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The Evaluation and Application of the TRIZ Method for Increasing Eco-Innovative Levels in SMEs

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Abstract: If in the past, the success of innovation was measured primarily in the economic sphere, recently the non-economic sphere has increasingly become more of a matter of corporate management and, therefore, of innovation management. Management's acquisition of non-economic aspects has been strongly influenced by the vision of sustainable development. Sustainability is a direction of action important for innovation as well, integrating economic, social, and environmental responsibility in the management of innovation, leading to sustainability-oriented innovation (SOI). Research on SOI approached innovation processes has been carried out in large companies, however in recent years the use of TRIZ (teoriya resheniya izobretatelskikh zadach) tools has been tried for SOI. The TRIZ-based approach is a valuable tool because it does not require an encyclopedic knowledge of field-specific technology and it enables the expansion of the scope of problem solutions beyond the skills of the team members. This paper discusses the concepts of sustainability, innovation, and risk management in small and medium-sized enterprises (SMEs) for the purpose of developing a flow chart for the implementation of the TRIZ method in SMEs and for evaluating the state of innovation in such companies. Through the use of the TRIZ method in the field of SMEs, fast and efficient processes, products, and sustainable services have been obtained.

Keywords: innovation; sustainability; risk management; sustainability-oriented innovation; strategy; life cycle dimension

1. Introduction

It is widely recognized that innovation is essential for companies that want to remain competitive and to compete successfully in the markets and the changing environment [1–3].

If in the past, the success of innovation was measured primarily in the economic sphere, recently, the non-economic sphere has increasingly become more a part of corporate management and, therefore, one of innovation management [1–5]. Thus, starting from the year 2000, some companies have measured the results of innovation in relation to environmental criteria [3]. As a result of uncertainty about what "environmental" means in practice, it is difficult to formulate environmental success criteria for innovation projects [3,4]. Although this may well be one constraint for the analysis of environmental innovations, other criteria can be identified that are very suitable. Thus, three weighting criteria are: (1) potential of minimizing environmental load; (2) level of novelty; and (3) environmental significance.

The 20th century has been dominated in terms of managing the revolutionary innovations, on one hand by TRIZ (teoriya resheniya izobretatelskikh zadach) (and OTSM—derivative of TRIZ) and on the other side by Kurzweil's Law of Accelerating Returns, according to which paradigmatic leap intervals are halved in each decade. TRIZ and OTSM were widely used for solving problems at a macroscopic scale while Kurzweil's Law explains the exponential growth of computing reaching up to quantum scale [6]. The Theory of Inventive Problem Solving, originally teoriya resheniya izobretatelskikh zadach—TRIZ was developed by Altshuller and his colleagues following the analysis of hundreds of thousands of patents starting from 1946. The main premise of TRIZ is that there is a set of universal principles that lead to inventions, principles that constitute the foundation of innovations and that lead to the advance of technology. To make the inventive process more predictable these principles can and should be identified, classified [7], and evaluated [8,9]. TRIZ solves unconventional issues, predicts new products and technologies, being the most comprehensive and systematic methodology of creativity and innovation ever developed [10]. Organizations that successfully apply TRIZ connect to the body of universal inventive knowledge, a fact that removes the dependency on occasional or spontaneous creativity of individuals or groups (Oxford Creativity). The TRIZ innovation method provides repeatability and predictability, and the user is not dependent on the usual thinking models [3,5].

Since 1990, the TRIZ method has been applied in many multi-national, innovative companies, such as Samsung, Hitachi, Siemens, and 3M. These companies have started to report significant success in implementation of this method. SMEs in the US and Europe have also reported significant benefits through the implementation of TRIZ. In China, TRIZ has been briefly mentioned recently in the context of Six Sigma—this concept is a set of techniques and tools for process improvement. However, the author is of the opinion that the potential of employing TRIZ as a "Systematic Innovation tool" is huge in China as the design and maunfacturing based industries (Original Equipment Manufacturer—OEM, Original Design Manufacturer—ODM, Original Brand Manufacturer—OBM) are expected to rapidly increase in the next few years [7]. "Innovation" in local Chinese industries like electronics or photonics has been slow in the innovative product design aspect. Hence, the awareness of TRIZ is expected to increase in China. In the context [10] in which Hong Kong sees innovation and creativity as a strategic weapon in the battle to gain and maintain competitive advantages and, after 2000, the migration of local businesses from OEM to ODM and OBM, many small and medium sized companies lacked access to the methodologies of support for innovation and creativity. The Hong Kong Government financed the implementation of TRIZ in a group of eight local companies for 15 months, each company participating with a team of 5–8 engineers and designers in training and utilization sessions. It has been observed that in Hong Kong and China companies prefer to use a small number of TRIZ tools, focusing their efforts in learning and applying their favorite tools, decreasing the complexity instead of having a strong impact on the overall efficiency of the method.

Inside the programme, the companies' objectives turn towards innovation and the use of TRIZ method leads to the development of innovative products, tangible financial benefits, and various patents. The obtained results can be seen as success stories. Thus, in one of the cases a 15% cheaper packaging solution was obtained, with the volume of packaging lowered by 10% which facilitates loading more products in a standard container, resulting in savings of several million HKD per year for the company. The solution is flexible and can be used in different configurations to protect many different products as well as being both reusable and biodegradable [11]. In the green supply chain, the benefits of this method are multiple, leading towards resolving issues of planning, optimization of storage space ,and improvement of transport systems [12,13].

Based on the concepts of sustainable development and investigating the use of TRIZ tools in cleaner production this paper shows how the implementation of the TRIZ method leads to significant results within a company. By integrating the principles of sustainability and the TRIZ method, companies can highlight incremental innovations. This work includes, in the first part, the theoretical

framework of these concepts, the Sustainability Innovation Parallelepiped model, and then the results of the case study following the application of the TRIZ method.

2. Materials and Methods

2.1. Sustainability-Oriented Innovation (SOI)

2.1.1. Sustainability-Oriented Innovation Concept

Sustainability is an important direction for innovation, offering to integrate ecological and social dimensions in innovation management leading to SOI [14–18]. This implies that in order to get true "sustainable" solutions, in addition to conventional economic aspects, the ecological and social aspects must be addresses as well. Accordingly, SOI aims to improve or build new products in which the guiding principles are, in an integrative concept, the economic, ecological and social criteria [18,19]. SOI is important for companies because:

- Both environmental regulations at national and supranational levels are growing, as well as the external pressure of the different stakeholders (NGOs, clients, local communities) requiring companies to tackle issues related to sustainability.
- Much more importantly, in terms of business, SOI may generate a competitive edge through more effective production from the standpoint of cost, stable relationships, and access to resources (e.g., supply contracts on a long-term basis), as well as new business opportunities through the differentiation of products and new markets [18].

Since SOI has to control the so-called "directional risk" [3,18], it is more complex than conventional innovation management—or in other words, SOIs are "better managed innovations" [3,19].

The introduction of sustainability in innovation management is important both from a moral and a business perspective [3,20]. From a moral perspective, researchers emphasize the role of corporations in solving both the challenges of society and global environmental issues (climate change, pollution). Such global problems are too complex to be resolved only by political actors and large corporations should be both responsible and able to engage in these issues. Their capabilities for research and development could route to new areas of innovation such as clean technologies and the base of the pyramid markets [3,13].

From a business perspective, the challenges posed by sustainability offer a significant potential for innovations and business related opportunities [3]:

- Regulations and laws in the social and environmental fields increase the pressure for innovation [3].
- Sustainability presents a new source of ideas and visions that leads to new business opportunities. Also, a number of empirical studies have identified positive correlations between sustainability and business success [3,4].

However, a series of studies shows that only a minority of enterprises see sustainability as a source of innovation [3]. Reluctance to promote innovation in the field of sustainability can be attributed to the high risks, among others, involved in this type of innovation [3,17,21].

