The role of intellectual property in new product development

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Abstract

The development of new products in the enterprise environment became a vital competitive dimension as a result of all political, commercial and technological changes that occurred globally in the last two decades, and as a consequence of this trend new product development (NPD) is considered a critical discipline for enterprises nowadays. The paper considers the growing role that intellectual property is playing in the enterprises technological strategies, ranging from the use of patent information and TRIZ methodology for technology evaluation and selection to the generation of new ideas for products. Thus, we propose a methodology to evaluate the product development strategies up to the current technological stage and to define the product evolutionary potential, with a case study for the application of the proposed methodology.

Resumo

O desenvolvimento de novos produtos no ambiente empresarial se tornou uma dimensão competitiva vital em função de todas as mudanças políticas, comerciais e tecnológicas que ocorreram, globalmente, nas últimas duas décadas. Como consequência disso, o processo de desenvolvimento de produtos (PDP) é considerado crítico para as empresas, hoje em dia. O trabalho considera o crescente papel que a propriedade intelectual está assumindo nas estratégias tecnológicas das empresas, a partir do uso das informações de patentes e da metodologia da TRIZ para a avaliação e a seleção de tecnologias, e de novas ideias para os produtos. Desta forma, propõe-se uma metodologia para avaliar as estratégias de desenvolvimento até o estágio tecnológico atual e definir o potencial evolutivo dos produtos, com um estudo de caso para a aplicação da metodologia proposta.

1. Introduction

Intellectual property (IP), mainly patents, has assumed a new strategic role in product development that goes well beyond the usual protection of technology and product design features. Product development, in turn, is representing a vital competitive dimension as a result of all changes that have occurred in the business environment over the last decades, making the new product development (NPD) process a critical discipline for enterprises nowadays.

Just as technological innovation and product development became essential in the business strategies of companies, corporate strategies also now have a greater influence on the choices and assumptions of NPD. And it is at the initial product planning phase, closely connected to the business strategies, that is perceived the new perspective provided by intellectual property in guiding the assessment and the selection of ideas for development, and in helping to define the technology strategies and the product design choices.

This new IP perspective in conjunction with the tools provided by TRIZ can be combined in a methodology to assess product development strategies and current evolution stage as well as to forecast the product evolutionary prospects in order to feed the product development process and to compare with competing technologies.

The paper presents in Section 2 some views about the growing strategic role played by new product development, intellectual property and TRIZ methodologies. Section 3 presents an introduction to TRIZ that includes the four metrics of a system evolution and the concept of evolution patterns, and the proposed methodology. Section 4 presents the case study introducing the reference product and its maturity stage, defining the product evolution trends and discussing the product technology evolution. Section 5 presents the conclusions about the case study results and the prospects of the proposed analytical framework.

2. The strategic relevance of NPD, intellectual property and TRIZ

In the last two decades, several authors have written about the systematization of the activities of new product development (NPD) in order to integrate all firm functions involved in the process, in a coordinated way. The proposed models may vary in layout but in general they show a sequence of activities starting from the search for a product idea up to the market launch, or even until the final disposal of the product.

Product development is defined by Ulrich and Eppinger (2011) as “the set of activities that start with the perception of a market opportunity and end with the production, sale and delivery of a product”. These authors model NPD in six phases: Planning, Concept development, System design, Detailed design, Testing and refinement, and Production start.

Referring particularly to the planning phase, Figure 1 illustrates its sequence of steps initiated by Identify opportunities, an important interface between business strategies and the NPD.

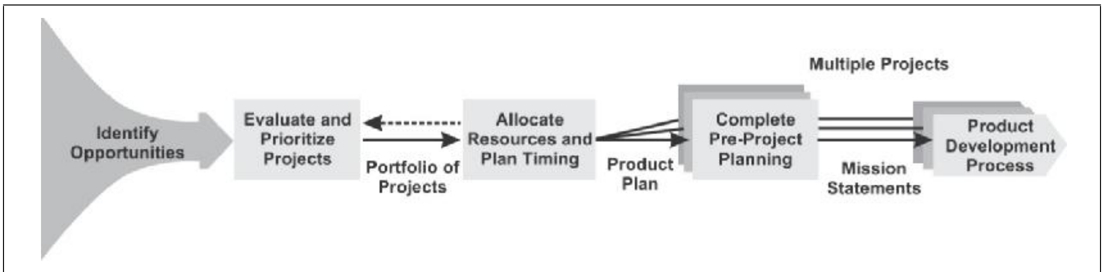


Figure 1: The process of product planning
Source: Ulrich and Eppinger (2011)

Thus, the planning phase is considered as beginning with corporate strategy, encompasses the assessment of technological developments and marketing goals, and finishes with the definition of the portfolio of products to be developed and with a mission statement for each project, the portfolio of products being considered as a supporting means for the overall business enterprise strategy (ULRICH; EPPINGER, 2011). According to these authors, “in the context of product development, an opportunity is an idea for a new product […] a hypothesis about how value might be created”.

Usually mentioned in the literature as one of the sources for new product ideas, patents also are increasingly providing competitive intelligence information and technology monitoring for NPD, as a consequence of the available databases and patent mining tools. So, in the stage of opportunities identification and especially in the concept generation phase, the technologies and the product features patented by others can be enhanced in a trajectory of technical evolution.

