance biodegradable plastic that can replace traditional oil-based plastics.	Renewi is a waste-to-product company that specializes in collecting and recycling waste streams into secondary raw materials and energy. They aim to promote circularity and reduce waste.
Repurpose	Sustainable production	Recycle
Tyres	Plastic	Waste
End of life	Production	End of life
Business to Business	Business to Business	Business to Business
Accessibility to discarded tires Design and craftsmanship Market demand Skilled workforce Promotion and marketing	Use of GHG feedstock Integration with existing plastics infrastructure Scalability of production Cost-competitiveness Regulatory approval	Efficient waste collection Advanced recyding technology Strong partnerships Market demand Government support Proper waste sorting
Environmental sustainability Social impact Unique designs Durable and long-lasting products Cost-effective	Creates biodegradable plastic Uses captured greenhouse gases Reduces plastic waste Products are cost-competitive Multiple applications for products	Promotes circularity Reduces waste Creates secondary raw materials and energy
Furniture	Plastics and packaging	Waste management
India	USA	UK
Asia	America	Europe
Enterprise	Enterprise	Enterprise
The Retyrement Plan is a circular economy enterprise that upcycles discarded tires into unique and innovative furniture and home decor items. By transforming waste materials into high-quality, durable products, the enterprise reduces waste and promotes sustainable living.	Newlight Technologies' plastic production is considered circular because it uses captured greenhouse gases as a raw material, reducing reliance on fossil fuels and creating a closed-loop system.	Renewi's extent of circularity is high, as the company focuses on transforming waste streams into secondary raw materials and energy through recycling and recovery processes, thereby reducing waste and promoting circularity.
Limited market demand Competition Transportation and logistics	Availability of carbon High production costs Biodegradation rate	Cost of waste management Limited public awareness Regulatory challenges and policies

Saathi	Miniwiz	EcoWorth Tech
Biodegradable sanitary pads	Upcycle waste materials	Upcycle waste products
Saathi specializes in creating biodegradable sanitary pads from banana fiber waste. The company's innovative approach to menstrual hygiene products not only provides a sustainable solution to the problem of menstrual waste but also generates livelihoods for farmers and promotes the use of natural materials.	Miniwiz specializes in upcycling waste materials to create new products. They use cutting-edge technology to transform waste materials into new products such as solar panels, building materials, and furniture. The company is committed to promoting sustainability and reducing waste through innovative manufacturing techniques.	EcoWorth Tech specializes in converting waste products into high-value materials for industrial use. The company uses a patented thermal decomposition process to create carbon black, activated carbon, and biochar from waste such as plastic, rubber, and biomass. By promoting circularity and reducing waste, EcoWorth Tech is creating new revenue streams for businesses and helping to mitigate the environmental impact of waste disposal.
Sustainable production	Repurpose	Repurpose
Organic materials	Waste	Waste
End of life	End of life	End of life
Business to Business	Business to Business	Business to Business
Accessibility Quality control Brand awareness Collaboration Innovation Regulatory support	Education and Awareness Suitability Quality and Durability Price and Availability Scalability and Replicability Collaborative Efforts	Efficient process Cost-effective Scalability Quality control Market demand Collaboration Regulatory support
Environmentally friendly Promotes circularity Empowers women	Reduces waste and promotes sustainability Produces innovative, award-winning products Showcases potential of advanced manufacturing techniques	Waste reduction Revenue generation
Cosmetics	Construction	Waste management
India	Taiwan	Singapore
Asia	Asia	Asia
Enterprise	Enterprise	Enterprise
Saathi creates biodegradable sanitary pads from banana fiber waste, promoting circularity and reducing waste. The company's approach to menstrual hygiene products represents a sustainable and circular solution to the challenge of menstrual waste.	Miniwiz demonstrates a high level of circularity in its operations by upcycling waste materials to create new products. This approach helps reduce waste and extends the life of existing materials, which contributes to a more sustainable and circular economy.	EcoWorth Tech's extent of circularity is high, as the company's waste conversion technology promotes the reuse and repurposing of waste materials, reducing the need for virgin materials. The high-value materials produced by EcoWorth Tech can be used as substitutes for virgin materials in a range of industries, creating a more closed-loop system that reduces waste and conserves resources.
Limited supply of raw materials Limited market demand Quality control	Higher costs than traditional products Production process can be time-consuming and complex Products may have different properties or characteristics than	High energy and capital costs Limited waste suitability Limited market demand

Green Rubber	Mycotech	Green Yatra
Upcycle tire waste	Upcycle agricultural waste	Upcycling waste materials
Green Rubber upcycles discarded tires into eco-friendly rubber products using its patented DeLink process. By removing contaminants from the rubber and transforming it into a high-quality material, Green Rubber promotes circularity and reduces waste. The company is committed to sustainable manufacturing and producing innovative products that benefit the environment.	Mycotech is a biotech company that focuses on upcycling agricultural waste into sustainable materials. The company uses mycelium, the root structure of mushrooms, to create a range of products, including leather-like materials and packaging. Mycotech's technology promotes circularity by creating a closed-loop system for agricultural waste and reducing the environmental impact of traditional material production.	Green Yatra is a non-governmental organization (NGO) that focuses on upcycling old newspapers, magazines, and books to create eco-friendly products. By converting these waste materials into items such as seed paper, pencils, and lampshades, Green Yatra is promoting sustainable design and reducing waste. The organization's innovative approach to waste management also generates employment opportunities and promotes environmental awareness in local communities.
Repurpose	Repurpose	Sustainable production
Tyres	Waste	Waste
End of life	End of life	End of life
Business to Business	Business to Business	Business to Business
Tire supply chain Required machinery Market demand Safety and sustainability Quality and durability	Quality control Cost-effectiveness Scaling up Market demand Innovation	Availability of waste materials Access to technology and equipment Quality control Marketing and outreach Partnerships and collaborations Innovation and creativity
Reducing tire waste and promoting circularity Creating eco-friendly rubber products Sustainable manufacturing practices Innovative, patented technology	Environmental sustainability Reduced carbon footprint High quality	Reduced waste Conservation of natural resources Employment generation Promotion of sustainable design Increased awareness
Automotive	Plastics and packaging	Paper
Malysia	Indonesia	India
Asia	Asia	Asia
Enterprise	Enterprise	Enterprise
Green Rubber's upcycling process has a high extent of circularity as it repurposes discarded tires and transforms them into high-quality, eco-friendly rubber products. By reducing waste and promoting the reuse of materials, the process supports a more sustainable and circular economy.	Mycotech's upcycling of agricultural waste promotes circularity by diverting waste from landfills and using it to create new products. The company's closed-loop production system also minimizes waste and supports a more circular economy.	Green Yatra's upcycling initiatives have a high extent of circularity, as they convert waste materials into new products, thereby reducing waste and conserving natural resources. By creating a closed-loop system for waste materials, Green Yatra is promoting circularity and contributing to a more sustainable and resource-efficient economy.
Dependence on a consistent supply of discarded tires Potential competition from cheaper, non-eco-friendly rubber products The need for specialized equipment and machinery	Limited availability Cost Consumer awareness	Limited availability of waste materials Quality control Limited market demand

Patagonia	Ford	Thenga
Sustainable outdoor clothing	Repurpose coffee waste	Upcycle coconut shells
Patagonia is an outdoor clothing and gear company that emphasizes environmental and social responsibility. They create products from sustainable materials and aim to reduce waste by promoting repair and reuse through their Worn Wear program. They also use their platform to advocate for environmental issues and support grassroots activism.	Ford's project involves repurposing discarded coffee chaff into a durable material that can be used in car parts. Coffee chaff is a waste product that is generated during the roasting of coffee beans, and Ford has developed a process to transform it into a composite material that is strong, lightweight, and sustainable.	Thenga upcycles discarded coconut shells to create a range of eco-friendly tableware and kitchenware products, such as bowls, plates, cups, and cutlery. The company sources its raw materials from local coconut farmers and uses a combination of traditional and modern techniques to process the shells into finished products. Thenga's upcycling efforts help reduce waste and promote sustainability, while also providing livelihood opportunities for local communities.
Sustainable production	Repurpose	Repurpose
Plastic	Organic materials	Organic materials
Production	Production	End of life
Business to Business	Business to Business	Business to Business
Understand values Durable products Recycled materials Reduce shipping impact Transparent supply chain	Material durability Manufacturing feasibility Regulatory compliance Consumer acceptance Supply chain sustainability	Education and Awareness Suitability Quality and Durability Price and Availability Sustainability and Ethics Collaborative Efforts
Strong commitment to sustainability and circularity. Use of recycled materials in their products. Programs and initiatives to encourage repair, reuse, and recycling of their products. Closed-loop supply chain for cotton garments. Transparency in their supply chain and production process	Sustainability Lightweight Durable Cost-effective Brand differentiation	Environmental Sustainability Natural and Biodegradable Unique and Stylish Local Economic Development Health Benefits
Textile technology	Automotive	Woodworking
USA	USA	India
America	America	Asia
Enterprise	Enterprise	Enterprise
Patagonia has made a strong commitment to circularity and has implemented various programs and initiatives to achieve it. While they have made significant progress, there is always room for improvement and they continue to work towards becoming more circular.	Ford's use of coffee chaff in car parts contributes to a more circular economy by repurposing a waste product into a valuable material. However, the extent of circularity also depends on how effectively the material is recycled or reused at the end of its life cycle.	Thenga's upcycled coconut shell products have a high extent of circularity as they use waste material and transform it into a new, valuable product, while promoting sustainability by creating a closed-loop system. The products are biodegradable and compostable after use, further contributing to the circularity of the product life cycle.
High cost	Limited applications New technology Scale-up challenges	Fragility Limited Availability Price

Noveon Magnetics
Recycle Rare-Earth Magnets
Noveon Magnetics is dedicated to recycling rare earth magnets, primarily derived from electronic waste. They utilize an innovative magnet-to-magnet recycling process, providing an efficient and environmentally friendly solution. The reclaimed magnets are then used in various industries, such as those producing electric vehicles and wind turbines.
Recycle
Metal
End of life
Business to Business
Access to Waste Efficient Processes Market Demand Regulatory Compliance Sustainability Focus Innovation Economic Feasibility Partnerships and Collaborations
Environmental Sustainability Resource Efficiency Economic Value Job Creation
Electronics
USA
America
Enterprise
Noveon Magnetics contributes significantly to circularity by reclaiming and reprocessing rare-earth magnets from electronic waste, transforming waste into a valuable resource. Their magnet-to-magnet recycling method minimizes the need for new raw materials, thus closing the loop in the lifecycle of these products and promoting a circular economy.
Waste Supply Technological Challenges Market Volatility

Appendix B

Guidelines on patent search

Steps to conduct a patent search for boosting Circular Economy practices

Karol Szymański

POLITECNICO
MILANO 1863

0. Glossary

Term	Definition
Assignee	The entity that has property rights to the patent, such as an individual or a company.
Bill of Materials	A comprehensive list of raw materials, components, assemblies, and other necessities for product manufacturing.
Circular Economy	An economic system that focuses on reducing waste and making the most of available resources by reusing, recycling, and refurbishing products and materials.
Classification Codes	A system of categorizing patents based on technology fields. It assists in narrowing down search results.
Claims	Specific legal statements in a patent document that define the scope of the protection granted by the patent.
Eco-Design	The practice of designing products with special consideration for their environmental impacts throughout their entire life cycle.
Espacenet	European Patent Office's (EPO) database for patent searches, providing access to patents from around the world.
Inventor	The individual or group of individuals responsible for the creation of the invention disclosed in the patent.
JPO	The Japan Patent Office, responsible for granting Japanese patents and registering trademarks in Japan.
Licensing Agreement	A legal contract that gives one party the rights to use and benefit from the intellectual property owned by another party.
Non-Patent Literature	Publications and documents that are not patents, such as academic papers, technical reports, and articles.
Patent Cooperation Treaty (PCT)	An international treaty that facilitates the process of applying for patents in multiple jurisdictions simultaneously.
Patent Landscape	An overview of patents within a specific technology area, often used to gain insights into trends, competitors, and opportunities.
PATENTSCOPE	World Intellectual Property Organization’s (WIPO) search service for international patent applications.
Revalorization	The process of adding value to waste materials, transforming them into valuable products or resources.
Secondary Raw Materials	Recycled materials that are used as raw materials in the manufacturing process.
Sustainable Innovation	Innovation that aims to meet present needs without compromising the ability of future generations to meet their needs.
USPTO	The United States Patent and Trademark Office, responsible for granting U.S. patents and registering trademarks.

1. Introduction

The following guideline explains how a patent search can be conducted to boost Circular Economy practices within the organization and identify resource transfer opportunities among sectors.

The potential of intellectual property to foster sustainable innovation makes it a valuable asset in boosting the circular economy. By leveraging IP rights, businesses can overcome institutional barriers and promote the dissemination of knowledge across industries. This, in turn, encourages the creation, adaptation, and distribution of green technology, facilitating shared innovation and the development of durable, recyclable products.