Reference [3] has developed a model called the "Sustainability Innovation Cube" in order to highlight the ways of minimizing the risks of innovation oriented towards sustainability. Starting from this pattern and taking into account technological advances and the dynamics of the business environment an updated model called "*Sustainability Innovation Parallelepiped*" has been developed. This model is presented in Figure 1.

The three dimensions of the Sustainability Innovation Cube are as follows [3,22,23]:

1. Target dimension examines the innovation effects depending on their impact on sustainability objectives. Target size distinguishes three criteria for assessing the effects of innovations, sometimes linked together: economic effects, social effects, and environmental effects.

2. Life cycle dimension. Target dimension alone is not sufficient to provide an evaluation structure for the sustainability effects of innovations that spread widely in time and space. For example, biofuels have a reduced environmental impact on use, but critical effects during production. Accordingly, specialty literature concerning the sustainability effects of product innovation focuses in particular on the role of the life cycle, taking into account parameters such as manufacture, use and reuse, and end of life.
3. Innovation type dimension consists of four criteria relating to innovations from the fields of Technology, Product-service system, Business model innovations, and Strategy.

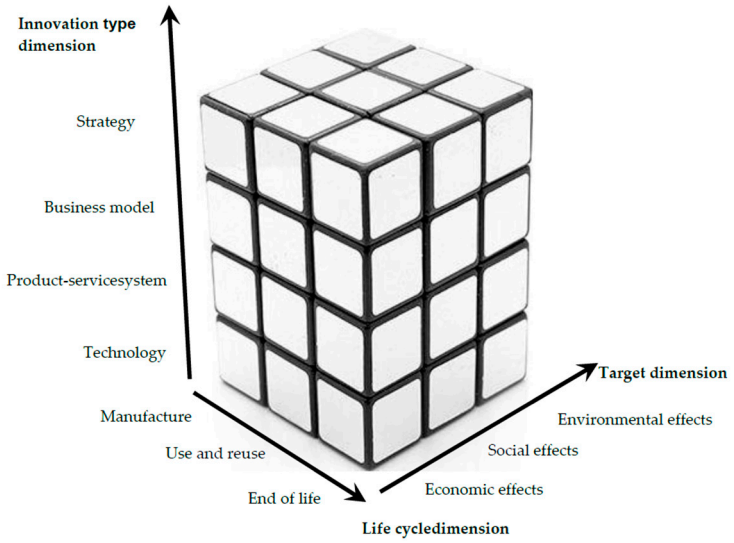


Figure 1. Sustainability Innovation Parallelepiped (adapted after [3]).

The Sustainability Innovation Parallelepiped highlights 36 individual areas indicating where sustainability effects could occur. These areas of sustainability can be seen as objectives to be addressed by innovation management [3].Several researchers [15] have formulated the problem of developing innovative processes that include aspects of sustainability in the form of four questions that companies should ask themselves:

1. How could we ensure that sustainability is part of our creative process?
2. How can we ensure that sustainability is part of the business process management?
3. When and how can an outside opinion be incorporated into the creative process?
4. What processes are most suitable for increasing the value of the company's intellectual capital?

Innovative companies currently use intense niche management, which is an important pillar of sustainable development [24]. Examples of sectors that could fit in this approach are: energy, biogas, public transportation systems, as well as the production of organic foods. The results of these experiments could act as a basis for broader changes in society, in terms of sustainable development. For example, a product with innovative technology might be introduced in small towns, before its distribution on the market [15].

2.1.2. Sustainability-Oriented Innovation in SMEs

Researches on sustainability-oriented innovation (SOI) have addressed innovation processes in large companies, since the year 2000 and extensive knowledge about SOI in SMEs has been generated.

SMEs are a heterogeneous group of companies in terms of size and diversity of their activity field [3]. Taking into account the dynamics of the business environment, it is difficult to clearly define

what an SME is, due to countries adopting different criteria depending on their goals and objectives. However, the majority of SMEs are defined by the number of employees that reach a threshold between 10 and 250 [25,26].

As seen above, SOI is complex and requiring more resources (time, money, and personnel), it has been discussed more often in larger companies. Small and medium-sized enterprises (SMEs) with fewer resources are often limited to rather reactive positions towards SOI, being obliged to comply with and respond to legal rules. However, varying degrees of proactive positions of SMEs have been observed [3]. It has been observed that other actors or intermediaries, such as professional associations, private-public partnerships, value chain partners, NGOs, among others, have a role to play in stimulating SOI in SMEs [18]. In [18] the answers for the following questions about SOI in SMEs are presented:

1. What practices of product and process innovations are implemented in SMEs and how do they interact?
2. What factors facilitate and/or are involved in the practice of product and process innovations?

For this they analyzed knowledge relating to these issues, generated after the year 2000 and contained in 82 key journal articles. It was observed that usually, the sample SMEs are involved in improving the manufacturing processes or the characteristics of the product with regard to environmental issues. In the field of product innovation, feasible concepts are Life cycle assessment (LCA), Life cycle costing (LCC), and eco design, while eco efficiency, cleaner production, Environmental Management Systems such as ISO 14001/EMAS [17] are discussed particularly inside the innovation process [17,18]. The authors have developed a comprehensive conceptual framework that integrates knowledge regarding sustainability strategies, innovation practices, products and processes, and the mechanisms of and actors involved in collaboration of SOI in SMEs. Reactive companies are more heavily influenced by regulations from the government and authorities and innovate, best case scenario, in the eco-efficiency field. Some of these companies use network approaches to overcome resource constraints and to engage in further SOI practices [17]. Pro-active and innovative SMEs are equipped with "green capabilities" and go beyond the regulations. They innovate e.g., in response to market demands (e.g., green products) and in this way they ensure their competitiveness, forcing the securing or the creation of niche markets for sustainable products. Pro-active companies use collaboration with value chain partners (e.g., larger buyers) to innovate together their products and processes. Research centers or universities play the role of building or facilitating SME specific research projects on SOIs. Since listening to customers and other value chain partners is not always enough or can even sometimes represent a barrier towards more radical innovation [3,17,21], collaboration with research centers or universities could be more important when SMEs embark towards radical innovation.

Specialty literature indicates that a wide range of traditional SMEs are still largely focused on incremental innovations even though innovation activities are quite heterogeneous in SMEs [17]. "However, most innovations cannot be seen as 'true' innovations for sustainability. The main 'problem' here is the incremental character of innovations within the studied SMEs" [3].

2.2. The TRIZ Method of Innovation and Creativity in Support of Sustainability

Sustainable approach in industrial development is a complex challenge that involves several spheres of knowledge, and the lack of a common vision regarding sustainability complicates this research aspect. In [27] a new tool is presented, known as the map of sustainability, designed to remove this obstacle during the preliminary analysis of sustainability issues. This tool is based on two key elements of TRIZ: the laws describing the evolution of Engineering Systems and the Operating System. Due to its level of abstraction this tool can be applied in different areas. The case study revealed that the use of the tool is fast and simple and it systematically leads the designer in different directions [27].

2.2.1. The TRIZ Laws of Evolution and Eco-Design

Evolution trends is one of the most widely known postulations of TRIZ. The concept of trends of evolution emerges from the idea that all technical systems evolve according to certain models. Consequently, it is possible to predict technological jumps that allow inventive solutions. The trends of evolution is one of the best tools that can provide an answer to the question "where to innovate towards?"

Nowadays, the problem is that the evolution horizons should include more organic products and the lines of evolution should reflect this change in objective. In [28], the evolution of TRIZ trends is compared with the eco-design tool Lifecycle Design Strategies—LiDS—in order to analyze the effects over the environment parameters taking into account the technological advances and the dynamics of the business environment. Lifecycle Design Strategies is a tool that provides the designer with an overall image of potential environmental improvements through the eight strategies associated with the entire life cycle of a product. However, LiDS tests are qualitative and based on an arbitrary evaluation system. The TRIZ evolution lines could solve the problem of the lack of quality of LiDS and could be used to determine the environmental impact of a product [28,29].