Zhang et al. (2007) state that "in a knowledge-driven economy, effective use of patent information is a contributor to the success of any enterprise […], as patent document collections have an unmatched wealth of detailed and practically-oriented business, legal and technical information".

Schuh e Grawatsch (2003) argue that all technology driven companies should focus immediately on the most promising and highly potential technologies to ensure a solid and sustainable technology base that is capable to cope with the shifting requirements of the market. These authors present TRIZ-based technology intelligence as a method that helps technology managers to identify competing technologies, in order to predict their evolution and to determine their potential.

Fey e Rivin (2005) introduce TRIZ as a solving tool for the two major stumbling-blocks to the NPD process, identification of a need and concept development. In addressing the first one, they ask the following key question: "What is the next winning technology to satisfy the potential or perceived market need?" These authors also reinforce the idea that a new product comes from a new concept and point out TRIZ as a developing tool for new product concepts, technologies and manufacturing processes.

3. An introduction to TRIZ and the proposed methodology

TRIZ is the acronym for the Russian words that mean Theory of Inventive Problem Solving, a theory created by Genrich S. Altshuller after analysing over 200,000 patents and concluding that the fundamental principles for ingenuity and problem solution were not limited by contradictions and design compromises (MAZUR, 1996).

Also, Terninko et al. (1998) point out that TRIZ is based on the view "that contradictions can be methodically resolved through the application of innovative solutions. This is one of three premises upon which the theory is built: (1) the ideal design is a goal; (2) contradictions help solve problems; (3) the innovative process can be structured systematically". As patents typically feature innovative solutions to contradictions, these solutions often representing identifiable points along recurring lines of evolution, the theory considers that specific patterns of evolution in designs can be followed to solve problems.

These patterns of evolution were originally called by Altshuller as general laws of dialectics or laws of the development of technical systems, considered by this author as an effective technology for solving inventive problems (ALTSHULLER, 1984).

Following in this section, it is presented the metrics for analysing a system evolution, derived from Altshuller's work with patents, in Subsection 3.1, the evolution concepts resulted from the general laws of dialectics, in Subsection 3.2, and the methodology used in the case study, in Subsection 3.3.

3.1 The four metrics for analysing a system evolution

In his work, Altshuller separated the patents according to five levels of inventiveness: (1) conventional solution; (2) small invention inside a paradigm; (3) substantial invention inside technology; (4) invention outside technology; (5) discovery, a level that represents only 1% of total inventions (TERNINKO et al., 1998).

And an important contribution of Altshuller's work was to combine his analysis with patents and the S-curve pattern of the life of technological systems, as described in this subsection. According to Altshuller (1984), we must know the maturity degree of a product to decide what is the best development strategy, the improvement of existing products or the search for fundamentally new solutions to envision a new product?

Figure 1A represents schematically such a curve depicting a system from childhood to maturity, with an initial slow development phase ending at point 'α', a fast development phase ending at point 'β', another slow development phase ending at 'γ' and a final phase that can be one of the alternative curves: stalling (curve 4), degradation (curve 5) or renaissance (curve 6).

As it is not always straightforward to get the necessary information to plot a performance S-curve for a system, Altshuller (1984) correlated other inventive activities with the S-curve to determine where a product is placed along its evolutionary S-curve. These other metrics are Number of inventions (Figure 1B), Level of inventions (Figure 1C) and Profitability of inventions (Figure 1D).

In his studies with patents, Altshuller realized that at the beginning of a new product or system life there are few but very creative and non lucrative inventions focused on the product or system. The curves in Figures 1B, 1C and 1D present peaks and inflexions that correspond to the points 'α', 'β' and 'γ' in Figure 1A to demonstrate how the quantity, the quality and the profitability of the inventions correlate with the different development phases of the product or system. Specifically for our methodology, it is proposed the number of inventions as a proxy for knowing the S-curve and the maturity stage of the product under analysis.

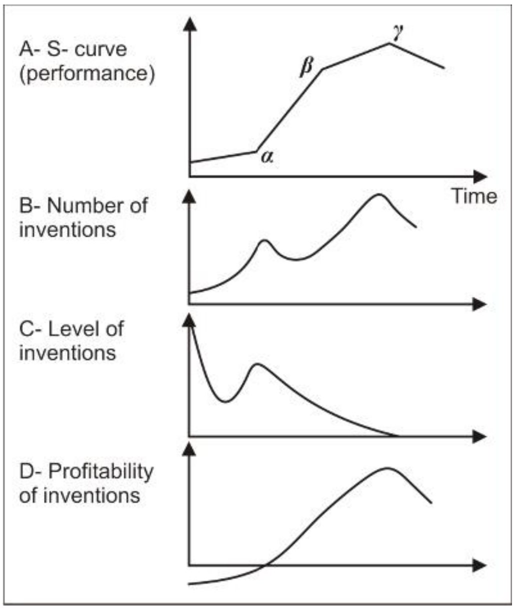


Figure 1 - The four metrics for analysing a system evolution
Source: Altshuller (1984)

3.2 The patterns of evolution and the evolutionary potential

In Altshuller (2002), the axiom that "the evolution of all technical systems is governed by objective laws" is considered the basis of TRIZ to indentify the patterns or laws by which this evolution occurs. Fey and Rivin (1999) provide also an interesting reading of the laws of evolution: "the laws of evolution reflect significant, stable and repeatable interactions between elements of technological systems and between the systems and their environment in the process of evolution".