In order to conduct the search effectively, it is crucial to establish the objectives. While the researcher should have specific intentions in mind, this guideline aims to showcase potential achievements and suggests some predicted targets. It is necessary to clearly identify the specific area within the circular economy on which to focus (e.g., recycling, waste management, sustainable materials). The areas of focus within the circular economy, which also guide the direction of the search, include:

I. Production and Consumption:
- Sustainable production methods (eco-design, resource efficiency, Design for Sustainability)
- Responsible consumption patterns (product longevity, conscious consumer choices)
- Waste as a resource (reuse, refurbish, remanufacture, revalorization opportunities)

II. Waste Management:
- Effective waste management strategies (waste reduction, recycling, proper disposal)

III. Secondary Raw Materials:
- Utilization of recycled materials (collection, sorting, processing)

IV. Competitiveness and Innovation:
- Circular economy as a driver of competitiveness (cost savings, new market opportunities)
- Fostering innovation (sharing platforms, collaborative consumption)

V. Global Sustainability and Resilience:
- Environmental, social, and economic dimensions of sustainability
- Creating resilient systems (adaptation to environmental challenges)

If it is not clear what target the researcher wants to follow, it is suggested to complete the questionnaire.

What can be achieved through patent search:

1. **Licensing agreements and technology transfer**: Organizations can enter into licensing agreements with patent holders to gain access to patented technologies or processes that support circular economy practices. This allows for the transfer of knowledge and technology, enabling wider adoption of sustainable solutions and fostering collaboration between organizations.
2. **Collaborative research and development**: Organizations can collaborate with patent holders or other stakeholders to jointly develop new circular economy technologies or enhance existing ones. By pooling resources, expertise, and intellectual property, collaborative R&D efforts can accelerate innovation and create more effective circular solutions.
3. **Research and development guidance**: Patents can provide insights into the state-of-the-art technologies and ongoing research in the field of circular economy. Organizations can analyze patents to gain a deeper understanding of emerging trends, technological advancements, and potential areas for further research and development. This can guide their own R&D efforts and help them align their innovation strategies with the latest developments in the circular economy space.
4. **Commercialization of patented technologies**: Organizations can leverage patented technologies to develop and commercialize circular economy products or services. By identifying relevant patents and acquiring the necessary licenses, businesses can bring sustainable innovations to the market, contributing to the growth of the circular economy.
5. **Knowledge sharing and open innovation**: Patents can be used as a basis for knowledge sharing and open innovation initiatives. Organizations can publish non-confidential aspects of their patented inventions, allowing others to build upon and improve the disclosed technologies. This encourages collaboration, fosters innovation ecosystems, and promotes the spread of circular economy practices.
6. **Policy advocacy and public awareness**: Organizations can utilize patent information to advocate for supportive policies and regulations that incentivize circular economy practices. By highlighting the value and impact of patented technologies, businesses can contribute to the development of a favorable policy environment that encourages circularity and sustainable innovation.
7. **Investment attraction and funding opportunities**: Patented technologies or inventions related to the circular economy can be attractive to investors and funding agencies. Organizations can leverage their patents to secure funding, attract investments, or form partnerships with entities interested in supporting sustainable initiatives.
8. **Education and training programs**: Patents can be used as educational tools to raise awareness and understanding of circular economy principles. Organizations can develop training programs, workshops, or educational materials that incorporate patented technologies as case studies, helping to disseminate knowledge and inspire future generations to contribute to the circular economy.

2. Non-patent literature

Before conducting a patent search, it would be beneficial to gain a general understanding of the principles of circular economy. If researcher is not familiar with these principles, non-patent literature can be utilized as a valuable resource for getting acquainted with the topic. Non-patent literature is typically more accessible than patents, making it a suitable starting point.

To gain general insights into the circular economy, it is advisable to explore non-patent literature, company websites and databases such as ScienceDirect or Google Scholar. These sources offer valuable information, including sustainability reports and scholarly articles, which provide data on corporate strategies, achievements, and trends.

In the context of this thesis, comprehensive research was carried out on non-patent literature, focusing on stories of organizations that have successfully implemented circular economy practices. The knowledge gained from this research will be presented in the form of patent search strategies. These strategies will be adapted and grouped according to the specific directions chosen by the researcher. Therefore, they will help formulate keywords and direct the search.

Strategies for selected areas of focus:

1. Production and Consumption
2. Waste Management
3. Secondary Raw Materials
4. Competitiveness and Innovation
5. Global Sustainability and Resilience

3. Keyword Formulation

The conclusions drawn from the previous chapter serve as a starting point for formulating keywords for patent searches. This is a very important step. Refining these keywords requires further steps, their importance varies depending on the direction chosen.

Generally compile a list of keywords related to the area of interest, including specific technologies, processes, or materials associated with the circular economy. Consider synonyms or alternative terms to broaden the search.

There are specific actions to be considered for the chosen area of focus. Exploring BOM is recommended for areas I, II and III. Exploration of Circular Economy terminology is recommended for targets IV and V:

3.1. Bill of Materials

Exploring the Bill of Materials (BOM) of a company's product is helpful as it enables tracking of patents relevant to that specific product. Check the Bill of Materials (BOM) for targets:

I. Production and Consumption:

- Enables resource optimization and sustainable design
- Facilitates the integration of circular economy principles

II. Waste Management:

- Identifies opportunities for waste reduction and proper handling of hazardous materials

III. Secondary Raw Materials:

- Allows for resource recovery and extraction of economic value from components

3.2. Circular Economy terminology

Exploring Circular Economy-related terminology aids competitiveness, innovation, and contributes to global sustainability and resilience. Explore Circular Economy terminology for targets:

IV. Competitiveness and Innovation:

- Supports sustainable practices and innovation
- Improves efficiency, cost savings, and customer satisfaction
- Identifies opportunities for product development and business model innovation

V. Global Sustainability and Resilience:

- CE terminology aligns with sustainability goals
- Reduces environmental impact and enhances resource resilience
- Enables adoption of sustainable approaches in operations and product management.

3.3. Brainstorming

An optional step can be carried out if the researcher has a diverse team to work with. It's recommended to conduct a brainstorming session to articulate the patent description for any chosen direction. In a brainstorming session, keywords related to the circular economy and chosen direction are generated by a diverse team. Using the 'Eco-design for improved product life cycle' direction as an example, potential keywords could include 'eco-design', 'sustainable materials', 'modular design', and 'recycle'.

4. Patent databases

Once relevant keywords have been identified to outline the patent, it is recommended that Google Patents be used as an initial search tool, if the user is new to patent searching. This is due to its functionality being similar to a regular Google search, making it an accessible first step. If the user is familiarized with patent databases, the search can be initiated in the chosen

database based on the user's preference, typically, WIPO or EPO are recommended options to start with as those are the most versatile databases. If researcher wants to explore the specifics of databases in order to choose the most suitable one, it is recommended to use a table that outlines the strengths and weaknesses of each database.
Choose a suitable database for the patent search based on factors like geographical scope and language requirements. Consider Google Patents for a broad search or non-English patents. Use USPTO for detailed information on US patents and EPO for European patents. For a global perspective, try EPO or WIPO databases. WIPO is the optimal choice for Patent Cooperation Treaty (PCT) filings (international application). Use professional patent translation services (e.g., *Patent Translations International*) for accurate analysis or legal purposes. Select a specific database to initiate the search and gather potentially relevant patents.
Begin a broad patent search, review the summaries and gather an initial group of potentially relevant patents for the target. Pay particular attention to the IPC/CPC codes assigned to each patent, as this will be useful for the next stage of the search.
Next step is to restrict the search to include relevant CPC/IPC classifications.

5. Patent Classification Systems

CPC and IPC codes are global systems used to categorize patents based on their technical features. Each patent is given one or more codes corresponding to the relevant technological sectors it covers. These codes, part of the patent's basic information, help locate related patents in the same or similar fields, simplifying patent searches.
Including Patent Classification Code Application, namely Cooperative Patent Classification (CPC) or International Patent Classification (IPC) in patent searches, is essential for specific technological areas' efficient exploration. These systems organize patents by technology areas, providing a more streamlined search. In the context of sustainability, the CPC and IPC can help locate patents linked to waste management or recycling through dedicated codes.
To narrow down your search to a specific IPC/CPC group, utilize the Boolean operator 'AND' along with the previously selected keywords.
CPC and IPC are introduced in the codes description.
After understanding classification codes, it's advisable to narrow the patent search to relevant classes. With the set of patents from the prior stage, look for any codes that overlap between patents. Aim to identify a shared code of complexity (a)(b)(c), such as H05K, but feel flexible to vary its complexity. It's possible that multiple classification codes may be relevant to the search, yet using about 1-3 codes is suggested. Once the relevant codes have been selected, the search for patents belonging to the selected classes should be narrowed down.
Classifications codes facilitate the identification of relevant patents by narrowing down the vast field of available data. The codes create a structured approach to locate inventions within similar technological sectors, eliminating irrelevant patents from the search results. By identifying a common code or codes, it is easier to target the search to patents that are most likely to be relevant to the area of interest.

6. Patents Analysis

Examine selected patents to understand prevailing technological trends, significant inventors, key assignees, search for potential opportunities and to identify technological gaps within the industry.

For the given areas of focus within the circular economy, the following sections of the patent would be particularly relevant:

I. Production and Consumption:

- Abstract and Description: Look for details on sustainable production methods, responsible consumption, and waste reuse.
- Technical solution/Statement of the Invention: Information on eco-design, resource efficiency, and Design for Sustainability.
- Claims: Identify the specific protections around sustainable production and consumption methods.

II. Waste Management:

- Abstract and Description: Insight into waste management strategies including reduction, recycling, and disposal.
- Technical solution/Statement of the Invention: Explanation of specific waste management techniques.
- Claims: Details on the protection of waste management inventions and methods.

III. Secondary Raw Materials:

- Abstract and Description: Information on the utilization of recycled materials and secondary raw materials.
- Technical solution/Statement of the Invention: Explanation of collection, sorting, processing, reuse, refurbish, and revalorization opportunities.
- Claims: Details on the specific protection around these methods.

IV. Competitiveness and Innovation:

- Background Art and Technical Field: Understanding of existing state of the art in circular economy innovation.
- Technical solution/Statement of the Invention: Details on circular economy as a driver of competitiveness and fostering innovation.
- Claims: Specific protections related to cost savings, new market opportunities, sharing platforms, and collaborative consumption.

V. Global Sustainability and Resilience:

- Abstract and Description: Overview of environmental, social, and economic dimensions of sustainability.
- Technical solution/Statement of the Invention: Specifics on creating resilient systems and adaptation to environmental challenges.
- Claims: Specific protection related to systems and methods for global sustainability and resilience.

These sections within a patent will guide the search and analysis for inventions and innovations related to the circular economy, helping to uncover insights that align with the specific areas of focus. In order to get familiar with relevant sections it is advised to study patent structure definition.

Reviewing the list of most active patent assignees is crucial to understand the market dynamics in terms of patent activities, identify potential opportunities, and determine which companies to engage with for potential partnerships. Multiple patents in sustainable manufacturing held by a company, such as Company A, could suggest a leadership position in that field.

It's also important to note that patent activity is high in countries with strong technological and industrial sectors. The United States, Japan, China, South Korea, and Germany are typically among the countries with the most patent activity.

It is suggested to focus on the aspects like understanding the structure of patents, reviewing the most relevant sections within them, refining the keywords used for search, gaining insights into current technological trends, identifying key assignees and crucial patent-submitting countries.

Refinement of the search process can be achieved by adjusting keywords based on the patents found. For example, if 'resource recovery' is a term frequently encountered in patents during research around waste recycling, its inclusion in subsequent searches is recommended.

Insights into current technological trends in the area of interest can be gained from the analysis of multiple patents. An increasing number of patents related to bio-degradable packaging, for instance, could suggest a shift towards more sustainable packaging solutions.

7. Legal Expert Consultation

If the researcher or organization has the resources it is possible to consult with a patent attorney or a professional patent analyst for an accurate interpretation of patent search findings before drawing conclusions or taking actions in specific cases. In patent analysis, consultation with a patent attorney or professional analyst is crucial when interpreting patent claims, assessing patent validity.

The interpretation of patent claims is considered necessary in several contexts. Primarily, it is used when the infringement of an existing patent by an invention or product needs to be avoided. Patent claim interpretation helps to understand the exact scope of the patent owner's rights, enabling the design of a product or process that circumvents these protected areas.

Additionally, the need to interpret patent claims arises when a Freedom to Operate (FTO) analysis is conducted. This analysis involves determining whether a product or process infringes the patent rights of others in a particular country. A clear understanding of the patent claims, obtained through interpretation, can help confirm that the operations in question do not infringe existing patents, ensuring freedom to operate.

Furthermore, when the validity of a patent is being assessed, the interpretation of patent claims becomes important. Even when a patent has been granted, it could still potentially be invalid due to the existence of prior art. In this scenario, any elements already present in the prior art, which could potentially undermine the patent's validity, can be identified through the interpretation of patent claims.

The goal of patent analysis, which requires the interpretation of patent claims, is to gain strategic insight into innovation and R&D and to reduce legal risk. By understanding patent claims, gaps in the current technology landscape can be identified, innovation around existing patents can be stimulated, potential infringements can be avoided, and a robust intellectual property strategy can be built. In addition, this can help inform decisions related to potential partnerships, licensing or investment opportunities.

Following detailed analysis, the insights can shape research and development strategies, including innovation, competitor analysis, risk management, investment decisions, and legal strategy formulation.

Given that each patent is unique, expert guidance is invaluable in navigating this complex, case-by-case process. Consultation becomes essential when these elements are involved, ensuring accurate interpretation and informed decision-making.