By comparing the trends of development of TRIZ and the eco-design tool, we can appreciate that some trend lines can improve ecological developments at all times, such as the evolution from macro-scale to nano-scale, energy transmission or reducing the complexity of the system, while others have a negative effect on several aspects of LiDS [4,5].

According to these results, the authors suggest that the evolution of those lines that have been shown to interact in a positive way with the ecological parameters can be used without ABR changes, and those that have presented negative interactions must be revised or replaced by others that reflect the reality of current eco-design tendencies [28,29].

Sustainability is one of the most important requirements that designers have to deal with, due to legal standards and regulations and the increasing awareness of the clients regarding environmental issues. As a response to this issue a multitude of methods are available that help the designer assess the life cycle of the product and offer suggestions on how to innovate the product or process in accordance with sustainability objectives. In [30], a way to use TRIZ concepts and tools is presented for evaluating and innovating a technical system that incorporates sustainability requirements in design practice. TRIZ methodology was evaluated as a potential for all existing methods of ecological design. Some TRIZ tools, such as Ideality, Resources and the Laws of technical systems evolution, have been reorganized in the form of eco-design guidelines for product innovation. The authors have applied and verified these guidelines in the field of household appliances and then assessed how the method works propositioning it to some students without any TRIZ experience. The positive results obtained have encouraged further development of the method [30].

2.2.2. Other Areas Where TRIZ Support Sustainability

Other areas related to sustainability in which researchers have been able to expand the scope of TRIZ are: cleaner production, forecasting of eco-products design, resolving conflicts between product functionality and environmental impact, risk management, ECO-innovation in SMEs, and Eco-Innovative Examples for all 40 TRIZ inventive principles.

A. Cleaner production

The standard approach of Cleaner Production originated in chemical engineering and goes through the following stages: tracing the process flow—input/output data collection—performing mass and energy balances—identifying the sources of waste and emissions—establishing priorities—identifying the options. The process of generating options is generally based on specialized knowledge or on the checklists provided by the manuals or the best available technology [29]. This approach applies to teams with a solid knowledge of chemical engineering.

The TRIZ-based approach is a valuable tool as it does not require an encyclopedic knowledge of section-specific technologies. It also allows the expansion of the space of solutions of the problem beyond the initial skills of the team members. It is an easy to explain approach because it begins with a concrete analysis, leading to the search of physical and chemical effects that enhance knowledge and solutions and to a replenishment of specialized encyclopedic knowledge [31,32].

B. Forecasting of the eco-products design

Engineers and designers should concentrate more on how to create as many environmentally friendly products as possible but insufficient knowledge often limits creative approaches for solving these problems. The capacity of creative design methods is based on user experience. Developing eco-friendly products requires an approach that can integrate an innovative design method, user experiences, and life cycle assessment. Innovative approaches to solving design issues can be developed by using patterns of evolution [33], a TRIZ instrument.

The TRIZ evolution model qualifies for this role because:

- It is an effective way to forecast future trends and developments.
- An innovative method of eco-design was designed by incorporating the rules of eco evolution and the ideality laws in order to create innovative and environment-friendly products and processes.
- The idea of biological evolution was integrated with TRIZ models of evolution and inventive principles to develop and to predict future ecological products.

The case study presented by [33] reveals that the use of TRIZ evolution models is a feasible way to identify a new eco-product design.

C. Resolving conflicts between product functionality and environmental impact

Generally, product designers may face a contradiction or conflict between improving product functionality and reducing environmental impact. The designs for environmental (DfE) tools currently available are inadequate because they focus on the identification of environmental aspects that need to be improved, rather than suggesting a way to improve the product; require too much information about product design in the conceptual design phase; take into account environmental issues alone, neglecting other important aspects such as functionality [34].

Tools to resolve this conflict, especially in the conceptual design phase, when a small number of design decisions have a large impact on product functionality and environmental impact are required. To overcome this obstacle, other design methodologies, such as TRIZ, have utilized design by analogy, well recognized for its innovative power. In [34] a tool is presented for conceptual design that provides designers with the necessary knowledge on solving the functionality—environmental protection contradictions—with very little information on the design of the product.

D. Risk management

Product development cycles shrink and products become more and more complex so that managing risk in the product development process becomes increasingly critical. Once the product has reached the end of the design phase most technical solutions have already been adopted and any change affects costs, so the prevention of failures in the early stage of the project, through a proactive approach, is more effective than the reaction to a lack of conformity. Companies are still reluctant to adopt risk management instruments, particularly for the design process if this is not required by standards or customer requirements. Still, there have been developed a number of tools, mainly to predict, assess, and prevent product failure or complications in the design phase and in the production process. Risk management tools are not fast and good enough to meet the requirements relating to products, that are constantly growing and to the acceptable rate of failures that decreases dramatically [10]. In [10] it was decided to build an improved model of risk management in design

to enhance the ability to anticipate problems and technical solutions and reduce failure occurrences. For this, TRIZ instruments have been adopted. Unlike the FMEA standard the resulting method allows for a better definition of the decomposition and functioning of the system and provides a clear definition of the events and failures that may occur in the system. The technicians using the method do not need to have a high-level of expertise in TRIZ tools. For evaluation, this method was tested through students with a basic knowledge of TRIZ and some industrial case studies were conducted.

E. ECO-innovation in SMEs

Eco-design methods such as Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA) recommend the best practices for industries, but their penetration is still weak. The complexity of these methods strongly limits their use in SMEs. Consequently, it requires a need for simplified methods giving similar results at lower costs. Even if these improvements have increased the ease of use, interpretation of the results requires people qualified in the field. In addition, eco-design is a common practice of undercutting the role of what, in TRIZ assumption, constitutes "resources" [35].

Most LCA-type methods are too complex and require too much time to fulfil the requirements of eco-design teams in SMEs [31]. The support provided for designers by existing Eco-design methods is very weak, not going beyond obvious and generic suggestions. Moreover, existing methods are very effective in the assessment phase or the improvement phase, but not in both. A detailed LCA analysis could require some months and a simplified LCA could demand a few weeks. This is still too much for most SME because their constraints are an important factor. SMEs cannot adopt these approaches due to their complexity and the fact that they are highly time-consuming. In addition, in the case of a new product in an early design stage, when envisaged decisions have the greatest impact on the environment, the data needed for a proper solution is not available or, at best, is insufficient. Thus, detailed LCA can only occur at the later stages, when substantial eco-innovative design modifications are impossible or unfounded from an economical point of view [31,35].

One of the results of the European project REMake, where around 250 SMEs, from six European countries were involved, is a new Eco-Design methodology that attempts to eliminate the mentioned disadvantages. The proposed method consists of a preliminary scan of a particular product or process by means of a simplified Life Cycle Assessment (LCA), in order to disclose the material and energy flows involved, as well as to assess their impact on the environment. Then "hot spots" of the product or the process are identified by the addition to the classic LCA criteria of a new indicator called "IFR (Ideal Final Result) index", conceived from the TRIZ "Ideal System". After the identification of these hot spots, in order to develop design options of the system, with a lower environmental impact, over 300 eco-design guidelines based on TRIZ are selectively used. TRIZ methodology was evaluated as a potential ally for existing eco-design methods. Some TRIZ tools, such as ideality, resources, and the laws of technical system evolution, were reorganized in the form of practical ecological guidelines. The guidelines consist of over 330 valid actions for the phases of pre-manufacturing, manufacturing, product use, and end of life. The goals can be achieved by eco-design directions/guidelines, which constitute detailed suggestions dealing with the way the "resource reduction" target can be achieved by specific problem solving paths, often inspired by classical TRIZ approaches and best green practices. This approach has been tested, with very good results, by means of case studies in SMEs in the productive sections of France and Italy. In all cases the results were fast and efficient, both in terms of products and processes. Another advantage of the approach is that it gives designers the essence of TRIZ heuristics, without the need for specific long-term training [35–37].