Altshuller (2002) and Terninko et al., (1998) indicate the following patterns or laws of evolution:

1. Evolution in stages or by the transition to a higher-level system
2. Evolution toward increased ideality
3. Evolution toward increased dynamism and controllability
4. Increased complexity then simplification (reduction)
5. Evolution toward micro level and increased use of *fields*
6. Synchronization and desynchronization, or symmetry and asymmetry
7. Non uniform development of system elements
8. Automation or evolution toward decreased human involvement

However, Fey and Rivin (1999) advice that these laws are more related to a general direction for further system transformation and that a more detailed and specific study of this transformation is provided by the lines of technological system evolution. Mann (2007) also works with 37 evolution trends (or lines) derived from the original TRIZ laws and divided into the dimensions of space, time and interface.

According to Mann (2007), the evolutionary trends were identified in the analysis of thousands of patents and are consistent with the ideality concept that is considered a driver of the technological evolution since the beginning of the TRIZ studies. This author emphasizes that the trends of evolution can play two relevant roles in the technical field, one as a strategic tool for predicting system evolution and the other as a problem solving tool.

Associated with the evolution patterns or trends there are the concepts of evolutionary limit and evolutionary potential of an existing system, the evolutionary potential being defined as the difference between the current stage and the evolutionary limit, a development limit of the system. Thus, a system can be compared with the general trends of TRIZ and be positioned in the evolutionary lines of these trends to identify the stages that have not been explored yet, in order to define the evolutionary potential of the system (MANN, 2007).

3.3 Proposed methodology

The focus of the analysis can be a product, a product line or a technology, it can be referred to a particular company's product or to a standard product in the market, or it can compare competing products and technologies. Nevertheless, the basic analysis starts with the selection of a reference product as done in the case study of this paper, the product and its related technology being described in more details in Section 4. Prior to any work, exploratory consults must be done at the reference product manufacturer web page and about some basics of the reference product technology.

The main steps for extracting information from the patent system, combining this information with TRIZ tools and doing the analysis are the following:

a. Definition of the product searching parameters
   This includes definition of patent databases, patent classifications of the reference product and the searching words.

b. Determination of the S-curve or the maturity stage using the metric of Number of inventions
   The patent classification structure is used to obtain a historical patent count for some major technical characteristics of the reference product and to represent its S-curve. As the USPTO (United States Patent and Trademark Office) patent filing data is considered a proxy for the inventing activity around the world, focusing the US market, the historical patent count within this database can provide an indication of the degree of product maturity along the S-curve

c. Searching into patent databases for patents of similar or analogous products
   This step includes searching for other patents of the reference product manufacturer, searching for patents of exemplar designs (remarkable designs that can represent evolution steps in the product history) and searching for patents of competitive products or technologies.

d. Selection of the evolution trends most suitable to the reference product
   Considering that the 37 evolution trends proposed by Mann (2007) are more specific and detailed than the rather generic patterns or laws of evolution, it is proposed a heuristics for using this collection of trends as a guide to compare the physical or operational features of the reference product with the product evolution examples and the reasons for the jumps, in each trend line, as pointed by this author. Usually, eight or ten evolution trends are selected to represent the product under study in the space, time and interface dimensions.

e. Definition of the current evolution stage in each trend considering the reference product or the exemplar designs of similar technology
   Either considering the reference product or the exemplar designs of similar technology found in the patent searches, the current product technology stage can be explained according TRIZ laws of evolution.

f. Plotting the evolutionary potential curve and discussing the product evolution
   A radar plot with the current stage in all trends considered will show the evolutionary potential for the product and/or its technology. The prospects for further evolution will depend on the maturity stage of the product technology as well as the developing pace of other competing technologies.

This methodology benefits from the analytical power of TRIZ tools in technology forecasting and idea generation, as it has been stated by several TRIZ researchers in the literature. However, one must recognize that the patent information is a small fraction of the available technical knowledge and also that the methodology would be impaired in areas or situations where the patenting activity is reduced. Nevertheless, even in situations where a company's patents do not represent product successes in the market, it is possible to perceive the company's development strategies and market focus through the analysis of its patent portfolio.

4. The evolution of the metal cans – a case study

The chosen reference product is the 18 liters (approximately 5 gallons) square metal pail manufactured by Brasilata, a can manufacturer established in Brazil since 1955.

A pail is a kind of metal can or bucket used for containing paints, flammable liquids and other products. Metal cans or “tin cans” have been manufactured in the last two centuries for containing a multitude of products, from edibles and beverages to several industrial products. Can sizes range from 0.2 liter to 30 liters and the usual shape is cylindrical but square or polygonal shapes are also popular as they are more effectively packed for storing or transportation.

The reference product is described in the Brazilian patent application BRPI0901615 (filed in 14.05.2009) and is designed for containing flammables in accordance with international standards. Figure 2 shows the reference product (all patent documents cited in this paper can be found in the Espacenet web page, see References).