Consulting a patent attorney might not always be needed in cases of initial patent searches, technology trend identification, preliminary competitor analysis, basic R&D guidance, geographical scope understanding, and patent status verification. These tasks can be carried out with keyword searches, patent classification systems, and high-level analyses. However, a patent attorney's advice can still be useful in these situations to ensure analysis accuracy, especially when making important decisions based on the results.

When analyzing patents with a legal expert to avoid patent infringement, it is important to focus on a few key aspects.

Patent claim interpretation and validity checks are key tasks conducted by patent experts. The possibility of any patent infringement is ruled out during these analyses. A Freedom to Operate (FTO) analysis is also performed to ensure no patent rights are violated.

Strategic insights about technology and innovation opportunities are identified in the process. Critical decisions involving partnerships, licensing, or investments are aided by these insights.

The expert also checks the status and geographical scope of the patent. Knowledge about the 'doctrine of equivalents' is provided to prevent possible indirect infringement.

Workaround strategies to existing patents are suggested by the expert. Each patent's uniqueness necessitates a case-by-case analysis. Expert consultation simplifies this process, ensuring accurate interpretations and informed decisions.

8. Strategic Application of Findings

Use the data from the patent search to inform research and development (R&D) strategies. This might involve innovating around existing patents, identifying potential partners for licensing or collaborations, or recognizing emerging technologies for investment.

Strategic application of findings can take many forms and serves to use insights gained through patent analysis to inform decision-making, inform R&D processes and strengthen competitive positions.

1. **Innovation and R&D strategy:**

Insights from patent analysis can be used to guide innovation and R&D activities. Understanding what has been patented can help identify gaps in the market or technology that a company or research can potentially fill. It can also direct research efforts away from areas that are heavily patented, reducing the risk of potential infringement.

2. **Competitor analysis:**

Patents provide a wealth of information about what competitors are doing. By analyzing patents, it can be understood where competitors are focusing their research efforts, predict future products or technologies they may be developing, and identify potential opportunities for operations or research.

3. **Risk management:**

By identifying patents that are relevant to the product or technology, steps can be taken to reduce the risk of infringing someone else's patent. This may include modifying the product or technology to avoid infringement or potentially negotiating a license to use the patented technology.

4. **Investment and acquisition decisions:**

The results of a patent analysis can also help inform investment and acquisition decisions. If a company has a strong patent portfolio in a key technology area, this can make it an attractive investment or acquisition target.

5. **Legal strategy:**

Armed with knowledge of the patent landscape, an effective legal strategy can be formulated. This may include applying for patents for own innovations, preparing for potential patent litigation or entering into licensing agreements.

Through the strategic application of insights from patent analysis, a position within the circular economy can be enhanced, legal issues can be avoided, and company or research can be guided towards areas that present the most potential for success in a circular context.

9. Real world example

XYZ Research Institute and the Development of a Circular Production System for Mechanical Components - Real-World Example

10. Evaluation

Enhancements to the guidelines are made possible through your feedback. Whether represented as a professional or a newcomer to the field, needs can be better met through your opinions.

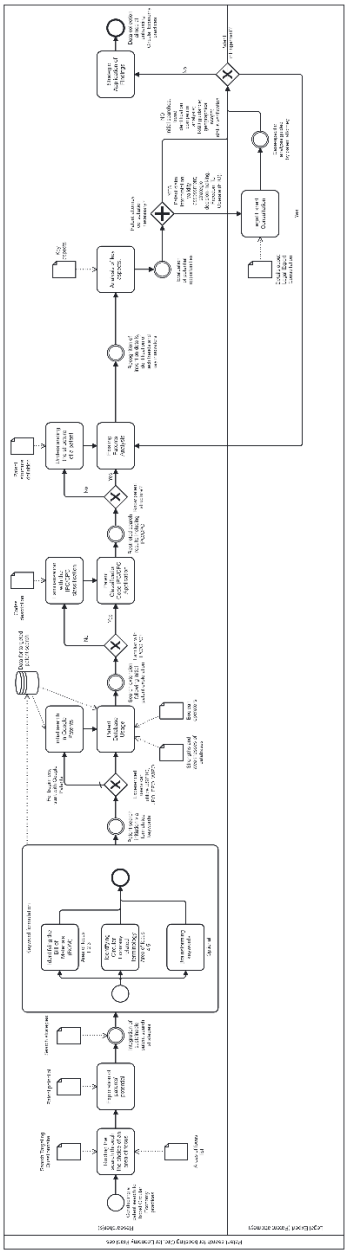
By having this questionnaire completed, a more effective and user-friendly tool, fostering innovation and collaboration in the circular economy, will be developed.

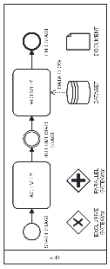
Honest responses on usability, satisfaction, functionality, and relevance will be utilized for the improvements.

https://forms.gle/RSxKxFVgRf5RHmyj8

Gratitude is extended for your assistance in making a difference!

Appendix B.1





Appendix B.2

Guideline Execution

This "Guideline Execution" is designed to assist users in navigating the guidelines and documenting insights gained at each stage. Users are encouraged to record observations from every step and note them within this template.

* Indicates required question

Note: The data collected via this form will be managed in compliance with the General Data protection Regulation (GDPR). We will use the collected information solely for research purposes. All published results will be in aggregated form, ensuring individual privacy.

1. Name
2. Role/Position *
3. Company/Organization *
4. Area of research *
5. 1. Introduction - Direction of the search *

Mark only one oval.

I. Production and Consumption

II. Waste Management

III. Secondary Raw Materials

IV. Competitiveness and Innovation

V. Global Sustainability and Resilience

6. 1. Introduction - Patent potential *

Check all that apply.

1. Licensing agreements and technology transfer
2. Collaborative research and development
3. Research and development guidance
4. Commercialization of patented technologies
5. Knowledge sharing and open innovation
6. Policy advocacy and public awareness

7. Investment attraction and funding opportunities

8. Education and training programs

7. 1. Introduction - Additional remarks

8. 2. Non-patent literature - Production and Consumption *

Check all that apply.

i. Internal Integration of Circular Principles

ii. Design for Recyclability

iii. Use of Organic Materials

iv. Product Lifecycle Management

v. Advanced Manufacturing Techniques

vi. Integration of Sustainability

vii. Customer Engagement (regarding revalorized products)

9. Additional remarks

2. Non-patent literature - Waste Management

10. Waste Management *

Check all that apply.

i. Comprehensive Waste Management

ii. Operational Autonomy

iii. Mechanization of Recycling Process

iv. Emphasis on Waste Reduction

v. Focus on End-of-life Stage

11. Additional remarks

12. 2. Non-patent literature - Secondary Raw Materials *

Check all that apply.

i. Versatility in Raw Materials

ii. Innovation in Recycling

iii. Modular Design

iv. Sustainable Revalorization

v. Intelligent Resource Management

13. Additional remarks

14. 2. Non-patent literature - Competitiveness and Innovation *

Check all that apply.

i. Openness to Innovation

ii. Sustainability Metrics

iii. Innovation in Supply Chain Management

iv. Third-party Support

v. Sustainable Business Models

15. Additional remarks

16. 2. Non-patent literature - Global Sustainability and Resilience *

Check all that apply.

i. Geographical Consideration

ii. Engagement across Sectors

iii. Regulatory Compliance

iv. Collaboration with Stakeholders

v. Promotion of Renewable Energy

17. Additional remarks

18. 3.1. Bill of Materials (keywords formulated - if not applicable write N/A) *

19. 3.2. Circular Economy terminology (keywords formulated - if not applicable write N/A)*

20. 3.3. Brainstorming (keywords generated)

21. 3.4. Keyword Formulation - Keywords generated *

22. 4. Patent databases - Utilized database *

Check all that apply.

Google Patents

Espacenet (EPO)

Patentscope (WIPO)

USPTO

JPO

Other:

23. 5. Patent Classification Systems - Utilized CPC *

24. 5. Patent Classification Systems - Utilized IPC *

25. 6. Patents Analysis - Relevant sections of the patent utilized in the process *

Check all that apply.

Title Abstract

Description

Technical field

Background art

Technical problem/Statement of purpose of the invention

Technical solution/Statement of the invention

Brief description of the drawing(s) and List of drawings

Detailed description and Specific description

Drawings Claims

26. 6. Patents Analysis - Key aspects focus *

Check all that apply.

Interpretation of patent claims Patent validity

Geographical scope Status of the patent

Freedom to Operate (FTO) analysis Doctrine of equivalents Workarounds

27. 6. Patents Analysis - Additional remarks

28. 7. Legal Expert Consultation (optional) - Remarks

29. 8. Strategic Application of Findings - Key Data/Knowledge Gathered *

Check all that apply.

1. Innovation and R&D strategy
2. Competitor analysis
3. Risk management
4. Investment and acquisition decisions
5. Legal strategy

30. 8. Strategic Application of Findings - Additional remarks

Appendix B.3

Evaluation of Guidelines on Patent Search

Note: The data collected via this form will be managed in compliance with the General Data Protection Regulation (GDPR). We will use the collected information solely for research purposes. All published results will be in aggregated form, ensuring individual privacy.

* Indicates required question

User Profiling Form for Patent Search Guidelines

Note: The data collected via this form will be managed in compliance with the General Data protection Regulation (GDPR). We will use the collected information solely for research purposes. All published results will be in aggregated form, ensuring individual privacy.

1. Name
2. Position *
3. Company/Organization *
4. Role in the Company *

Research & Development

Legal Compliance Strategy

Planning Product

Development

5. Experience in the Role *

Less than 1 year 1-3 years

4-6 years

7 years or more

6. Patent Search Experience *

No experience

Occasional searcher

Frequent searcher

Expert searcher

7. General Information Search Experience *

No experience

Occasional searcher

Frequent searcher

Expert searcher

8. Highest Degree Obtained *

High School

Bachelor's Master's

PhD or higher

9. Impact of Our Guidelines on Your Work *

Extremely positive

Somewhat positive

Neutral

Somewhat negative

Extremely negative

10. Comments on Guidelines' Utility (especially if unfamiliar with patent search):

Usability of Guidelines on Patent Search

Note: The data collected via this form will be managed in compliance with the General Data Protection Regulation (GDPR). We will use the collected information solely for research purposes. All published results will be in aggregated form, ensuring individual privacy.

11. 1. I found the guidelines easy to use. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

12. 2. The organization of information in the guidelines was clear. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

13. 3. I felt confident using the guidelines. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

14. 4. I believe I could use the guidelines without the need for support. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

15. 5. The content in the guidelines was easy to understand. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

16. 6. The guidelines met my expectations. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

17. 7. I think most people would learn to use these guidelines very quickly. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

18. 8. The guidelines were too complex. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

19. 9. I felt the need to consult external help when using the guidelines. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

20. 10. The guidelines provided me with all the information I needed. *

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

21. 11. Please provide any additional comments, suggestions, or insights that could help us tailor the guidelines to better serve the specific needs and objectives of your organization.

Usefulness of Guidelines on Patent Search

Note: The data collected via this form will be managed in compliance with the General Data Protection Regulation (GDPR). We will use the collected information solely for research purposes. All published results will be in aggregated form, ensuring individual privacy.

22. Understanding: Describe in your own words the main purpose of the guidelines as you understand it. *

23. Comprehensiveness: Were there any areas in the guidelines that you felt were lacking or needed more detail? If yes, which areas? *

24. Clarity: Were there any sections in the guidelines that were unclear or confusing? Please specify. *

25. Relevance: How do you perceive the relevance of the guidelines to your specific needs related to patent search? *

26. Practicality: Were you able to apply the steps or recommendations from the guidelines in a real-world patent search scenario? If yes, describe any challenges you faced. *

27. Comparison: If you've used other patent search guidelines before, how does this one compare in terms of utility and clarity? *

28. Outcomes: Can you describe any positive outcomes or benefits you experienced as a result of following the guidelines? Conversely, were there any negative outcomes? *

29. Examples and Illustrations: Were the examples and illustrations in the guidelines helpful? Why or why not? *

30. Recommendations: Based on your experience, what improvements or additions would you recommend for the guidelines? *

31. Final Thoughts: Do you have any other feedback or comments about the guidelines that haven't been covered in the previous questions? *

Task Load Index

Please rate the perceived workload of using the guidelines based on your experience. For each of the six factors listed below, mark the position on the scale that reflects your experience.

32. Mental Demand: How mentally demanding was the task of using the guidelines? *

Very Low

1

2

3

4

5

6

7

Very High

33. Physical Demand: How physically demanding was the task of using the guidelines? *

Very Low

1

2

3

4

5

6

7

Very High

34. Temporal Demand: How hurried or rushed was the pace of the task with the guidelines? *

Very Low

1

2

3

4

5

6

7

Very High

35. Performance: How successful do you feel in accomplishing what was asked of you using the guidelines?*

Very Low

1

2

3

4

5

6

7

Very High

36. Effort: How hard did you have to work to achieve your level of performance with the guidelines?*

Very Low

1

2

3

4

5

6

7

Very High

37. Frustration Level: How insecure, discouraged, irritated, stressed, and annoyed were you when using the guidelines?*

Very Low

1

2

3

4

5

6

7

Very High

Thank You for Your Valuable Feedback!