F. Eco-innovative examples for all 40 TRIZ inventive principles

Technology development plays an essential role in economic growth, but is also a key factor of the ecological crisis. Manufacturers usually emphasize the novelty and usefulness of their innovative products, but often neglect their environmental impact. Those who are trying to reach a balance between technical innovation and environmental protection are the researchers [38–43]. Due to the

intricate design requirements or insufficient experience, design engineers may not easily be able to decide between some parameters which often conflict. Many researchers have identified application examples of one of the TRIZ tools, namely inventive principles in their activity fields. To extend the application of TRIZ in eco-innovation, they studied the relationship between eco-innovation and the inventive principles of TRIZ, more accurately the way the 40 inventive principles of TRIZ can be found in eco-products or eco-innovative processes.

2.2.3. The Need for Using the TRIZ Method in SMEs

Taking into account the needs of the business environment regarding sustainability and innovation, most companies adopt and implement various activities to align themselves to the evolution of the business environment [44,45]. Although the R&D activities have been considered for a long time as the most important factor in explaining the innovation capacity and, to a certain extent, the only important indicator for evaluating the innovation capacity, some empirical studies have shown that a significant number of companies do not invest in fact in their own R&D department.

Innovation based exclusively on company's internal knowledge and abilities is a difficult process, which is not easily available even to large enterprises with research departments, not to mention to SMEs. As seen before, one possibility to accelerate the innovation process lies in looking for solutions outside the enterprise. According to the open innovation paradigm, external scientific data are an important performance factor [44–46]. However, some companies benefit from the external data to a larger extent than others due to different assimilation capacities.

Considering that for large enterprises, which have the means and resources to support innovation, the open innovation method is a common fact, then this model seems even more appropriate for SMEs, which are not able to cover the high costs of internal R&D. The open innovation methods like TRIZ allow for significant cost and time savings in implementing new technological solutions [47]. On the other hand, innovation should be a systematic and continuous activity, which should make use of creative techniques and innovation methods, one of the most efficient methods being the TRIZ systematic innovation method.

2.2.4. Implementing the TRIZ Method in SMEs

Before investigating how to implement the TRIZ method in SMEs, it is necessary to first analyze who the promoters of innovation through this method could be, because in no organization "does innovation just happen automatically" [48,49].

In a company involved in process innovation, labor division becomes an essential success factor. Considering the barriers and the resistance inside organizations in terms of availability and skills, the innovation process must be promoted using different infrastructures: IT, methods, and various marketing tools. [50–52]. Based on the model proposed [53], which presents the theory of a triplet of promoters as a team which promotes innovation in a large enterprise, a new approach has been developed by introducing the strategic promoter. This quadruple (see Figure 2) is comprised of a strategic promoter, a promoter with decision-making power, a technology promoter, and a process promoter:

1. The strategic promoter has expertise in the field of planning, organization, coordination, and supervision. He plays an essential role inside the projects as he contributes to achieving the objectives of the organization in accordance with the established plan [52].
2. The decision-making promotor has the required hierarchical power to lead the project, to ensure the necessary resources and to help overcome the obstacles which may appear during the project. The decision-making promotor will overcome potential obstacles through authority bestowed within the organization. Due to the fact that the decision-making power belongs to management, it has to be said that the statement according to which higher-level management support is a success factor in innovation projects, should be nuanced.

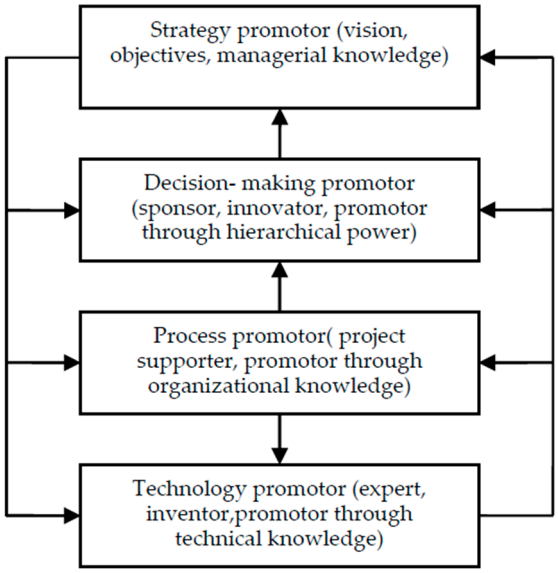


Figure 2. The promotors' quadruple characteristic to large enterprises (developed after [53]).

On one hand, top-level management support is critical, because it enhances the legitimacy of the project innovation and it is a signal of the commitment of the organization. On the other hand, the support of top-level management should not be confused with involvement in the operational phases of innovation projects. The extensive involvement of top-level management may jeopardize the free exchange of knowledge and experiences.

3. The technology promotor, also called expert, has a vast technical expertise in the area where the innovation takes place. He or she plays an important role in the project because it has the knowledge necessary for applying the innovation.
4. The process promotor connects the decision-making promotor with the technology promotor (the expert) and has the ability to bring together the human resources required for the innovation process. The process promotor must overcome the administrative barriers through his or her knowledge about the organization, by recognizing and removing organizational obstacles [49,53].

Promotors can also be found, under a different name, in the specialty literature on the use of TRIZ method in SMEs. Thus, for [54], the implementation of the TRIZ method is the work of two "main players", between whom "there is a tandem": the project manager and the TRIZ expert. In [54], a comparative case study is presented on the implementation of the TRIZ method between two medium sized enterprises with approximately 100 employees, this role being undertaken in each organization by a "porteur" (supporter) who acts as an entrepreneur.

The profile of the two "porteurs" acting in both companies is also presented:

- They have undergone a one-year master program in innovative design based on the TRIZ approach, and have a very good knowledge of the company, each having been employed for ten years in the company;
- They have adapted the TRIZ method to the SMEs' needs and resources by choosing a simplified approach based on a selection of key-principles (contradictions, ideality and evolution laws);
- In both cases, we can talk about assimilating TRIZ to the extent that promotors transformed their knowledge in competences dedicated to the development of the innovation function;
- By applying the TRIZ-inspired methods, they became involved in an active attempt to change the designers' practices, that is, in a form of organizational innovation;

- Full autonomy regarding the TRIZ application. This autonomy is reflected in the organization chart—both being directly subordinated to the entrepreneur—but actually having a significant action freedom;

Starting from the works of [38,49,53,54] it can be concluded that, for implementing TRIZ in SMEs, two promoters are necessary and sufficient: the decision-making promotor and the technology promotor (expert). In [54], a particular case is presented, where the two promotors are found to be the same person. In the hypothetical case of using the TRIZ innovation and creativity method in the Moby company, the role of the decision-making promotor could be taken on by the manager, while the second promotor could be a TRIZ expert from the outside. In this respect, the three fundamental TRIZ methods were presented to the manager: contradictions, ideality, and the evolution models [54]. Regarding the contradiction examples, it should be taken into account that some of these can be taken from the organization's tacit knowledge fund, explained and provided as examples: if the processing precision increases, then quality increases, but costs are higher; if the dimensions of an element become larger, its resistance increases, but material consumption increases as well and it may also affect weight; if products are customized, then new clients can be attracted, but costs increase, etc.