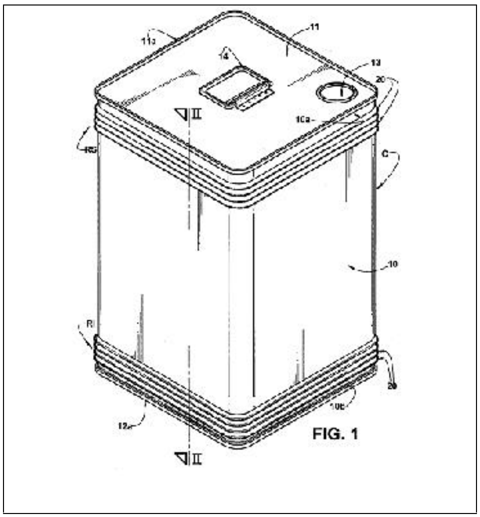
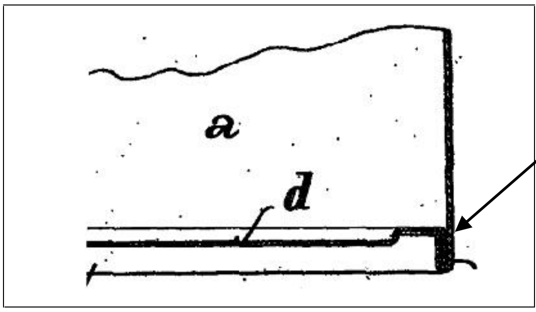


Figure 2 – The square pail according to the BRPI0901615

Square and cylindrical metal pails are normally formed by a container body or vertical wall joined to bottom and cover walls. The body usually has a vertical joint made by welding or seaming on the metal plate. Seaming is a hook type of joint, leakage proof, that is also the preferred way for joining the body to the bottom and cover walls.

Inventions using seam joints date back to more than a century ago, at least, see Figures 3 and 4 (the patent application dates are informed between brackets, after the patent numbers).



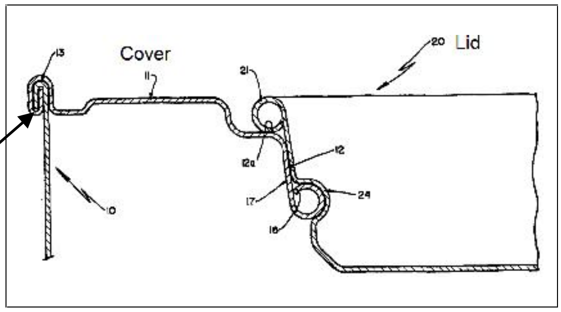
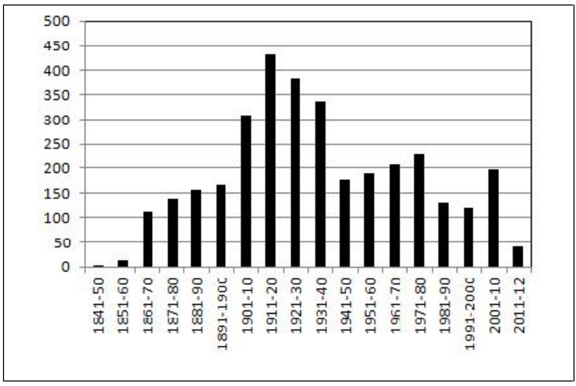


Figure 3 – GB191126611 (28.11.1911) **Figure 4 – BR7400485U (03.05.1994)**

4.1 Patent information and the maturity stage of metal cans

Patent information was searched considering the patent classification structure and the keywords related to some product technical characteristics. It was mainly used the EC classification of the European Patent Office (EPO) for metal containers formed by two or more rigid components (B65D7 main group) and the EC classification for lids or covers for rigid and semi-rigid containers (B65D43 main group). Searches were done at the Espacenet free access database and at the Epodoc database, a proprietary database of the EPO (the EC classification system was replaced in January 2013 by the CPC system, a cooperative classification system developed by the USPTO and the EPO).

There were selected the Brasilata patent documents related to the development of the reference product and the most historically relevant worldwide documents, some of them being discussed in more details in this paper. Histograms of the patent applications to the USPTO were obtained for inventions classified in the main groups B65D7 (Figure 5) and B65D43 (Figure 6) of the CPC system.



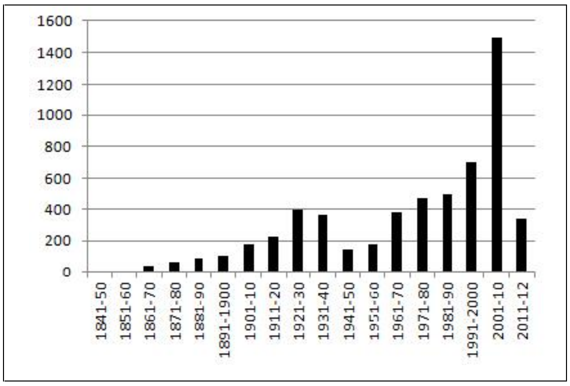


Figure 5 – Inventions in B65D7 group **Figure 6 – Inventions in B65D43 group**

On comparing these histograms with Altshuller’s metric Number of inventions (Figure 1B), one can observe the following points:

- Both histograms present oscillations in the number of inventions as the product technology evolves, similarly to Figure 1B;
- B65D7 main group (Figure 5) shows a decreasing invention rate for the body design of multi-component metal cans, probably indicating that the technology is very mature and beyond point ‘γ’ in the S-curve of Figure 1A;

- B65D43 main group (Figure 6) indicates a remaining effort to improve can lids and covers and one may assume that the S-curve of these components is still in a slow development pace, probably between points ‘β’ and ‘γ’ (it must be observed also that this main group refers to either metal and non-metal containers);
- In general, the metal pail technology is in a mature stage thus providing enough information about product evolution for understanding past development strategies as well as for devising future development alternatives and possible threats.

Also there were made searches for containers made wholly or mainly by plastics for comparing the case study product with a competing technology, in the discussion of Section 4. See a histogram of plastic containers in B65D1 main group (containers formed in one piece, made of plastics or other materials), in Figure 7.

Plastic containers seem to be still in a fast development stage, probably reaching point ‘β’ in the S-curve of Figure 1A. One may suggest that the emergence of the plastic industry during the second half of the twentieth century impaired the metal container development from that time on.

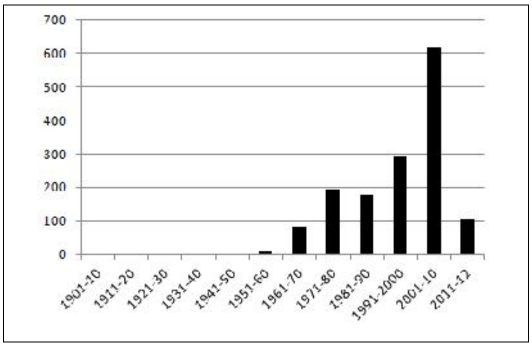


Figure 7 – Plastic container inventions in B65D1 group

4.2 TRIZ evolution trends of the reference product

This section presents six of the ten evolution trends that were considered the most suitable for evaluating the reference product, based on the research work made by Mann (2007) to expand the original Altshuller’s laws to 37 trend lines of evolution. Mann divided these trend lines into the space, time and interface dimensions as they favor to change the perspective on problems and to think about situations from all angles (MANN, 2007).

The selected trends are presented here considering that normally technical evolution occurs through stages in trend lines that evolve from left to right in its way to enhance ideality, the current stages of the reference product or the metal pail technology being indicated by shaded boxes in the trend lines. At the end of this section, a radar plot is drawn showing the evolution of the ten selected trends for the metal pail technology.

a. Surface segmentation

Smooth surface	→	Surface w/ 2D rib protusions	→	3D roughened surface	→	Roughened surface + active elements

This is a space trend derived from the law of evolution toward micro level and increase use of fields. Typically, evolution in surface segmentation results in better grip, traction, heat transfer or aerodynamic controllability, among other improvements.

Many patents of pails and buckets found in this work presented 2D ribs or beads on side wall for reinforcement purposes in order to prevent wall buckling when sheet metal thickness is reduced, see examples in Figures 8 and 9. Also Brasilata manufacturer had some earlier designs with wall reinforcements, but regarding the reference product the side ribs seen in Figure 2 have another purpose as it will be discussed below (see Dynamization, item ‘c’).

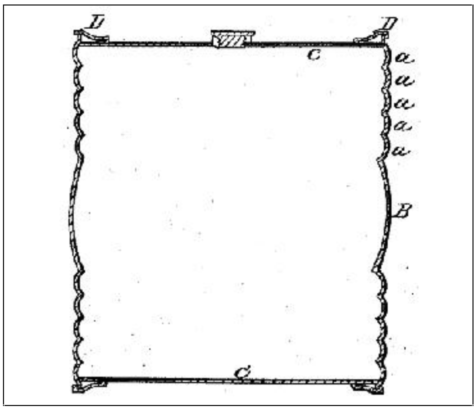


Figure 8 – US16944 (31.03.1857)

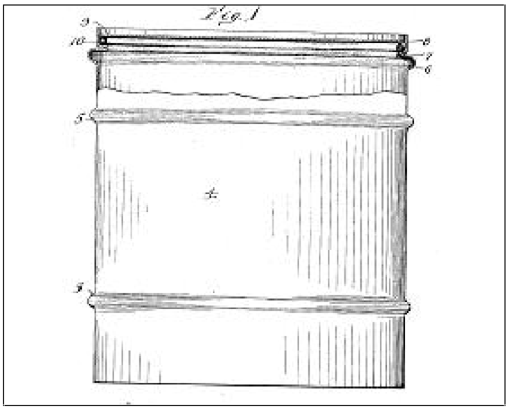


Figure 9 – US1385413 (27.01.1919)

b. Webs and fibers

Homogeneous sheet structure	→	2D regular mesh structure	→	3D fibre alignment according to load conditions	→	Addition of active elements

This trend is focused on the evolution of materials as the development of composites and materials with active elements that improve strength/weight ratios, increase flexibility or durability, add new functions, etc.