We sincerely appreciate the time and effort you took to fill out our questionnaire and evaluate our guidelines. Your feedback is invaluable to us as it helps us improve and refine our resources. Understanding your experience and insights is crucial in ensuring that our guidelines are both effective and user-friendly. Once again, thank you for your contribution to our continuous improvement process. We're committed to offering the best guidance possible, and with your help, we're one step closer.

Appendix B.4

Strengths and weaknesses of databases:

Database	Strengths	Weaknesses
Google Patents	• Intuitive interface • Integration with Google's search • Automated translations • Good for preliminary searches.	• Lacks specialized features (patent family information, legal status updates, citation analysis, advanced search filters, analytics, alerts) • Updates may not be current.
USPTO	• Official source for all U.S. patent documents • Highly detailed searches • Supports various search parameters (inventor, classification codes, real-time patent status, patent families, citation details, assignee info, image-based searches)	• Complex interface • U.S. patents only • No translation services
EPO	• Access to 120 million global patent documents • Multilingual translations • Robust classification system • Invention timeline view • Patent family information, • Legal status data • Advanced search operators	• Complex interface • Machine translations may be inaccurate.
WIPO	• Access to international PCT applications • Supports global patent searches • Multiple language support • WIPO Translate for patent vocabulary • Linked to "IPC Green Inventory" for green technologies • Supports Chemical Structure Search • Enables Cross-Lingual search • Access to patent families, citations, and legal status	• Complex interface • Possible update delays • Inaccuracies in translation tool • Limited coverage of national-level patents
JPO	• Official source for Japanese patents • Highly reliable • Detailed data	• Language barrier • Limited English capabilities • Covers only Japanese patents.

Appendix B.5

Boolean operators:

Boolean operators are utilized in patent searches to refine and narrow down search results. Their purpose is to combine keywords and specify the relationship between them. The following examples demonstrate the usage of Boolean operators in a patent search:

- **AND** operator: The AND operator is employed to retrieve results that include both of the specified keywords. For instance, if the search query is "plastics AND recycling," the results will consist of patents that contain both the terms "plastics" and "recycling."
- **OR** operator: By using the OR operator, the search is broadened to retrieve results that include either of the specified keywords. For example, if the search query is "waste management OR recycling," the results will include patents that contain either the term "waste management" or "recycling."
- **NOT** operator: The NOT operator excludes specific terms from the search results. For instance, if the search query is "plastics NOT recycling," the results will include patents that mention "plastics" but do not reference "recycling."
- **Wildcard (*)**: The asterisk (*) serves as a wildcard character in patent searches, representing one or more characters to expand the search. For example, if the search query is "recycl*," the results will include patents with terms such as "recycle," "recycling," "recyclable," and so on.
- **Parentheses ( )**: Parentheses are employed to group terms and operators in complex queries, providing more precise control over search results. For example, the query (battery OR cell) AND charger retrieves patents where either the term "battery" or "cell" is present, and the term "charger" is also present.
- **Quotation marks** " ": Quotation marks are used to search for documents that contain the exact phrase enclosed within them. For instance, searching for "solar cell" within quotation marks retrieves patents that specifically mention the exact phrase "solar cell" in the document.
- **Proximity**: Proximity search in patent search finds patents where specific terms appear close to each other, providing precise results. Users specify terms and maximum distance, narrowing down search results. For example, searching for "solar panel" within a proximity of 5 words retrieves patents where "solar" and "panel" appear within that distance.

Example Patent Searches Using Boolean Operators:

Searching for inventions related to electric vehicles but not related to charging stations:

Query: electric vehicle AND NOT charging

Searching for inventions related to solar energy storage, considering both batteries and capacitors:

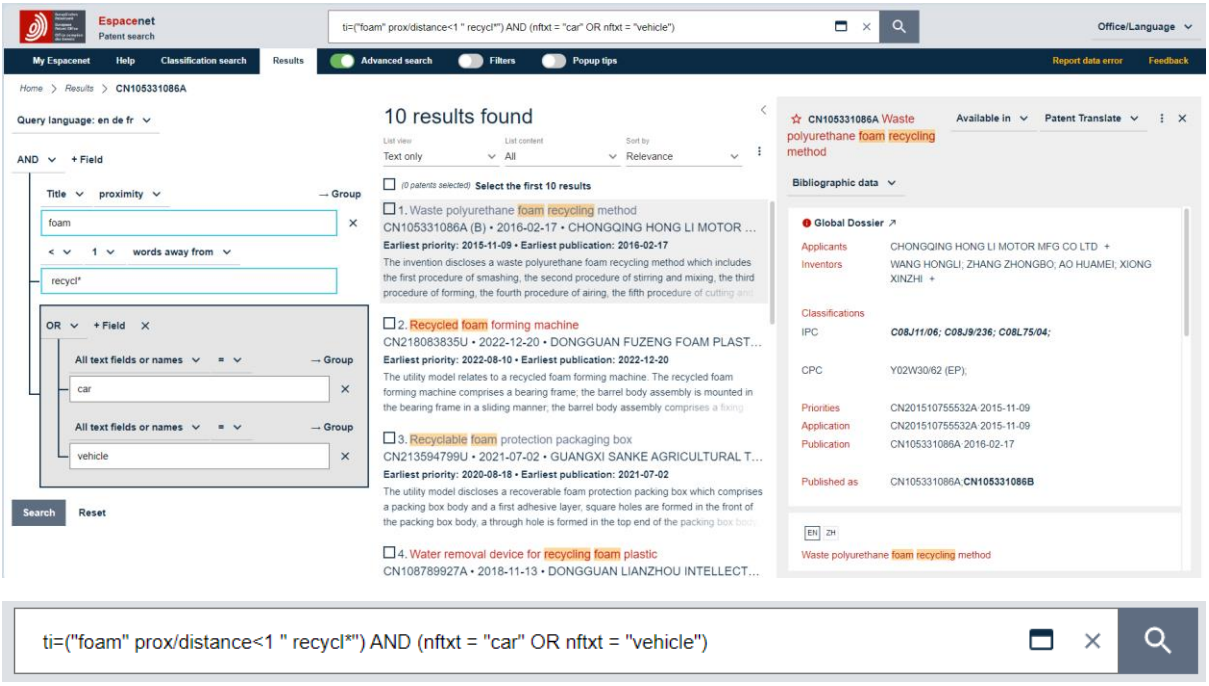
Query: solar AND (battery OR capacitor)

Searching for inventions related to recycling of either plastics or metals:

Query: recycl* AND (plastic OR metal)

ESPACENET example:

The query "<link>ti=("foam" prox/distance<1 " recycl*")</link> AND (nftxt = "car" OR nftxt = "vehicle")" is a specific type of proximity search query used in patent searches. Let's break down the components of this query:

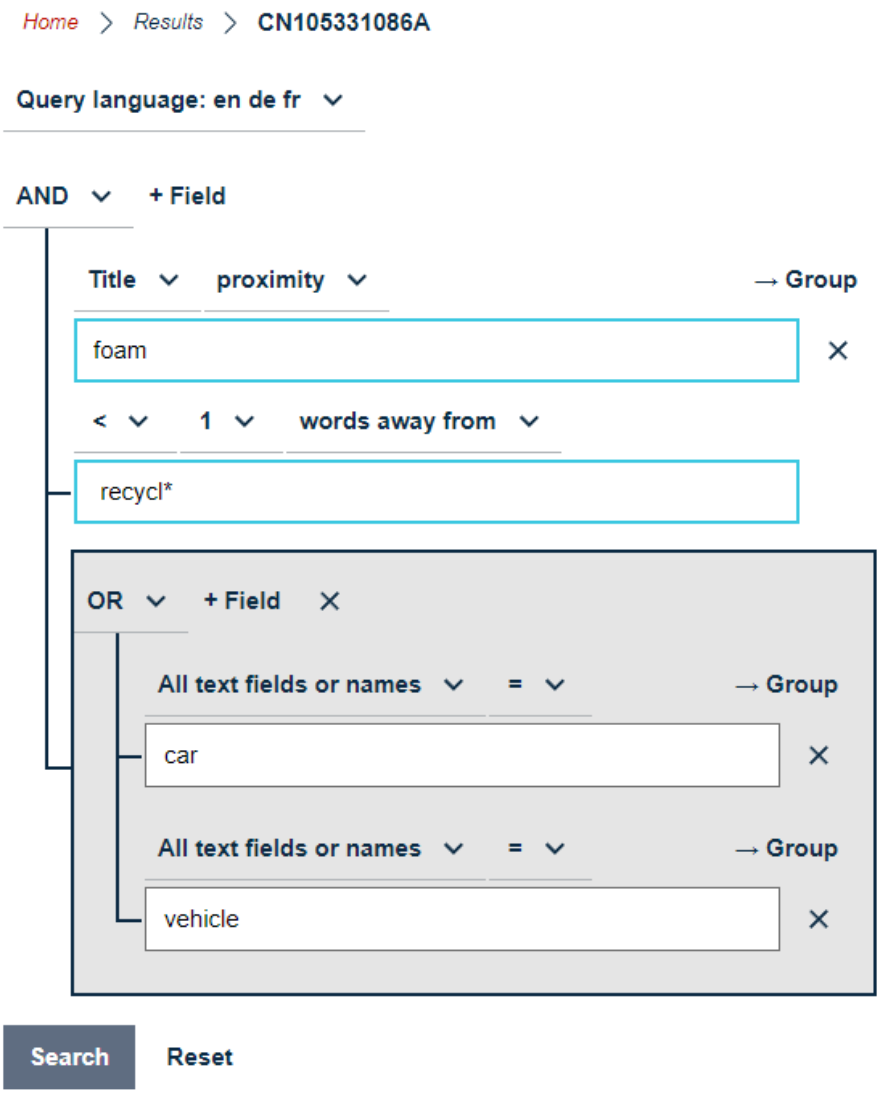


- "<link>ti=("foam" prox/distance<1 " recycl*")</link>": This part of the query focuses on the title field (ti) of the patents. It utilizes the "prox" operator to perform a proximity search between the terms "foam" and "recycl*". The "prox/distance<1" specifies that the terms should appear adjacent to each other or with no words in between. This means that the terms "foam" and "recycl*" should appear next to each other in the patent title.
- "(nftxt = "car" OR nftxt = "vehicle")": This part of the query focuses on the non-full-text field (nftxt) of the patents. It uses the OR operator to search for patents that contain either the term "car" or the term "vehicle" in the non-full-text field. This part aims to find patents related to cars or vehicles.

By combining these two parts with the AND operator, the query ensures that the retrieved patents meet both conditions simultaneously. In other words, the patents must have the specified proximity between "foam" and "recycl*" in the title field and include either the term "car" or the term "vehicle" in the non-full-text field.

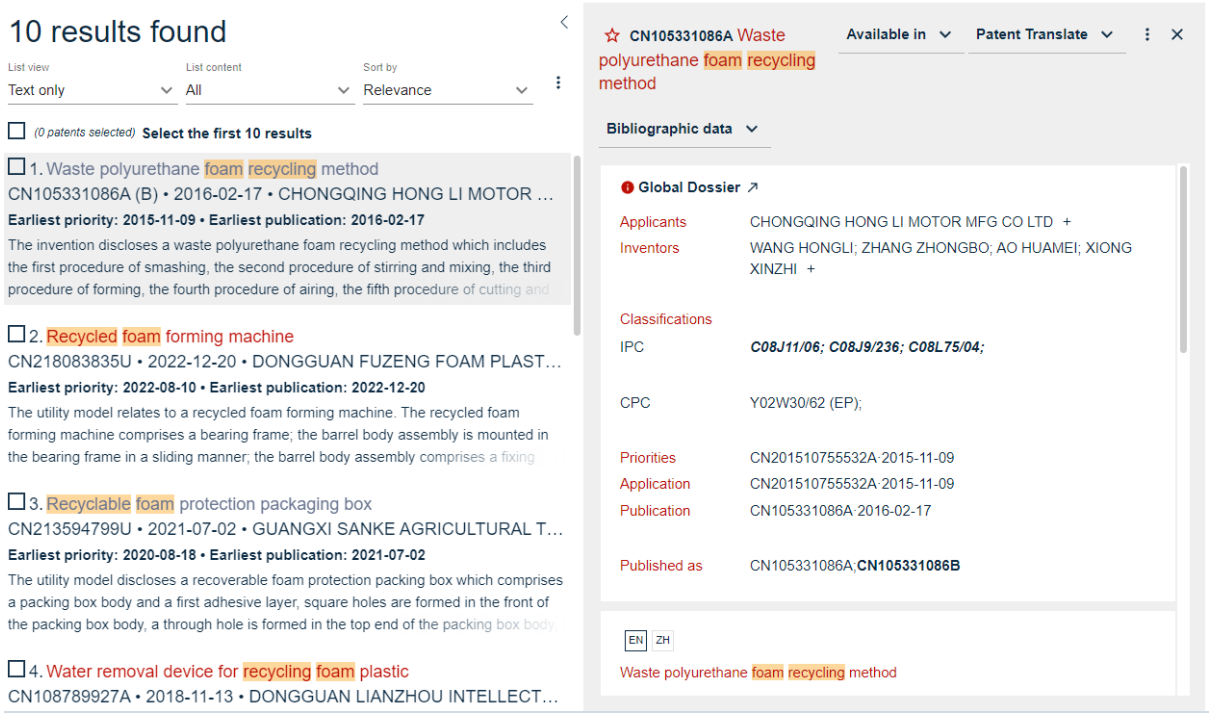
In summary, this query is designed to find patents where the term "foam" is in close proximity to a term starting with "recycl*" in the title field, along with the presence of either "car" or "vehicle" in the non-full-text field. This allows for a more precise retrieval of patents that discuss foam-related topics, recycling, and automobiles.