3. Case Study on the Possibility of Using TRIZ in a Medium-Sized Enterprise in the Center Region, Romania

3.1. Overview of Organization

The company Moby LLC (the name is fictional), which makes the object of this case study [38], was founded in 1991 and it is situated in size close to the lower limit of medium-size companies. Its main activity corresponds to the Romanian CAEN code 3109, furniture production.

3.2. The Moby's Innovation Context

The Moby company does not carry research and development (R&D) activities. Like other SMEs, Moby is dependent on external sources of innovation knowledge. Despite this, before accessing this type of knowledge, especially the knowledge from research centers, in order to be able to absorb and assimilate them more easily, it would be useful for SMEs to organize their own capacity for processing this knowledge, such as a design department. The Moby company does not have a design department, its functions being partially fulfilled, according to the manager, by the two engineers specializing in wood processing and who are part of the Production Department. This is not a novelty as it is a known fact that SMEs often carry out, informally, occasional R&D activities by using human resources from other departments of the company [39]. Although the activity of a design department is rather focused on incremental improvement than radical innovation, it facilitates the use of the extended information network The companies which do not have a design department do not master well the processing of data required for innovation and face difficulties in consulting the appropriate data sources, in obtaining access to the data network and in assimilating the latest technologies [40].

The Moby company has not defined innovation as a strategic objective for sustainable growth and does not have an explicitly formulated innovation strategy. When asked what innovations have the company made, the manager's answer was "none". The situation is different when considered from the Oslo Handbook [41] perspective, which provides a more comprehensive and exact overview of the innovation process. Using the innovation examples in Annex B of the Oslo Manual, we can identify the following directions in which innovations were made in the last five years by the Moby company: product (goods and services), marketing, process, and organizational. The approach is presented in Figure 3.

Further evaluating the five innovative directions, for Moby, we can identify the actions of each direction that contribute to the innovation process. Actions identified in directions of the action are:

a. Goods and services innovations (Product innovation)

a1. Changes in components, materials or other elements which improve performance significantly
a2. Adding new functions or characteristics to the existing goods, which result in a significantly improved performance.

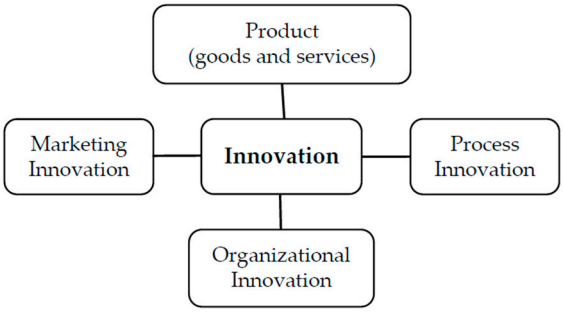


Figure 3. The main innovative directions of the analyzed company.

These innovations were incremental improvements of the goods, did not require massive investment, and were generated from the customers' demands regarding the safety and protection of young children.

The consulting services are based on identifying customer needs by using a client profile. The customer profile is shaped as a result of applying a checklist. This profile contributes to the development of products without losses and changes.

b. Process innovations

b1. New or improved equipment (orbital polishing machine, drilling machine in two planes) and software used to make a product or provide a service, for reducing the unit cost or to increase the quality of an existing product/service.
b2. First time introduction of computer aided design by using the AutoCAD software to digitize the customer's profile for the requested products
b3. Significantly improved methods and/or competences used to make/deliver a product/service or for reducing the unit cost or to increase the quality of an existing product/service.

Based on the principles of sustainability and re-use, sawdust is disposed of mechanically and it fuels the thermal heating system, which, in its turn, provides heat for the dryer and for the working spaces. The use of renewable sources for heating and drying represents important directions provided by the European Commission [43]. Waste reduction in institutions and companies contributes to pollution and emissions of greenhouse gases reduction [44]. The use of life cycle analysis contributes to sustainable product development [45].

b4. New or significantly improved methods, equipment, and software for logistic activities by utilizing a stock management software.
b5. New or significantly improved methods, equipment, and software for ancillary activities (accounting, calculus, maintenance) through the use of a modular software adapted to the field of activity of the company and which may be updated according to the requirements of regulatory authorities.

c. Marketing innovations

c1. A new geographic market area or a new market segment. Over the last years, the company has entered markets in Austria and Germany.

d. Organizational innovations

Introducing first time of purchasing or production management systems, such as supply chain management, business re-engineering, lean production, quality management system etc. Quality Management (International Organization for Standardization (ISO)—ISO 9001), Environment Management (ISO 14000) and Risk Management (ISO 31000) standards were implemented [51].

The innovations mentioned above were mostly based on external readily available data. This confirms that the acquisition of external data, obtained from a variety of sources, including customers, improves the SMEs performance in terms of innovation [36,42].

We previously listed the five innovative directions with their respective activities belonging to the Moby company. However, the company faces problems whose solutions are not so simple:

a. Due to on-line sales, the number of product handling movements increases. If the protection level of the packaging increases, the number of complaints regarding product damage decreases, but the costs increase;
b. If the number of elements made from solid wood is reduced, the costs are reduced, but the mechanical resistance of the furniture decreases.

Here is a formulation in terms of contradictions, specific to the TRIZ method, of two problems the Moby company is facing. To solve these problems, it is necessary to use some creative techniques or the TRIZ innovation and creativity method. The manager of the Moby company knows about brainstorming and value analysis, but he has never used them. If the creative techniques, especially brainstorming, are generally known, the TRIZ innovation method is in fact unknown. That is why we investigated the way this method could be implemented in SMEs.

It is noted that one of the unresolved issues the Moby company is facing—packaging—is similar to that presented in the introduction as being resolved in a SME in Hong Kong, through the TRIZ method.

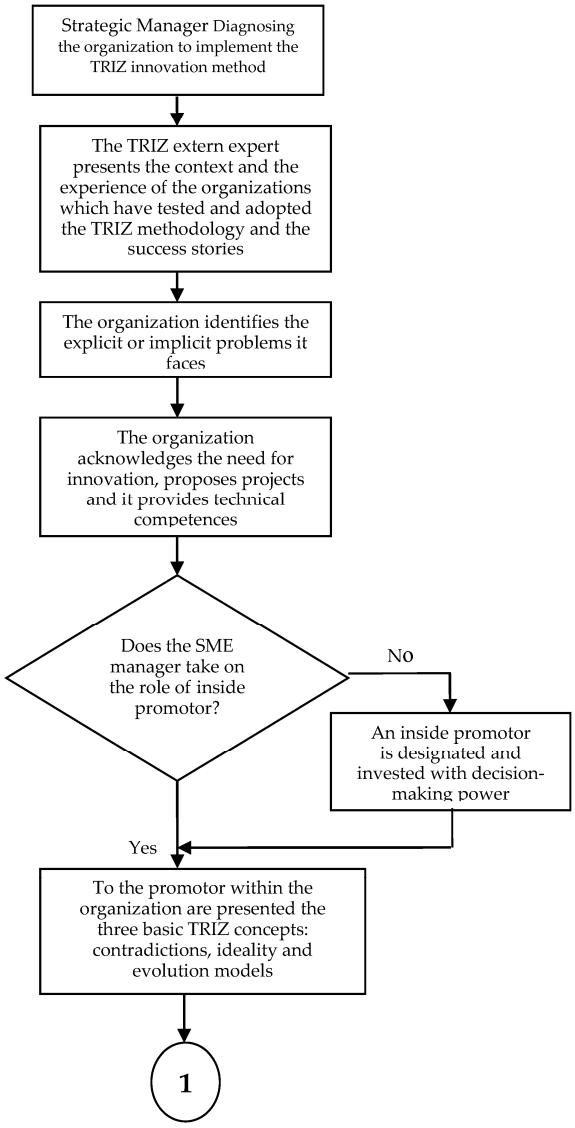
3.3. Necessary Steps in Implementing TRIZ Method in the Company Moby