Traditionally, metal containers are made of thin homogeneous sheet, as the reference product and many other examples in this paper, so this trend is still at stage one. However, it was found an example of a pail that could be manufactured from a metal/plastic composite sheet (see Figure 12 and item ‘d’, Matching to external non-linearities), so metal containers may be evolving to the second stage as acknowledged at the ‘2D regular mesh structure’ stage (the partially shaded box in the evolution line).

c. Dynamization

Immobile system	→	Jointed system	→	Fully flexible system	→	Fluid or pneumatic system	→	Field based system

This trend line is equivalent to the evolution line of increasing flexibility and is based on the law of evolution toward increased dynamism and controllability. According to Fey and Rivin (2005), in the law of increasing dynamism (flexibility) “the technological systems evolve in the direction to more flexible structures capable of adaptation to varying performance regimes, changing environmental conditions, and of multifunctionality”.

The reference product represents a good example of the stage ‘jointed system’ where flexibility is improved: the pail body has corrugations to weaken the side wall instead of strengthening it in order to protect the upper or lower seams and the integrity of the lid seal in cases of pail falls (see Figures 10 and 11).

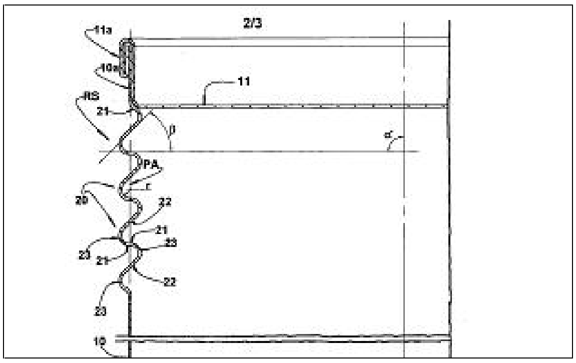


Figure 10 – BRPI0901615 – upper side

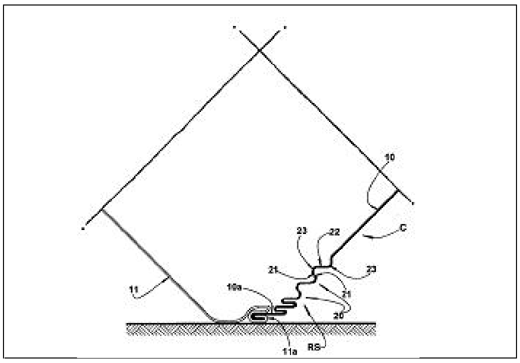


Figure 11 – BRPI0901615 – fall test

d. Matching to external non-linearities

Linear consideration of system	→	Partial accounting of non-linearities	→	Full accommodation of non-linearities

This is a time trend derived from the law of synchronization and desynchronization, or symmetry and asymmetry. It accounts for the identification of non-linearities that a system may be exposed during operation, the evolution occurring with contradiction-breaking designs that solve these non-linearities. The evolution upon this line would reduce complexity, cost and risk of catastrophic failure, or improve reliability and user safety.

Designs considering multi-stacking of pails, rough handling or harsh ambient conditions may provide such ‘partial accounting’ as shown in the trend line. The weakening design of the BRPI0901615 wall, as shown above, is an example of such accounting. Some other examples are the reinforced cover to side wall joint made by Electron Beam or Laser welding in the metal or metal/plastic composite can, of Figure 12, and the seal design of a pail lid to withstand vapor pressure of liquid flammables at abnormal temperatures, as shown in Figure 13.

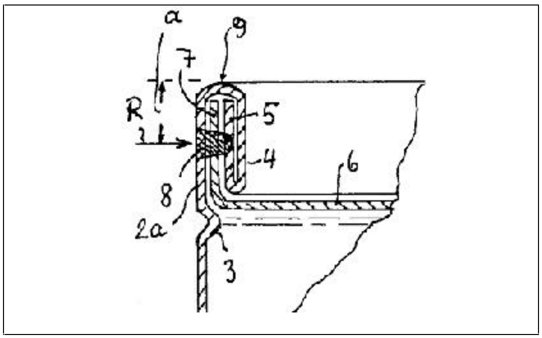


Figure 12 – DE3842452 (16.12.1988)

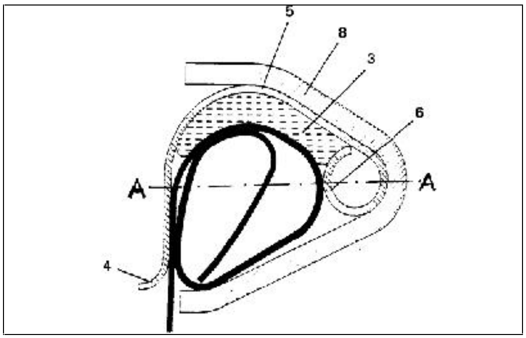


Figure 13 – EP0565762 (16.04.1992)

e. Controllability

Direct control action	→	Action through intermediary	→	Addition of feedback	→	Intelligent feedback

Also derived from the law of evolution toward increased dynamism and controllability, this trend achieves its ideal or final stage when the need for a control system disappears and the system becomes self-controlled.