The purpose of using these formulas, such as "nftxt" (non-full-text) and "ti" (title), is to specify the specific fields within the patent documents that should be searched. However, users typically don't need to manually input these formulas themselves. Instead, they can utilize the search interface provided by the platform, which often includes options or dropdown menus to select the desired fields.



By selecting the appropriate field, such as "title," "abstract," or "full-text," users can indicate where they want their search terms to be applied. The platform then takes care of generating the query or formula automatically based on the user's selections.

This user-friendly approach simplifies the search process and eliminates the need for users to have in-depth knowledge of the underlying formulas or query syntax. It allows users to focus on selecting the relevant fields and entering their search terms, making the patent search experience more accessible and intuitive.


10 results found
List view
Text only
List content
All
Sort by
Relevance
(0 patents selected) Select the first 10 results
1. Waste polyurethane foam recycling method
CN105331086A (B) • 2016-02-17 • CHONGQING HONG LI MOTOR …
Earliest priority: 2015-11-09 • Earliest publication: 2016-02-17
The invention discloses a waste polyurethane foam recycling method which includes the first procedure of smashing, the second procedure of stirring and mixing, the third procedure of forming, the fourth procedure of airing, the fifth procedure of cutting and
2. Recycled foam forming machine
CN218083835U • 2022-12-20 • DONGGUAN FUZENG FOAM PLAST…
Earliest priority: 2022-08-10 • Earliest publication: 2022-12-20
The utility model relates to a recycled foam forming machine. The recycled foam forming machine comprises a bearing frame; the barrel body assembly is mounted in the bearing frame in a sliding manner; the barrel body assembly comprises a fixing
3. Recyclable foam protection packaging box
CN213594799U • 2021-07-02 • GUANGXI SANKE AGRICULTURAL T…
Earliest priority: 2020-08-18 • Earliest publication: 2021-07-02
The utility model discloses a recoverable foam protection packing box which comprises a packing box body and a first adhesive layer, square holes are formed in the front of the packing box body, a through hole is formed in the top end of the packing box body
4. Water removal device for recycling foam plastic
CN108789927A • 2018-11-13 • DONGGUAN LIANZHOU INTELLECT…
CN105331086A Waste polyurethane foam recycling method
Available in
Patent Translate
Bibliographic data
Global Dossier
Applicants
CHONGQING HONG LI MOTOR MFG CO LTD +
Inventors
WANG HONGLI; ZHANG ZHONGBO; AO HUAMEI; XIONG XINZHI +
Classifications
IPC
C08J11/06; C08J9/236; C08L75/04;
CPC
Y02W30/62 (EP);
Priorities
CN201510755532A·2015-11-09
Application
CN201510755532A·2015-11-09
Publication
CN105331086A·2016-02-17
Published as
CN105331086A;CN105331086B
EN ZH
Waste polyurethane foam recycling method

Appendix B.6

Codes description:

CPC (Cooperative Patent Classification) or IPC (International Patent Classification)

Letter Designation	CPC Section	IPC Section
A	Human Necessities	Human Necessities
B	Performing Operations; Transporting	Performing Operations; Transporting
C	Chemistry; Metallurgy	Chemistry; Metallurgy
D	Textiles; Paper	Textiles; Paper
E	Fixed Construction	Fixed Construction
F	Mechanical Engineering; Lighting; Heating; Weapons; Blasting Engines or Pumps	Mechanical Engineering; Lighting; Heating; Weapons; Blasting Engines or Pumps
G	Physics	Physics
H	Electricity	Electricity
Y	General Tagging of New Technological Developments; General Tagging of Cross-over technologies spanning over several sections of the IPC; technical subjects covered by former USPC cross reference art collections and digest	

The CPC classification system arranges subject matter into hierarchical arrays. Each part of this hierarchical structure is identified by classification symbols. Specifics about each element of the classification symbol are described below.

(a) Section Symbol – Each section is designated by one of the capital letters A through H and has an associated section title. There are nine sections, eight of which correlate to the sections of the International Patent Classification (IPC). The ninth section is used for classifying documents covering subject matter pertaining to a plurality of the sections. The table below shows the sections with their associated CPC and IPC section titles.

(b) Class Symbol – Each class symbol consists of the section symbol followed by a 2-digit number (e.g., H05). Each class symbol is associated with a title.

(c) Subclass Symbol – Each subclass symbol consists of the class symbol followed by a letter (e.g., H05K). Each subclass symbol is associated with a title.

(d) Main Group Symbol – Each main group symbol consists of the subclass symbol followed by a one- to four- digit number, slash, and the number 00 (e.g., H05K13). Each main group

number is associated with a main group title which precisely defines a field of subject matter within the scope of its subclass and a definition.

(e) Subgroup Symbol – Each subgroup symbol consists of the main group symbol, but the number “00” in the main group symbol is replaced with an alternative number of up to six digits (e.g., H05K13/00). Each subgroup symbol is associated with a title and definition.

Let's consider an example where the interest lies in the reuse of components, particularly electronic components. A relevant patent might carry the CPC code "H05K13/00". The structure of this code is as follows:

- The letter "H" designates the section, which in this case is Electricity.
- The digit "05" identifies the class: Electric Techniques Not Otherwise Provided For.
- The letter "K" points to the subclass: Printed Circuits; Casings or Constructional Details of Electric Apparatus; Manufacture of Assemblies of Electrical Components.
- The digit "13/00" highlights the group and subgroup: Apparatus or processes specially adapted for manufacturing or adjusting assemblages of electric components.
- Using this classification code, other patents related to the same technology can be discovered. Inputting "H05K13/00" into the classification search field of a patent database, all patents categorized under the same code will be displayed, presenting a list of patents related to the reuse of electronic components.

It's essential to remember that a single patent might have several classification codes if it covers multiple areas of technology. Examining all these codes can facilitate a more comprehensive and inclusive patent search.

For additional information about specific CPC codes visit:
https://www.cooperativepatentclassification.org/home

Appendix B.7

Patent structure definition:

Understanding the structure of a patent is a prerequisite for conducting a patent examination. This structure is set out as follows.

Title – A very general description of the patent. Only for the purpose of introduction to the topic. On the other hand, this might be quite uninformative if the secret is requested to be kept as long as possible, since the full document is published over a year after filing a patent. The title indicates what the patent application/patent is about. Titles can be descriptive but are often very general. Such vague titles are chosen so as not to give too much information, which can be used by competitors, for example. However, some patent offices require that titles that are too vague be changed to titles that clearly identify the invention.

Abstract - The abstract usually contains a brief overview of the invention. It can be used as a starting point for assessing the subject matter and relevance of a patent application for patent searchers and examiners.

Description - The description shall consist of all parts of the document except the information on the title page and the summary description. The invention must be disclosed in a sufficiently clear and complete manner to be realized by a specialist in the field.

Technical field – If the abstract does not hint at what the patent relates to, it should already be clear in this section what the invention is and what technical field is behind it. The context of an invention usually includes a description of the state of the art. This part presents the knowledge that was available at the time the patent application was filed. The statement of the state of the art is often used to describe problems, shortcomings or defects in existing technology. In general, this part presents what is already known, rather than what is new, i.e., the invention.

Background art – What is already known before the invention – *state of the art*

Disclosure of invention

- **Technical problem/Statement of purpose of the invention** - Simply said, it is a sort of a design hypothesis (objective) formulated in form of the patent problem that is proved by creating technical solution (patent disclosure).
- **Technical solution/Statement of the invention** - The objective should be proven by the disclosure of the invention. The abstract of the invention should present its purpose, exact nature, essence and operation. The claimed invention should be disclosed in such a way that the technical problem (or problems) to which it relates can be assessed and the solution can be understood. Typically, the abstract discusses

the merits of the invention, particularly in comparison to the state of the art, or shows how it solves existing problems. The summary of the invention often paraphrases the claims, so in published patent applications it usually reflects the broadest biography of the claims made at filing.

Brief description of the drawing(s) and List of drawings - A brief description of the drawings should include a legend and a very general, concise explanation of what they represent.

Detailed description and Specific description - The detailed description provides a thorough discussion of the invention, enabling it to be made and applied by a person with standard skills in the field to which the invention belongs. This is the most essential part of a patent application, usually consisting of two elements:

- a general discussion of the invention and a description of how it can be used in practice
- specific examples (Industrial applicability)

The general discussion should describe the broadest possible conception of the invention. For example, if the invention relates to a device, all the components of the invention and their potential variations should be described, as well as an indication of how the device can be used and how it can be produced. In doing so, potential techniques, sources etc. that can be used are disclosed. It is important to show a large range of elements so that the description can support broader patent claims. Equally important is the description of preferred examples of implementation. These generally represent more limited versions of the invention and are provided to support narrower claims if the patent office rejects the broader ones. In some fields, such as mechanical inventions, the general presentation of the invention includes a detailed discussion of the drawings and a description of the numbered elements contained in the drawings. This section should also contain definitions of key terms, i.e., all terms that appear in the patent claims, where it is very important that they be understood in accordance with the inventor's intention.

Drawings - Most patents/patent applications contain drawings, which are used to characterize the invention. Almost all types of drawings can be used in the descriptions. Documents for mechanical inventions may include technical drawings, e.g., isometric drawings, plans, exploded drawings and cross-sections, inventions related to software, processes and methods - usually diagrams.

Claims - The scope of protection that an invention receives is determined by the claims of the patent. They determine how far the rights of the owner of the invention extend and what conduct infringes them. The claims should identify and clearly claim the subject matter which the applicant considers to be his invention or define the subject matter for which protection is sought, should be clear and concise and be supported by a description. Each claim should be

written as a separate sentence. It may however consist of several points. The way the claim is worded has a very strong influence on whether the thing will be covered by the claim. Patent claims can be divided into two basic groups: independent and dependent. Independent claims are important in themselves and do not cover or refer to other claims. Dependent claims, on the other hand, are related to and include at least one other claim. Dependent consists of its own elements and the elements of the other claims on which it depends. Patent claims may also depend on more than one claim (compound dependent claims).

Appendix B.8

Most active patent assignees:

The Patent 300®, created by Harrity Patent Analytics, is a highly regarded resource in the intellectual property industry. It provides valuable patent insights and competitive intelligence specifically focused on the world's leading technology organizations. The Patent 300® is an annual compilation that identifies and ranks the top 300 companies, organizations, and universities based on the number of U.S. patents they have been granted each year. It serves as a comprehensive guide to understanding the patent landscape and the innovative activities of key players in various sectors.

RANK	OWNER	2022 US UTILITY PATENTS	CHANGE FROM 2021
1	SAMSUNG ELECTRONICS CO., LTD.	8513	0%
2	INTERNATIONAL BUSINESS MACHINES CORPORATION	4743	-44%
3	LG CORPORATION	4580	5%
4	TOYOTA JIDOSHA K.K.	3056	11%
5	CANON K.K.	3046	-10%
6	TAIWAN SEMICONDUCTOR MFG. CO. LTD.	3038	8%
7	HUAWEI TECHNOLOGIES CO., LTD.	3023	3%
8	BOE TECHNOLOGY GROUP CO., LTD.	2725	27%
9	RAYTHEON TECHNOLOGIES CORPORATION	2684	0%
10	QUALCOMM	2656	22%
11	SONY CORPORATION	2638	1%
12	INTEL CORPORATION	2501	-9%
13	DELL TECHNOLOGIES	2445	19%
14	APPLE INC.	2313	-11%
15	ALPHABET INC.	2077	2%
16	AMAZON.COM, INC.	2051	-3%
17	MICRON TECHNOLOGY INC.	1921	7%
18	MICROSOFT CORPORATION	1888	-25%
19	HYUNDAI MOTOR COMPANY	1786	20%
20	HITACHI, LTD.	1557	3%
21	PANASONIC CORPORATION	1521	-11%
22	TELEFONAKTIEBOLAGET LM ERICSSON	1419	1%
23	JOHNSON & JOHNSON	1377	-11%
24	FUJIFILM HOLDINGS CORP	1360	-7%
25	HONDA MOTOR COMPANY, LTD.	1351	11%