Starting from the data in the works [52,54] and the discussion with the Moby manager, the sequence of steps necessary in implementing the TRIZ method in an SME can be established [34]. These steps are shown in Figure 4. The steps of this flowchart involve:

The process begins with diagnosing the organization in order to implement the innovation method TRIZ (potential problems are identified, material and human resources of the organization):

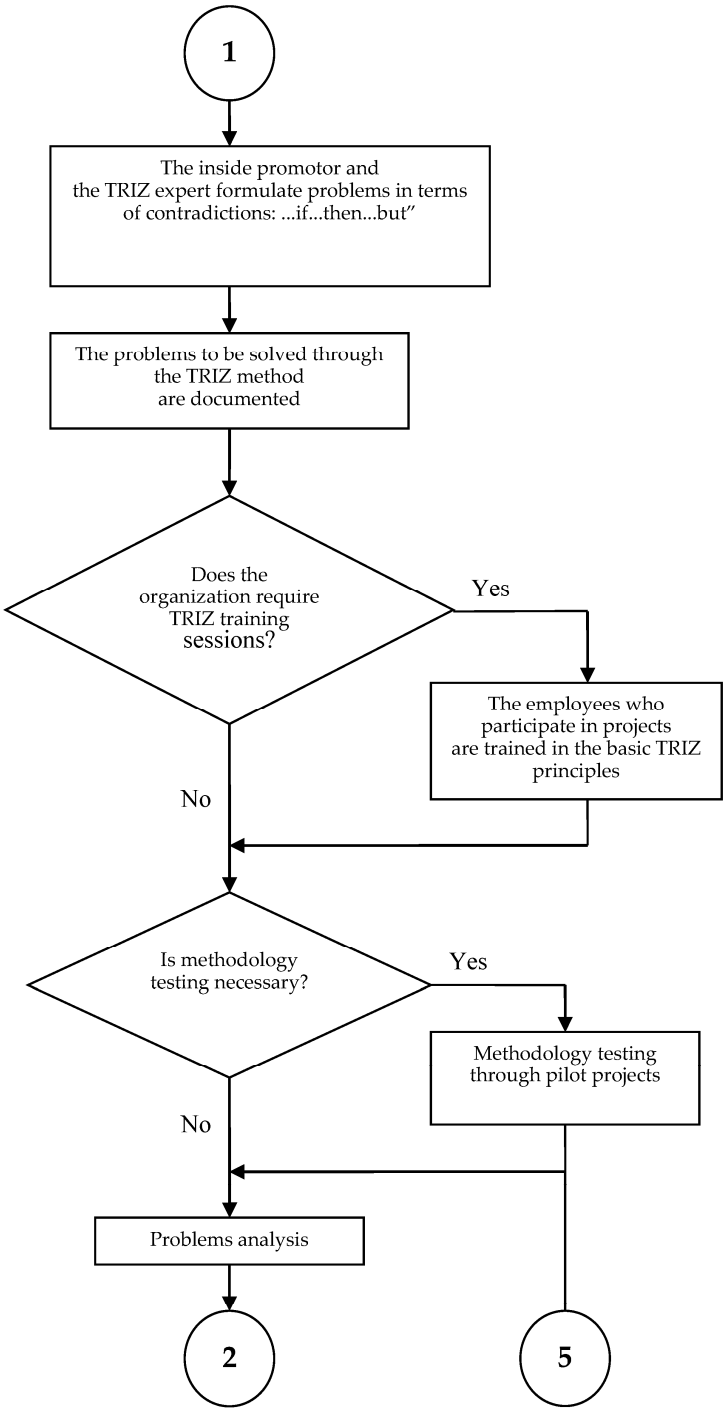
- (1). TRIZ expert (the consultant from outside the organization) presents the background and experience of organizations that have tested and adopted TRIZ methodology and "success stories"—so basically he presents a portfolio of his or others' achievements.
- (2). The organization identifies the explicit or implicit problems faced by that organization this means that the organization must submit both explicit and implicit problems (i.e., those that were not explained).
- (3). The organization recognizes the need for innovation, proposes projects (from the problems shown) and provides technical expertise (specialists from inside).
- (4). Innovation cannot happen if it is not promoted, thus somehow things have to be pushed. The SME manager assumes the role of promoter from the inside? If not, then an inside promoter is designated and invested with decision making.
- (5). To the promoter from within the organization there are presented, first, three core concepts of TRIZ: the contradictions, the ideality and the patterns of evolution.
- (6). The promoter from the inside of the organization and the TRIZ expert formulate problems in terms of contradiction, that means TRIZ specific terms: "if... then... but".
- (7). The problems to be solved by the TRIZ method are documented, that means they are described in the documents to be made: contracts, minutes, etc.
- (8). If the organization wants a broader and with a perspective approach, it can request training in TRIZ.

- (9). If it is deemed necessary the methodology is tested by pilot projects.
- (10). The proposed problems to be solved are analyzed, and if difficulty or quantity requires, additional TRIZ skills are mobilized (specialists).
- (11). The appropriate TRIZ tools are identified, and the organization defines the innovation level they want (change through redesign or completely new concept) based on costs that may incur and allocates a budget.
- (12). Using the TRIZ tools the solutions are developed.
- (13). If the resulting solutions are patentable then it will be proceeded accordingly.
- (14). Validation of the proposed solutions: the solutions are supported by management and their implementation approved.
- (15). The implementation of the solutions.
- (16). In the process, taking into account that TRIZ provide solutions with a high degree of generality, ways to achieve larger innovative solutions can be identified.
- (17). Feed-back: measurement the impact of innovation and improvement of previous steps.



(**a**)

Figure 4. *Cont.*



(**b**)