Two examples of the 'action through intermediary' stage were identified:

- Figure 4 shows a Brasilata design that indicates the container violation if there is an unauthorized opening of the lid, as forcing the lid out of its sealing areas will necessarily result in marks and scratches in the container cover;
- Figure 14 refers to a lid design that expands (through the weakening zones '46', see reference numbers in the drawings) to relieve any internal pressure increase that might occur inside the container and at the same time it aligns the wrinkles '47' that are formed to the closing lid lugs '31' to minimize the chances of breaching the seal.

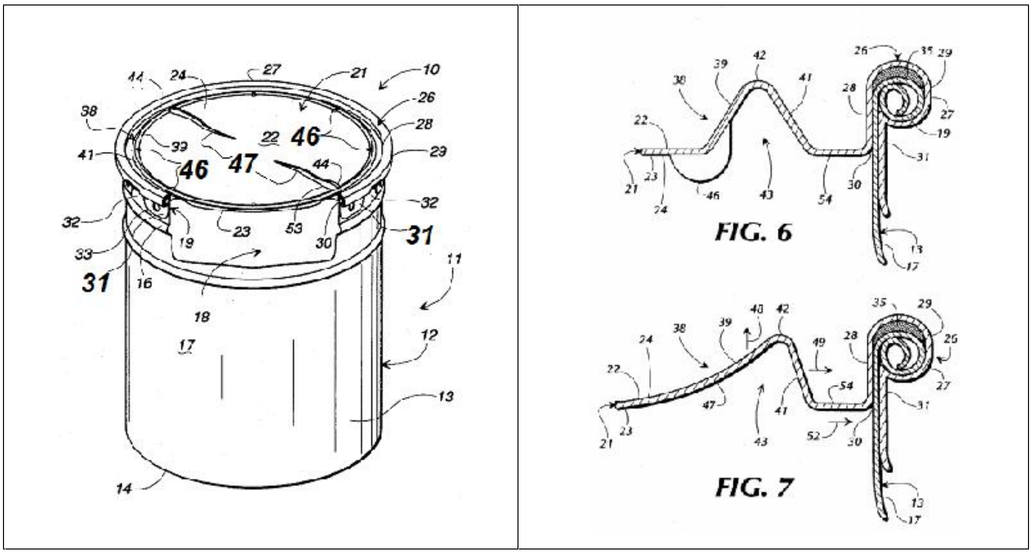


Figure 14 – US5685449 (21.03.1996)

f. Customer purchase focus

Performance	→	Reliability	→	Convenience	→	Price

Mann (2007) correlates the stages in this trend to the S-curve of a system, ‘performance’ being placed at the system childhood, ‘reliability’ and ‘convenience’ at the raising part of the curve and ‘price’ at system maturity.

As the can technology is two hundred years old and also, as it was observed from the patent search, the technology is in its maturity stage and price seems to be the main focus, the price reduction strategy being accomplished primarily by means of design changes that result in thickness reduction of can metal parts. This is particularly relevant for the container structure or body design as shown by the decreasing patent rate in Figure 5. The cover wall and lid designs still present an inventive effort, as shown in Figure 6, to cope with customer needs concerning reliability, convenience and price.

The radar plot of Figure 15 shows the current stage of the evolution trends of metal pail technology with some trends more advanced than others. The shadow area is related to the reference product and the overall pail technology, whereas the line crossing the ‘webs and fibers’ trend line at 2,50 (mid scale) extends this area taking into account the metal/composite pail as a more developed design. The evolutionary limit of the technology is the periphery of the radar plot and the evolutionary potential is the area between the current stage area and the periphery.

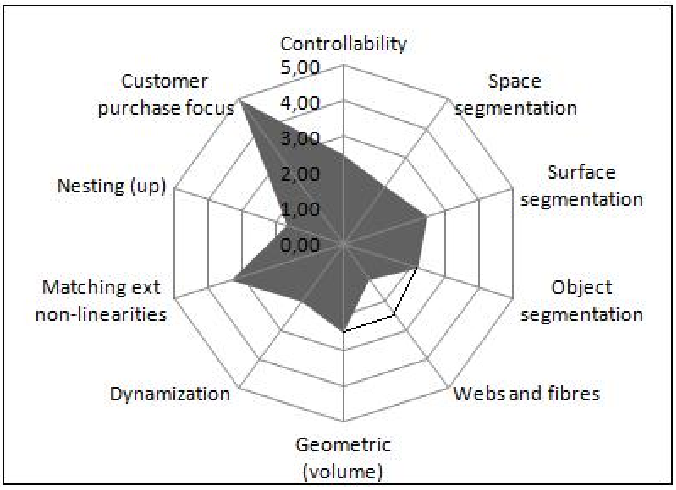


Figure 15 – The radar plot of metal pail evolution

4.3 Discussion of the metal pail evolution

In this section it is discussed the development strategy used by the metal can industry and the prospective for the metal pails, in comparison with plastic pails, using the information gathered from the patent system and the evolutionary analysis made with the reference product.