26	THE HEWLETT-PACKARD COMPANY (HP INC.)	1348	35%
27	FORD MOTOR COMPANY	1342	-20%
28	GENERAL ELECTRIC COMPANY	1327	-15%
29	MEDTRONIC PLC	1306	12%
30	MITSUBISHI ELECTRIC CORPORATION	1277	0%
31	SK GROUP	1254	16%
32	SEIKO EPSON CORPORATION	1241	1%
33	ROBERT BOSCH GMBH	1190	17%
34	TOSHIBA CORPORATION	1126	3%
35	SIEMENS AG	1123	10%
36	THE BOEING COMPANY	1117	-14%
36	TCL CORPORATION	1117	33%
38	DENSO CORPORATION	1027	-8%
39	NEC CORPORATION	1013	9%
40	MURATA MANUFACTURING CO., LTD.	1007	17%
41	BBK ELECTRONICS CORPORATION	1004	27%
42	META PLATFORMS, INC.	995	-17%
43	THE UNITED STATES OF AMERICA FEDERAL GOVERNMENT	973	-8%
44	SAUDI ARABIAN OIL COMPANY	963	12%
44	HALLIBURTON COMPANY	963	5%
46	CISCO SYSTEMS, INC.	962	-5%
47	AT&T INC.	911	-15%
48	TEXAS INSTRUMENTS INCORPORATED	910	-6%
49	KONINKLIJKE PHILIPS N.V.	840	-8%
50	NIPPON TELEGRAPH & TELEPHONE CORP.	815	89%
50	KYOCERA CORPORATION	815	-2%
52	APPLIED MATERIALS, INC.	793	5%
53	TENCENT HOLDINGS LTD	789	24%
54	VMWARE, INC.	762	-18%
55	ORACLE CORPORATION	759	10%
56	HONEYWELL INTERNATIONAL INC.	750	-20%
57	GENERAL MOTORS COMPANY	734	-3%
58	WESTERN DIGITAL CORPORATION	733	-4%
59	CAPITAL ONE FINANCIAL CORPORATION	708	1%
60	NOKIA CORPORATION	694	0%
61	RICOH COMPANY LTD.	676	-13%
61	VERIZON COMMUNICATIONS INC.	676	-3%
63	BROTHER INDUSTRIES, LTD.	659	10%
64	INFINEON TECHNOLOGIES AG	657	-4%
65	SAP SE	656	4%

66	SHARP CORPORATION	653	-24%
67	FUJITSU LIMITED	652	-18%
68	SALESFORCE.COM, INC.	634	7%
69	PORSCHE AUTOMOBIL HOLDING SE	633	-8%
70	LENOVO GROUP LIMITED	632	10%
71	KIOXIA HOLDINGS CORPORATION	625	-7%
72	COMMSCOPE INC.	624	30%
73	BAIDU, INC.	618	43%
74	SUMITOMO ELECTRIC INDUSTRIES, LTD.	611	-13%
75	THE BANK OF AMERICA CORPORATION	608	19%
76	TDK CORPORATION	594	11%
77	STMICROELECTRONICS	587	-4%
78	UNIVERSITY OF CALIFORNIA	570	-15%
79	TOKYO ELECTRON LIMITED	565	21%
79	SOFTBANK GROUP CORP.	565	-3%
81	SAFRAN S.A.	560	2%
82	AIRBUS SE	523	12%
83	MITSUBISHI HEAVY INDUSTRIES, LTD.	522	-2%
84	THE HEWLETT PACKARD ENTERPRISE COMPANY	511	-4%
85	3M COMPANY	508	-11%
85	BAYER AG	508	4%
87	XIAOMI INC.	503	33%
88	BOSTON SCIENTIFIC CORPORATION	494	-7%
89	CORNING INCORPORATED	483	13%
90	CATERPILLAR INC.	482	1%
91	NXP SEMICONDUCTORS N.V.	471	-2%
92	ROLLS-ROYCE HOLDINGS PLC	464	-13%
93	CONTINENTAL AG	459	1%
94	SAMSUNG ELECTRO-MECHANICS	457	-5%
94	DEUTSCHE TELEKOM AG	457	10%
96	DEERE & COMPANY	452	4%
97	STRYKER CORPORATION	444	-8%
98	ADVANCED MICRO DEVICES, INC.	438	-2%
99	SNAP INC.	437	24%
100	THE PROCTER & GAMBLE COMPANY	433	-20%

https://harrityllp.com/patent300/

Appendix B.9

Legal Expert Consultation:

If the researcher or organization has the resources it is possible to consult with a patent attorney or a professional patent analyst for an accurate interpretation of patent search findings before drawing conclusions or taking actions in specific cases. In patent analysis, consultation with a patent attorney or professional analyst is crucial when interpreting patent claims, assessing patent validity.

The interpretation of patent claims is considered necessary in several contexts. Primarily, it is used when the infringement of an existing patent by an invention or product needs to be avoided. Patent claim interpretation helps to understand the exact scope of the patent owner's rights, enabling the design of a product or process that circumvents these protected areas.

Additionally, the need to interpret patent claims arises when a Freedom to Operate (FTO) analysis is conducted. This analysis involves determining whether a product or process infringes the patent rights of others in a particular country. A clear understanding of the patent claims, obtained through interpretation, can help confirm that the operations in question do not infringe existing patents, ensuring freedom to operate.

Furthermore, when the validity of a patent is being assessed, the interpretation of patent claims becomes important. Even when a patent has been granted, it could still potentially be invalid due to the existence of prior art. In this scenario, any elements already present in the prior art, which could potentially undermine the patent's validity, can be identified through the interpretation of patent claims.

The goal of patent analysis, which requires the interpretation of patent claims, is to gain strategic insight into innovation and R&D and to reduce legal risk. By understanding patent claims, gaps in the current technology landscape can be identified, innovation around existing patents can be stimulated, potential infringements can be avoided, and a robust intellectual property strategy can be built. In addition, this can help inform decisions related to potential partnerships, licensing or investment opportunities.

Following detailed analysis, the insights can shape research and development strategies, including innovation, competitor analysis, risk management, investment decisions, and legal strategy formulation.

Given that each patent is unique, expert guidance is invaluable in navigating this complex, case-by-case process. Consultation becomes essential when these elements are involved, ensuring accurate interpretation and informed decision-making.

Consulting a patent attorney might not always be needed in cases of initial patent searches, technology trend identification, preliminary competitor analysis, basic R&D guidance, geographical scope understanding, and patent status verification. These tasks can be carried out with keyword searches, patent classification systems, and high-level analyses. However, a patent attorney's advice can still be useful in these situations to ensure analysis accuracy, especially when making important decisions based on the results.

When analyzing patents with a legal expert to avoid patent infringement, it is important to focus on a few key aspects.

Patent claim interpretation and validity checks are key tasks conducted by patent experts. The possibility of any patent infringement is ruled out during these analyses. A Freedom to Operate (FTO) analysis is also performed to ensure no patent rights are violated.

Strategic insights about technology and innovation opportunities are identified in the process. Critical decisions involving partnerships, licensing, or investments are aided by these insights.

The expert also checks the status and geographical scope of the patent. Knowledge about the 'doctrine of equivalents' is provided to prevent possible indirect infringement.

Workaround strategies to existing patents are suggested by the expert. Each patent's uniqueness necessitates a case-by-case analysis. Expert consultation simplifies this process, ensuring accurate interpretations and informed decisions.

Appendix B.10

Real-World Example:

XYZ Research Institute and the Development of a Circular Production System for Mechanical Components

XYZ Research Institute is a leading organization in mechanical engineering research. They aim to develop a production system that integrates the principles of the circular economy, reduces waste, and uses secondary raw materials effectively.

1. Introduction:

Objective: XYZ wishes to address the challenge of waste in mechanical components' production. They aim to reuse discarded materials, thus promoting a circular production process.

2. Non-patent literature:

Research: XYZ delves into Google Scholar, sustainability reports, and company websites to understand current industry trends and successful implementations of circular practices in mechanical engineering.

Findings: They discover that many industries face challenges in reusing metals and alloys, but some pioneers have made strides using innovative techniques.

3. Keyword Formulation:

Bill of Materials: XYZ lists metals and alloys used in their production processes.

Circular Economy Terminology: "Recycling," "Waste Reduction," "Metal Revalorization," etc.

Brainstorming: Integrate findings from non-patent literature to refine keywords, e.g., "Alloy Refurbishment Techniques."

4. Patent Databases & Classification Systems:

Search: Using patent databases, XYZ identifies patents relating to metal and alloy recycling in mechanical component production. Relevant classification codes are found i.e. B09B, C22B, Y02P.

Classification Systems: XYZ categorizes found patents based on their applicability, innovativeness, and alignment with circular economy principles. XYZ restricts the search for the found codes.

5. Patents Analysis:

Analysis: XYZ identifies a patent owned by a company, UVW, detailing a unique process to refurbish used metals, making them suitable for high-grade mechanical production.

6. Legal Expert Consultation:

Legal Insights: Before proceeding, XYZ consults a patent attorney. The attorney confirms that while the UVW process is patented, there are certain aspects that can be innovated upon without infringement.

7. Strategic Application of Findings:

R&D Strategy: XYZ embarks on an R&D project, focusing on improving the UVW process while integrating unique features from their own research.

Competitor Analysis: They find that while UVW is a leader, other companies are also looking into similar circular solutions.

Risk Management: Constant checks ensure that the innovations remain non-infringing.

Legal Strategy: XYZ realizes that a collaboration with UVW could be mutually beneficial. They approach UVW for a potential partnership.

8. Outcome:

After a series of negotiations, XYZ Research Institute and UVW enter into a licensing agreement. XYZ gets the rights to use the patented process, integrating their unique improvements, and in return, UVW gets access to XYZ's research insights and potential innovations in the future. This collaboration leads to the production of mechanical components with a significantly reduced carbon footprint and waste.

Visualization of the Process:

I. Introduction: Define Objective (Circular Production System)
II. Non-Patent Literature: Understand Industry Trends
III. Keyword Formulation: Bill of Materials, Terminology, Brainstorming
IV. Patent Databases & Classification: Search and Categorize Relevant Patents
V. Patent Analysis: Identify Key Patents (UVW Process)
VI. Legal Expert Consultation: Ensure Non-Infringement
VII. Strategic Application of Findings: R&D, Competitor Analysis, Risk Management, Partnership with UVW
VIII. Outcome: Licensing Agreement with UVW

This example illustrates how XYZ Research Institute, through a methodical approach guided by your guidelines, successfully integrates the principles of the circular economy into mechanical component production and fosters collaboration with an industry player.

Appendix B.11

Request for Review of Guidelines

Dear […],

I am reaching out to you regarding the work I am conducting for my master thesis at Politecnico di Milano on leveraging intellectual property to boost circular economy practices.

The aim of my research is to formulate an approach that investigates possibilities for sustainable practices across different industrial sectors. This will be achieved by analyzing patent data, as well as utilizing other relevant sources of information and knowledge.

I am excited to share with you a specific section of my thesis called "Guidelines on Patent Search." These guidelines aim to provide a step-by-step process for conducting effective patent searches, enabling organizations to enhance their circular economy practices and identify valuable resource transfer opportunities across sectors.

I am currently seeking individuals (or teams) from diverse backgrounds, irrespective of their familiarity with patent search, Circular Economy, or Sustainability, to participate in testing these guidelines. The primary goal is to assess their effectiveness in achieving their intended objectives.

Your support in this activity would be greatly appreciated. I kindly request your assistance in going through the guidelines and evaluating their outcomes. If the guidelines prove to be helpful, they can serve as a foundation for implementing actions that promote circular economy practices and sustainability.

To facilitate your participation, I have attached the guidelines in PDF format along with a graphical representation. It is important to note that I encourage you to collect and provide feedback during your use of the guidelines, rather than waiting until the very end of the activity. Towards the end of the PDF, you will find a form specifically designed to gather feedback aimed at improving the guidelines.
In the second paragraph of the introduction, you will find the provided links for accessing the graphical representation and the data collection template. Additionally, the link to the feedback questionnaire can be found at the conclusion of the guideline.

Thank you in advance for your cooperation and valuable contribution to this research. Your insights will play a crucial role in refining and enhancing the guidelines for wider adoption.

Please feel free to reach out to me if you have any questions or require further clarification. I am more than happy to assist you.

The guidelines are enclosed in this email as a PDF attachment. In addition, a backup link is provided below for easy access.

https://drive.google.com/file/d/12-BwmN2hTK1ECdhtOFu979gtGghJQ39T/view?usp=sharing