Figure 4. *Cont.*

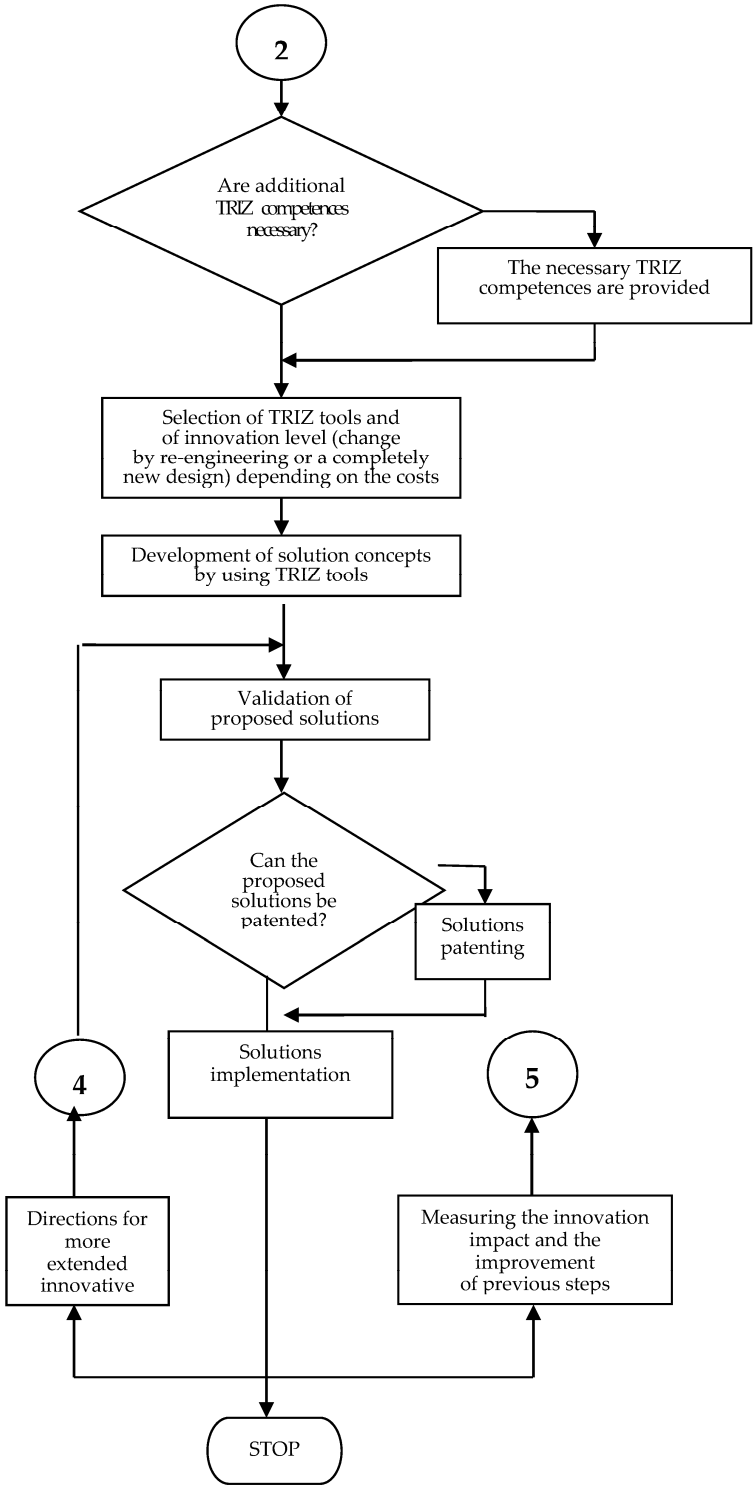


Figure 4. The flow chart of the required steps for implementing the TRIZ method in SMEs (pats (**a**–**c**) of the above figure).

4. Discussion

The case study confirmed the principles of specialized literature, being an example of implementing new concepts in the field of sustainability. As a result of this case study, it was confirmed that:

a. SME innovation is geared toward incremental improvements rather than radical innovations.
b. The innovation effort of SMEs is reactive, being heavily influenced by customer requirements in general and in the particular case of sustainability-oriented innovation of regulations.
c. SME protects its market niche through competitive prices and through incremental innovations.
d. In SMEs it is possible to use TRIZ, however its implementation hits the lack of resources specific to this type of company, considering that Romania does not have an advanced innovation system, such as, for example, Taiwan or Hong Kong.
e. The innovative directions seen, mainly in SMEs are: product, service, process, marketing, and organizational innovations. These directions are essential in order to become competitive and sustainable companies.
f. Goods and services innovations confirm the fact that in the case of SMEs which innovate without research, the relationship with the clients is the most important external knowledge source when it comes to performance in good innovation [42], especially in the case of a company like Moby that does not collaborate with Research Centers or Universities.
g. The quadruple of promoters proposed for large enterprises is considered to be an important pillar in attaining the objectives of the organization through the inclusion of a strategic promoter within the implementation process.

5. Conclusions

Over the past seven years using TRIZ tools for sustainability-oriented innovation was tried, the positive results obtained encouraged further research. TRIZ-based approach is a valuable tool because it does not require an encyclopedic knowledge of field-specific technology and it enables the expansion of the scope of problem solutions beyond the skills of the team members. Through TRIZ, sustainability-oriented innovation efforts connect to the universal body of inventive knowledge, in particular with the physical and chemical effects that enhance solutions and at the same time compensate specialized encyclopedic knowledge. By using TRIZ tools in the field of sustainability-oriented innovation, results were fast and efficient, both in terms of products and processes. Another advantage of the approach is that it gives designers the essence of TRIZ heuristics, without the need for specific long-term training.

Unfortunately, the TRIZ method is little known, and even less applied, in Romania, a country situated in the last place in the European Union Innovation Scoreboard 2015 and 2016.

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References

1. Christiansen, A.; Buen, J. Managing environmental innovation in the energy sector: the case of photovoltaic and wave power development in Norway. *Int. J. Innov. Manag.* **2002**, *6*, 233–256. [CrossRef]
2. Preuss, L. Contribution of purchasing and supply management to ecological innovation. *Int. J. Innov. Manag.* **2007**, *11*, 515–537. [CrossRef]
3. Hansen, E.G.; Grosse-Dunker, F.; Reichwald, R. Sustainability innovation cube—A framework to evaluate sustainability—oriented innovations. *Int. J. Innov. Manag.* **2009**, *13*, 683–713. [CrossRef]
4. Gabriel, M.; Schöggl, J.-P.; Posch, A. Early front-end innovation decisions for self-organized industrial symbiosis dynamics—A case study on lignin utilization. *Sustainability* **2017**, *9*, 515. [CrossRef]
5. Siqueira, R.P.; Pitassib, C. Sustainability-oriented innovations: Can mindfulness make a difference? *J. Clean. Prod.* **2016**, *139*, 1181–1190. [CrossRef]
6. Hede, S.; Ferreira, P.V.; Lopes, M.N.; Rocha, L.A. TRIZ and the paradigms of social sustainability in product development endeavors. *Procedia Eng.* **2015**, *131*, 522–538. [CrossRef]