Best regards,

Karol Szymanski

Appendix C
Evaluation of Guidelines on Patent Search

0. Overview

Role/Position

Mid Manufacturing Planner

Manufacturing Engineer

project designer

Design Engineer

Innovation Manager

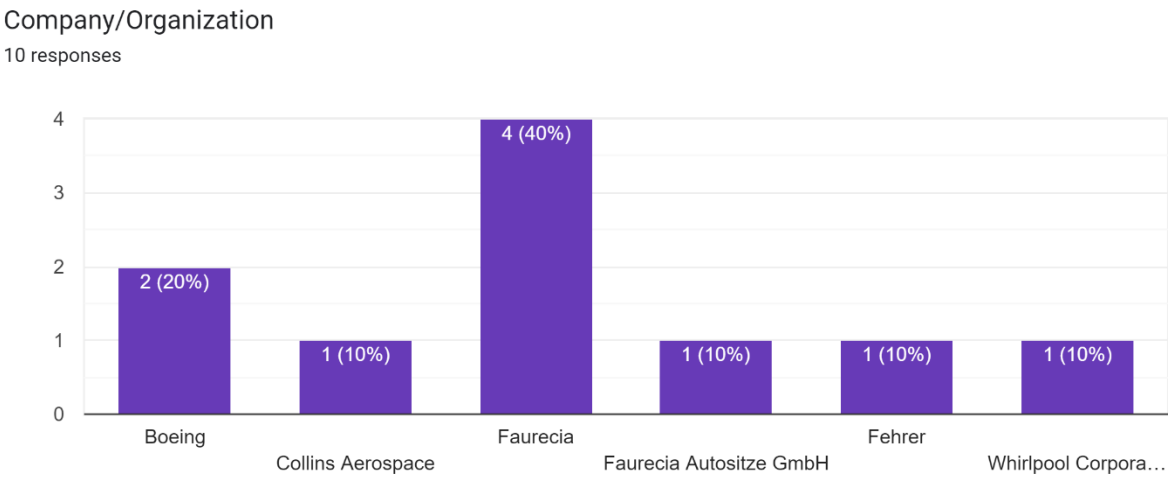
Product Engineer

System Architect

Sustainability Engineer

Research and Development

Senior Sustainability Engineer



Area of research

Recycling of composite materials

Cold Oxidation for Volatile Organic Componds

recertify and reuse airplane parts

Sustainable Seat Foam

Revalorization opportunities

Foam recycling

Plastic parts handling and recycling

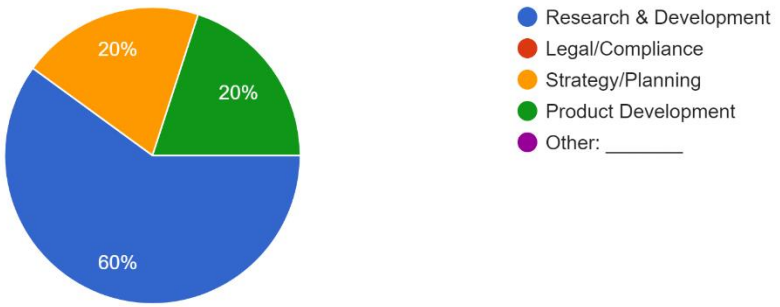
Global Sustainability Solutions

Sustainability

enhance sustainability

Role in the Company

10 responses



Experience in the Role

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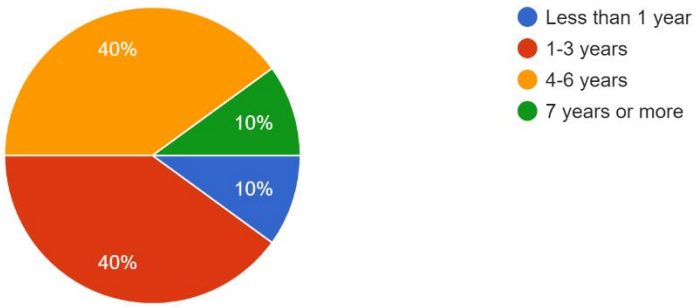
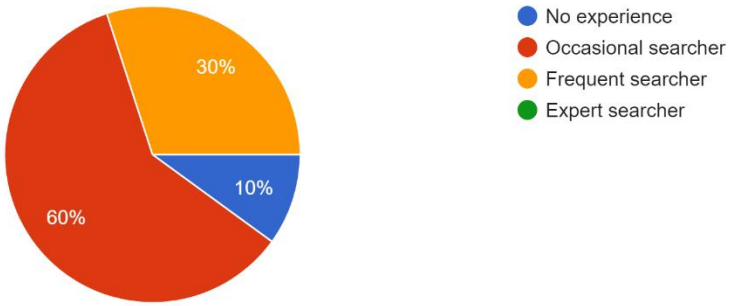


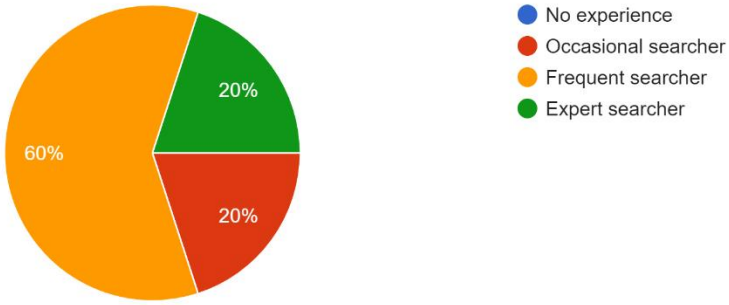
Patent Search Experience

10 responses



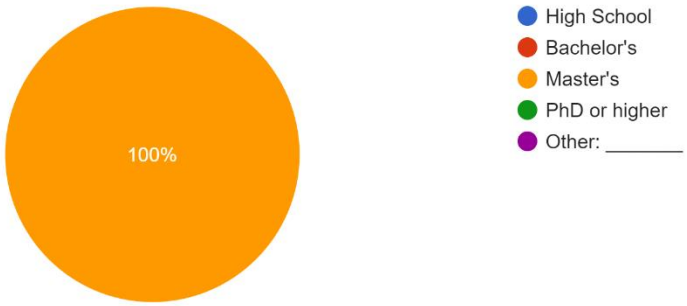
General Information Search Experience

10 responses



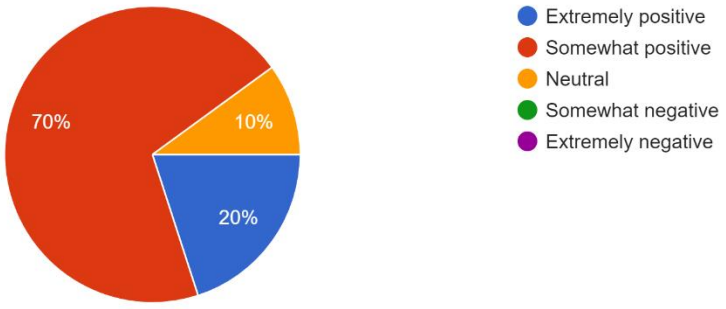
Highest Degree Obtained

10 responses



Impact of Our Guidelines on Your Work

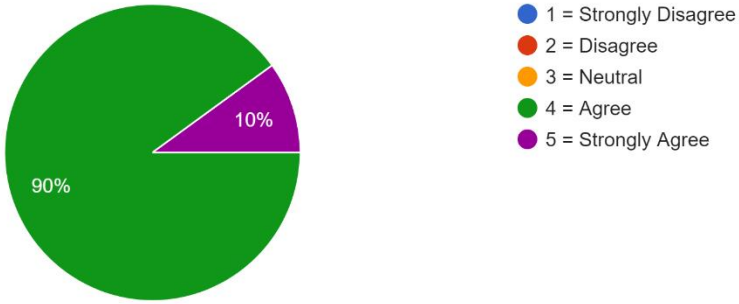
10 responses



1. Usability of Guidelines on Patent Search

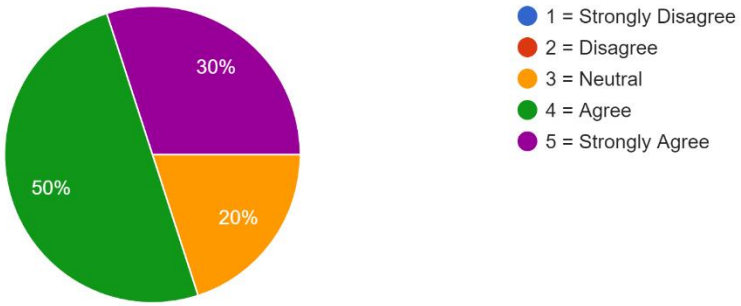
1. I found the guidelines easy to use.

10 responses



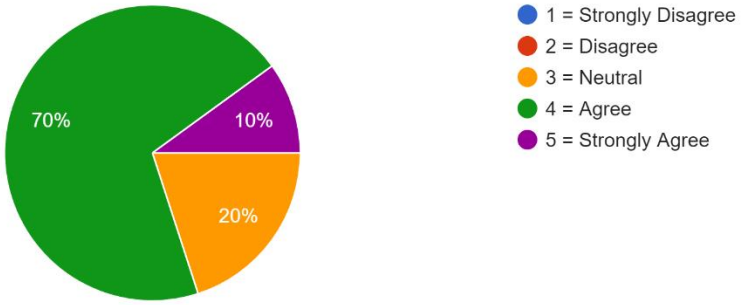
2. The organization of information in the guidelines was clear.

10 responses



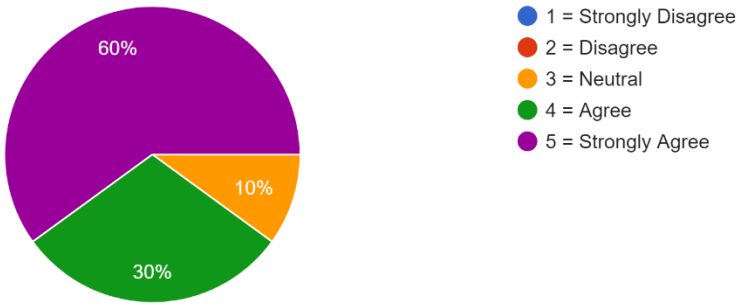
3. I felt confident using the guidelines.

10 responses



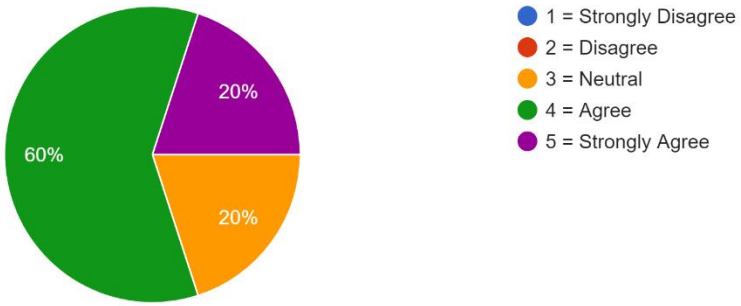
4. I believe I could use the guidelines without the need for support.

10 responses



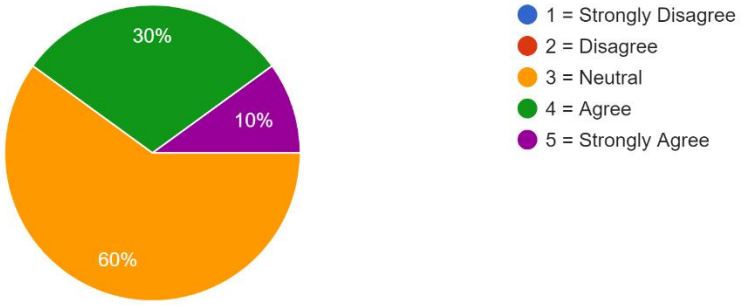
5. The content in the guidelines was easy to understand.

10 responses



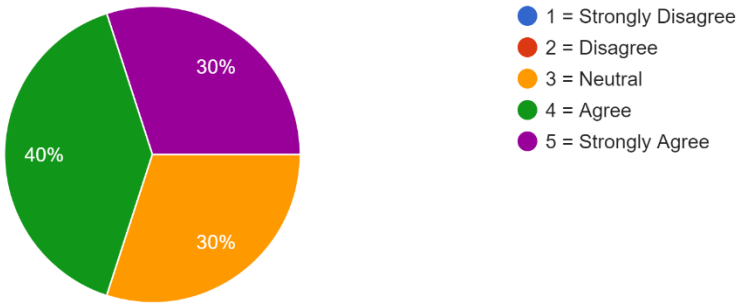
6. The guidelines met my expectations.

10 responses



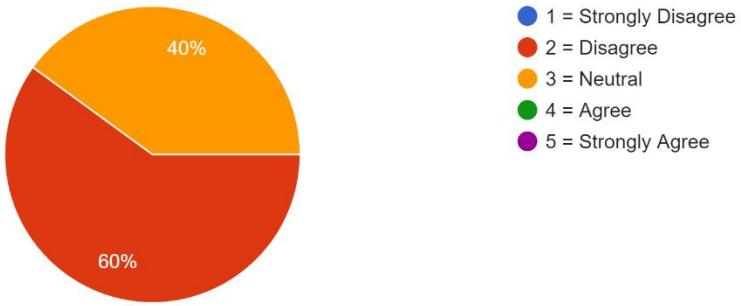
7. I think most people would learn to use these guidelines very quickly.

10 responses



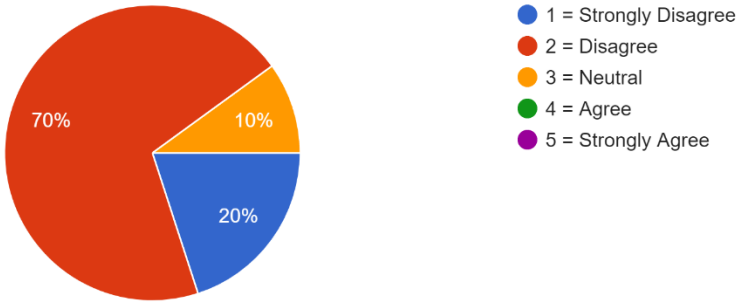
8. The guidelines were too complex.

10 responses



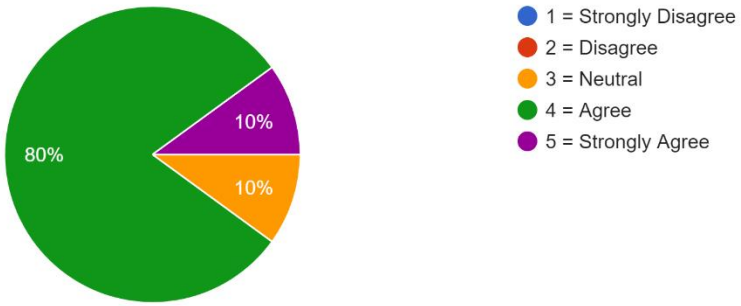
9. I felt the need to consult external help when using the guidelines.

10 responses



10. The guidelines provided me with all the information I needed.

10 responses



2. Usefulness of Guidelines on Patent Search

Understanding: Describe in your own words the main purpose of the guidelines as you understand it.

- To search for patents that might be useful for upgrading companies circular economy practices.
- The guidelines are meant to help company and users to search in the patent literature in order to increase their awareness about circular economy.
- The purpose of the created guide is to introduce the knowledge of patent search and use, to learn about patent search tools and how to use them for engineering work
- Easy to understand, but requires time to go through it
- Searching for the opportunity for sustainable innovation.
- Improving sustainable practices within the company
- patent search support with focus on circular economy
- Boosting circularity in the global sense using patents
- It's a guideline to quickly learn how to search through patent databases.
- The guide is a set of rules for the introduction of new technical or managerial solutions in companies or enterprises using the circular economy, it is intended mainly for people who use patents or work with them and use them. It is also a guide for those who are just beginning their adventure with patents.

Comprehensiveness: Were there any areas in the guidelines that you felt were lacking or needed more detail? If yes, which areas?

- At the beginning of graphical guidelines.
- No, everything was easy to understand.
- -
- Guidelines are extensive and comprehensive. It might be its disadvantage.
- Guidelines include a lot of details.
- Instructions were complex. For some searches it might be too much, but it would help in other searches.
- detailed in the sustainability field. Not very detailed in the patent search area itself.
- It was very detailed and well sorted for the target I chose
- No
- I didn't find things to complement and add to the knowledge of this guide

Clarity: Were there any sections in the guidelines that were unclear or confusing? Please specify.

- No
- No, everything was clear enough.
- -
- It was clear enough
- Some parts are complex and require a focus when reading
- Clear
- Some patent search methods might be more clear
- It required my focus to get things clear, but I got to the point
- in chapter 3 in the form - switched order of translation of chapters (Keyword Formulation - Keywords generated should have the number 3.1) - this was the only thing that stopped my work, because I had to find it in the guide, here I also had a problem with moving between windows

Relevance: How do you perceive the relevance of the guidelines to your specific needs related to patent search?

- The outcome was satisfying and might be put in use in the future.
- The guidelines are for sure relevant, but I cannot see the need of them. The same process could be followed easily and without the need of any guidelines.
- The guidelines were specific and helpful in finding and completing the next steps of the guide
- Yes, it was relevant to my search.
- Relevant for the objectives i've had
- Relevant. I got the good search results
- relevant for the circular economy field
- It was relevant for my search
- Guideines showed me other ways to search for patents (more streamlined)
- I do not deal with patents on a daily basis, but this is useful knowledge that I am eager to use in my work

Practicality: Were you able to apply the steps or recommendations from the guidelines in a real-world patent search scenario? If yes, describe any challenges you faced.

- Yes. There might be a challenge to find a "perfect" patent to fit company's current needs.
- I was able to apply easily the steps.
- in case of need and necessity to search for patents I would use the presented guide, there are clear guidelines that the user should follow and it presents several patent sources where you can search for the necessary information
- It was not easy to find a relevant patent. After some iterations I got to the point.
- yes, I was able to apply them
- yes. I applied suggestions given
- practical and very general. Instructions try to cover a lot of fields at once.
- I performed some patent search, so it was easy to familiarize with this and the sustainability tips were helpful
- Yes. Main challenge is to use specific keywords to find best suited results.
- I don't understand the question

Comparison: If you've used other patent search guidelines before, how does this one compare in terms of utility and clarity?

- I didn't use any other patent search
- It is difficult for me to see the utility of this guidelines, since the process is quite logic and obvious.
- is useful and clear, the advantage is active links, taking the user to a specific form/description/scheme
- It helped creating keywords for my area of research
- never
- I only used the step by step instructions how to use patent database, i.e. Espacenet
- it is more complex that normal patent search guideline. Describes a lot about sustainability itself.
- None comparison

- No previous patent search guidelines.
- this is a guide that "leads by the hand", if you follow the steps and tips given then you will not make a mistake and you will quickly find information

Outcomes: Can you describe any positive outcomes or benefits you experienced as a result of following the guidelines? Conversely, were there any negative outcomes?

- Positive outcome was the fact of finding easily potental patent that might be put in use.
- Neutral outcomes.
- detailed descriptions provided knowledge of some aspects in the field of management, after using the guide I found it to be a time-saving tool for creating a product concept and properly searching for patents and understanding the different parts of the product
- Interesting ideas for PUR foam production in the patent.
- Strategies helped with target my search and make the query successful
- Interesting ideas found in the patents
- i went through couple of patents that were irrelevant, but I found a proper one eventually.
- I found some patents that could be helpful in boosting circular economy.
- It was a fast way to find relevant patents.Now I am also aware of more patent databeses.
- Positives: quick search for information, no need to use other data sources to find information on the phrases and issues under consideration,
- finding an interesting patent that I may be able to implement in the life of the company
- Among the negatives, I will include moving around the guide what I described in the previous steps

Examples and Illustrations: Were the examples and illustrations in the guidelines helpful? Why or why not?

- There was no ilustrations and examplees at the time of use of the guideline.
- The map is helpful to understand better the text and the process
- helpful, I had similar diagrams in college, they were understandable and clear to me
- Graphical representation helped go through the process.
- yes, they were helpful. The example and the graphic representation
- yes, they were helpful
- helpful and representative
- real world example explains clearly how the guidelines could help
- Yes, after a break it was easy to get back on track with graphical guideline.
- yes, so allowed to understand the process

Recommendations: Based on your experience, what improvements or additions would you recommend for the guidelines?

- -
- Add some firs steps in grahic guideline, add pictures showing the exact places where to click during searching the patent (especially for begginers)
- It is difficult for me to see the utility of this guidelines, since the process is quite logic and obvious. Therefore I cannot suggest any improvement.
- Yes
- I would try to make it more simple to go through but keep the level of details. Maybe the format could change
- I would make more accessible and shorter.
- more guidance on patent search
- make it more graphical then descriptive, but the content is there
- There is none for now.

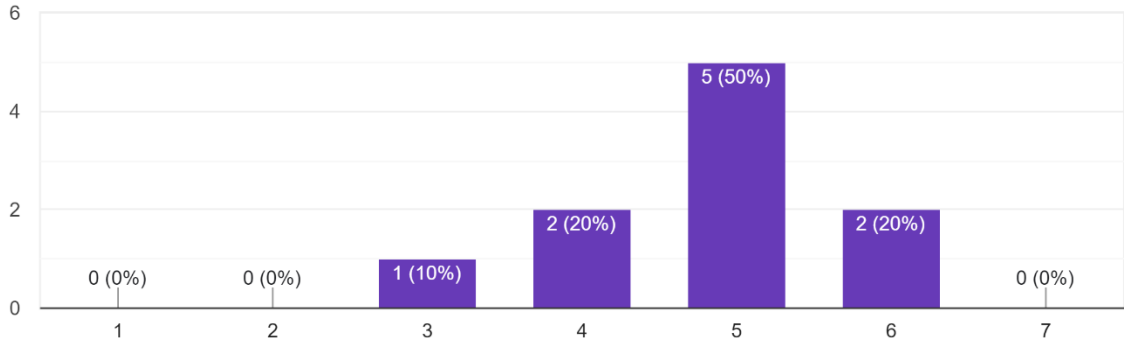
Final Thoughts: Do you have any other feedback or comments about the guidelines that haven't been covered in the previous questions?

- No
- -
- The guidelines put into theory a process that is already existing, known and easy to follow based only on common logic. They are suited for circular economy, but they could be suited for whatever topic, since nothing new is added that a normal user already own thanks to the common sense and logic.
- Interesting idea, and very complex
- Interesting concept to connect sustainability with patent search
- Guidelines were comprehensive and give a good lesson about circularity and patents
- n/a
- Really good concept. Need some work on process facilitation, but I know that patent search is a complex process and might be difficult
- Task Load Index

3. Task Load Index

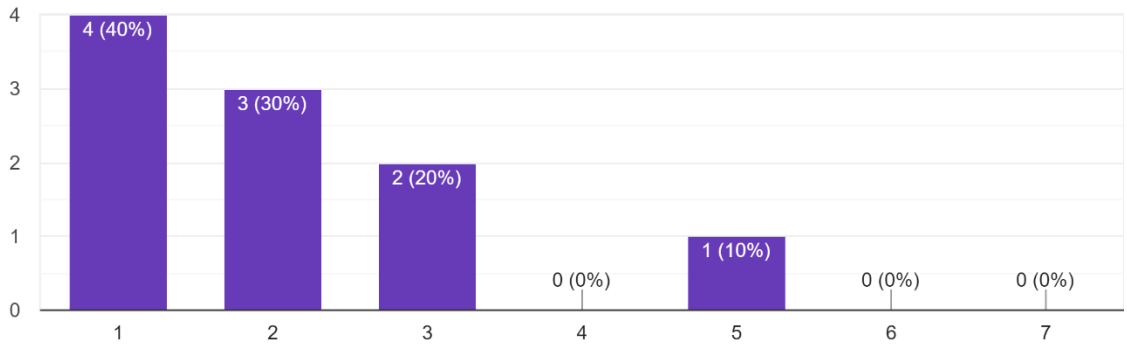
Mental Demand: How mentally demanding was the task of using the guidelines?

10 responses



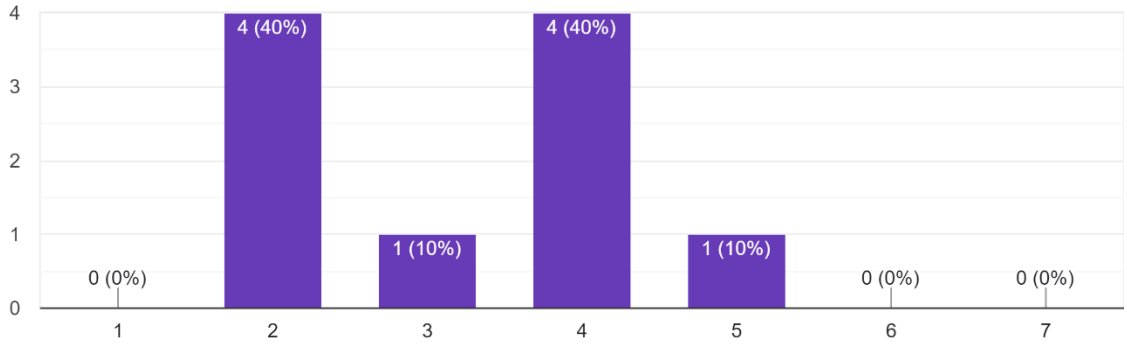
Physical Demand: How physically demanding was the task of using the guidelines?

10 responses



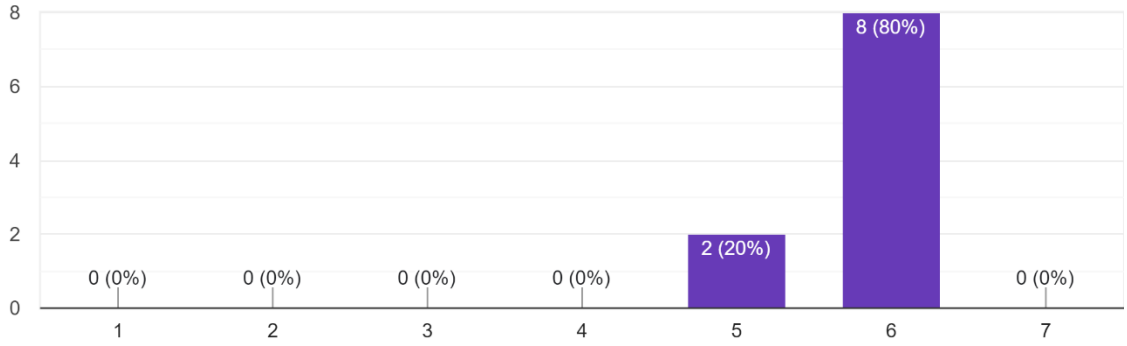
Temporal Demand: How hurried or rushed was the pace of the task with the guidelines?

10 responses



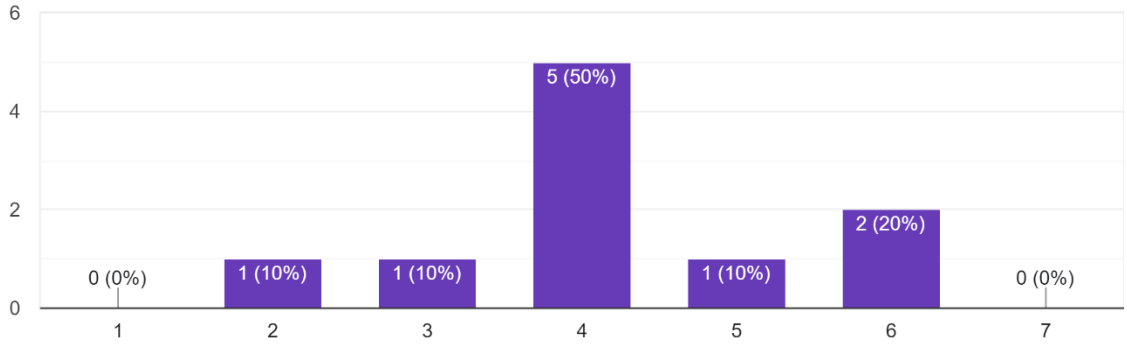
Performance: How successful do you feel in accomplishing what was asked of you using the guidelines?

10 responses



Effort: How hard did you have to work to achieve your level of performance with the guidelines?

10 responses



Frustration Level: How insecure, discouraged, irritated, stressed, and annoyed were you when using the guidelines?

10 responses