7. Chulvi, V.; González-Cruz, M.C.; Mulet, E.; Aguilar-Zambrano, J. Influence of the type of idea-generation method on the creativity of solutions. *Res. in Eng. Des.* **2013**, *24*, 33–41. [CrossRef]
8. Ahi, P.; Searcy, C. A comparative literature analysis of definitions for green and sustainable supply chain management. *J. Clean. Prod.* **2013**, *52*, 329–341. [CrossRef]
9. Dempsey, N.; Bramley, G.; Power, S.; Brown, C. The social dimension of sustainable development: Defining urban social sustainability. *Sustain. Dev.* **2011**, *19*, 289–300. [CrossRef]
10. Regazzoni, D.; Russo, D. TRIZ tools to enhance risk management. *Procedia Eng.* **2011**, *9*, 40–51. [CrossRef]
11. Mann, D.; Poon, J.; Driver, M. Case studies from a breakthrough innovation product design programme for local industries. *Triz J.* **2006**, *2*, 35.
12. Luthraa, S.; Govindanb, K.; Kannanb, D.; Manglac, S.-K.; Gargd, C.-P. An integrated framework for sustainable supplier selection and evaluation in supply chains. *J. Clean. Prod.* **2017**, *140*, 1686–1698. [CrossRef]
13. Cioca, L.-I.; Ivascu, L.; Rada, E.-C.; Torretta, V.; Ionescu, G. The study of sustainable development and technological impact on co_2 reducing conditions: Case study of Romania. *Sustainability* **2015**, *7*, 1637–1650. [CrossRef]
14. Cheng, C.C.J.; Yang, C.-L.; Sheu, C. The Link Between eco-innovation and business performance: A taiwanese industry context. *J. Clean. Prod.* **2014**, *64*, 81–90. [CrossRef]
15. Barbieri, J.C.; Vasconcelos, I.F.-G.; Andreassi, T.; Vasconcelos, F.-C. Innovation and sustainability: New models and propositions. *R. Adm. Empr.* **2010**, *50*, 146–154. [CrossRef]
16. Feng, T.; Wang, D. The Influence of Environmental Management Systems on Financial Performance: A moderated-mediation analysis. *J. Bus. Ethics* **2016**, *135*, 265–278. [CrossRef]
17. Weng, H.-H.R.; Chen, J.-S.; Chen, P.-C. Effects of green innovation on environmental and corporate performance: a stakeholder perspective. *Sustainability* **2015**, *7*, 4997–5026. [CrossRef]
18. Klewitz, J.; Hansen, E.-G. Sustainability-oriented innovation of SMEs: A systematic review. *J. Clean. Prod.* **2014**, *65*, 57–75. [CrossRef]
19. Ben Moussaa, F.-Z.; Rasovskab, I.; Duboisc, S.; Guioc, S.; Benmoussaa, R. Reviewing the use of the theory of inventive problem solving (TRIZ) in green supply chain problems. *J. Clean. Prod.* **2017**, *142*, 2677–2692. [CrossRef]
20. Salzmann, O.-U.; Steger, A.; Ionescu-Somers, A. Determinants of corporate sustainability management: An empirical contingency approach. In *Corporate Social Responsibility*; Springer Gabler: Wiesbaden, Germany, 2008.
21. Perrini, F.; Tencati, A. Sustainability and stakeholder management: The need for new corporate performance evaluation and reporting systems. *Bus. Strategy Environ.* **2006**, *15*, 296–308. [CrossRef]
22. Kölsch, D.; Saling, P. How to measure social impacts? A socio-eco-efficiency analysis by the seebalance method. *Int. J. Sustain. Dev.* **2009**, *11*, 1–23. [CrossRef]
23. Gauthier, C. Measuring corporate, social and environmental performance: The extended life-cycle assessment. *J. Bus. Ethics* **2005**, *59*, 199–206. [CrossRef]
24. Zetterlund, H.; Hallstedt, S.; Broman, G. Implementation potential of sustainability-oriented decision support in product development. *Proc. CIRP* **2016**, *50*, 287–292. [CrossRef]
25. Ayyagari, M.; Thorsten, B.; Demirguc-Kunt, A. Small and medium enterprises across the globe: A new database. *Small Bus. Econ.* **2007**, *29*, 415–434. [CrossRef]
26. Boons, F.; Lüdeke-Freund, F. Business models for sustainable innovation: State-of-the-art and steps towards a research agenda. *J. Clean. Prod.* **2012**, *45*, 9–19. [CrossRef]
27. D'Anna, W.; Cascini, G. Supporting sustainable innovation through TRIZ system thinking. *Procedia Eng.* **2011**, *9*, 145–156. [CrossRef]
28. Chulvi, V.; Vidal, R. Usefulness of evolution lines in eco-design. *Procedia Eng.* **2011**, *9*, 135–144. [CrossRef]
29. Prajogo, D.; Tang, A.K.Y.; Lai, K.-H. The diffusion of environmental management system and its effect on environmental management practices. *Int. J. Oper. Prod. Manag.* **2014**, *34*, 565–585. [CrossRef]
30. Russo, D.; Regazzoni, D.; Montecchi, T. Eco-design with TRIZ laws of evolution. *Procedia Eng.* **2011**, *9*, 311–322. [CrossRef]
31. Fresner, J.; Jantschgi, J.; Birkel, S.; Bärnthaler, J.; Krenn, C. The theory of inventive problem solving (TRIZ) as option generation tool within cleaner production projects. *J. Clean. Prod.* **2010**, *18*, 128–136. [CrossRef]
32. Chang, D.; Lee, C.; Chen, C. Review of life cycle assessment towards sustainable product development. *J. Clean. Prod.* **2014**, *83*, 48–60. [CrossRef]

33. Yang, C.-J.; Chen, J.-L. Forecasting the design of eco-products by integrating TRIZ evolution patterns with CBR and Simple LCA methods. *Expert Syst. Appl.* **2012**, *39*, 2884–2892. [CrossRef]
34. Fitzgerald, D.-P.; Herrmann, J.-W.; Schmidt, L.-C. A Conceptual Design Tool for Resolving Conflicts between Product Functionality and Environmental Impact. *J. Mech. Des.* **2010**, *132*, 1–16. [CrossRef]
35. Russo, D.; Schöfer, M.; Bersano, G. Supporting ECO-innovation in SMEs by TRIZ eco-guidelines. *Procedia Eng.* **2015**, *131*, 831–839. [CrossRef]
36. Machiba, T. Eco-innovation for enabling resource efficiency and green growth: Development of an analytical framework and preliminary analysis of industry and policy practices. *Int. Econ. Econ. Policy* **2011**, *7*, 357–370. [CrossRef]
37. Kong, T.; Feng, T.; Ye, C. Advanced manufacturing technologies and green innovation: the role of internal environmental collaboration. *Sustainability* **2016**, *8*, 1056. [CrossRef]
38. Burz, G.; Marian, L. Case study on the implementation of the TRIZ innovation method in SMEs. *Rev. Manag. Econ. Eng.* **2014**, *13*, 81.
39. Ortega-Argiles, R.; Vivarelli, M.; Voigt, P. R&D in SMEs: A paradox? *Small Bus. Econ.* **2009**, *33*, 3–11. [CrossRef]
40. Bougrain, F.; Haudeville, B. Innovation, collaboration and SMEs internal research capacities. *Res. Policy* **2002**, *31*, 735–747. [CrossRef]
41. Organisation for Economic Co-operation and Development. Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data. Available online: http://www.oecd:sti/inno/oslomanualguidelinesforcollectingandinterpretinginnovationdata3rdedition.htm (accessed on 10 March 2017).
42. Moilanen, M.; Østbye, S.; Woll, K. Non-R&D SMEs: External knowledge, absorptive capacity and product innovation. *Small Bus. Econ.* **2014**, *43*, 447–462. [CrossRef]
43. European Commission. Renewable Energy Directive—National Action Plans. Available online: https://ec.europa.eu/energy/node/71 (accessed on 10 January 2017).
44. Rada, E.-C.; Bresciani, C.; Girelli, E.; Ragazzi, M.; Schiavon, M.; Torretta, V. Analysis and measures to improve waste management in schools. *Sustainability* **2016**, *8*, 840. [CrossRef]
45. Torretta, V.; Rada, E.-C.; Ragazzi, M.; Trullic, E.; Istrated, I.A.; Cioca, L.I. Treatment and disposal of tyres: Two EU approaches. A review. *Waste Manag.* **2015**, *45*, 152–160. [CrossRef] [PubMed]
46. Xavier, A.-F.; Naveiroa, R.-M.; Aoussatb, A.; Reyesc, T. Systematic literature review of eco-innovation models: Opportunities and recommendations for future research. *J. Clean. Prod.* **2017**, *149*, 1278–1302. [CrossRef]
47. Campodall'Orto, S. TRIZ—Innovazione Sistematica per le Pmi Lombarde. Introduzione. Available online: http://lazio-side.it/showdocument.php?id=6248 (accessed on 17 January 2017).
48. Bhushan, N. The Elegant Solution and TRIZ. Available online: http://www.triz-journal.com/archives/2008/10/03/ (accessed on 17 January 2017).
49. Goduscheit, R.-C. Innovation promoters—A multiple case study. *Ind. Mark. Manag.* **2014**, *43*, 525–534. [CrossRef]
50. Cioca, L.-I.; Moraru, R.-I.; Babut, G.-B. A Framework for Organisational Characteristic Assessment and their Influences on Safety and Health at Work. In Proceedings of the 15th International Conference the Knowledge-Based Organization, Sibiu, Romania, 26–28 November 2009; Volume 2, pp. 43–48.
51. Ivascu, L.; Cioca, L.-I. Opportunity Risk: Integrated Approach to Risk Management for Creating Enterprise Opportunities. In Proceedings of the 2nd International Conference on Psychology, Management and Social Science, Shenzhen, China, 23–24 January 2014.
52. Ryszko, A. Proactive Environmental Strategy, Technological Eco-Innovation and Firm Performance—Case of Poland. *Sustainability* **2016**, *8*, 156. [CrossRef]
53. Hauschildt, J.; Kirchmann, E. Teamwork for Innovation—The 'Troika' of Promotors. *R&D Manag.* **2001**, *31*, 10–34. [CrossRef]
54. Lerch, C.; Schenk, E.; Cavallucci, D. Emergence d'une fonction d'innovation en PME: Le rôle de l'intrapreneur. *Manag. Int.* **2012**, *16*, 71–84. [CrossRef]