The overall design strategy was pursued to obtain packed product integrity (no leakage or contamination) together with container reliability in rough handling and multi-level stacking. This was accomplished by the seaming or double-seaming design, by using body walls with ribs or corrugations to minimize buckling, by reinforcement in the bottom area and by continuously improving the upper wall and lid design to fulfill special containers applications. Cost reductions were obtained mainly through metal thickness reduction and specialized can manufacturing technology. Brasilata followed the same pattern developing different wall corrugation profiles to reduce metal thickness as well as has produced inventions in the cover and lid design area to improve reliability and usefulness.

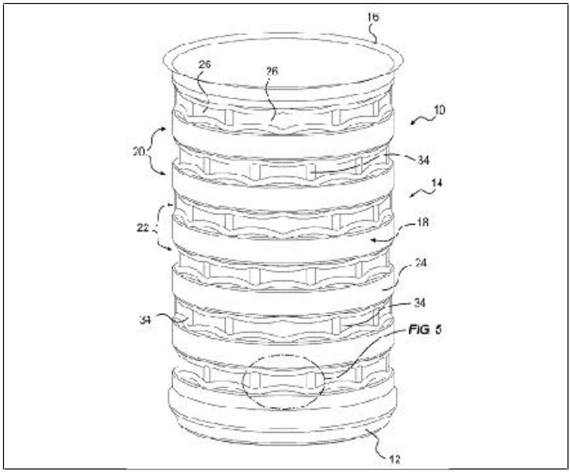
The ‘surface segmentation’ with 2D rib protusions wall is a typical local quality inventive principle of TRIZ that has being used in many product designs as a reinforcement solution. However, in the reference product the introduction of ribs or grooves to weaken the wall and protect the seams and seals is based in another TRIZ design principle, the convert harm into benefit principle, also known as “blessing in disguise”. In the other side, looking into the plastic pail technology, it was found a pail with 3D rib protrusions that benefits from the plastic manufacturing capabilities to enhance further this trend (see Figure 16).

The metal can industry has not evolved much in the ‘space segmentation’ (not presented in this paper) and ‘web and fibers’ trends. If an example of a metal pail in the second stage of ‘web and fibers’ trend line was found (the metal/plastic composite pail of Figure 12), a more advanced 3D fibre aligned, third stage in the evolution line, was found within the plastic pail industry (the multi axially oriented synthetic plastic/plastic composite container of the US3305158).

The evolution in trends like ‘dynamization’, ‘matching to external non-linearities’, ‘controllability’ and ‘customer purchase focus’ resulted mainly from customization and product reliability efforts made by the metal can industry. Consider, for instance, the case of the European patent EP1892191, a multi-use container manufactured by a seaming or double-seaming process that produces square pails with low curvature corners and high sealing ability for storing food, beverages or discrete products as storage batteries – in this case, the main reason for evolving in the ‘customer purchase focus’ trend line was to reach the convenience stage without impairing the product reliability or performance.

The radar plot in Figure 15 pictured an evolutionary potential for metal pails that could be promising as many trends are in their initial stages, however the histogram of Figure 5 presents a different situation as the patenting rate of metal containers is clearly decreasing. The best evolution strategy here would be in the direction of composite materials, combining metal, plastics and other synthetic materials, thus consolidating the evolution in the ‘webs and fibers” trend line. This could induce evolution in trends like ‘space and surface segmentation’, ‘dynamization’, ‘controllability’ and ‘decreasing density’.

Plastic containers, in the other side, have evolved more sharply or present a more promising future for technical evolution. Figure 16 shows the pail with 3D rib protusions wall mentioned earlier. Figure 17 presents a major advantage of plastic containers as they can progress easily in the ‘increasing asymmetry’ trend line “to match the forms that suit the users” (as stated by Mann, 2007).



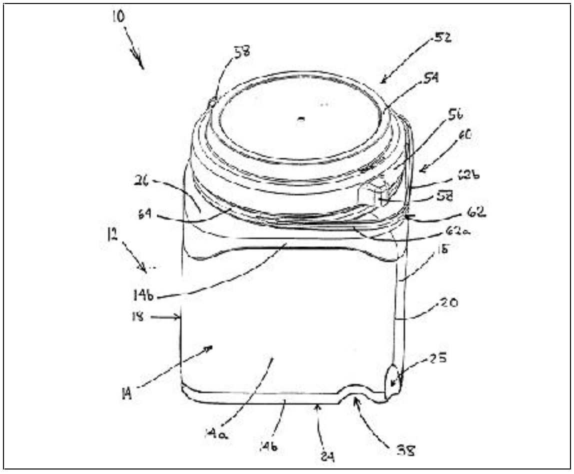


Figure 16 – US20110226788 (08.11.2010)

Figure 17 – US20040011831 (02.07.2003)

5. Conclusion

In this paper it was highlighted the strategic relevance that intellectual property and TRIZ (the theory of inventive problem solving) represent for product development. A brief introduction to the theory and a methodology for analysing product technical evolution were presented. The methodology is based in a product retrospective view using information obtained from the patent system, this information being used to depict the product in trends that can be regarded as “dimensions” for predicting product evolution.

A case study was done having a typical metal pail as an example, the reference product being chosen from the product line of a Brazilian can manufacturer. The patent information provided a proxy of the product S-curve, the metal pail being considered in a very mature level. The patent retrospective view gave also enough insight to define the current product stage in ten trend lines along its way towards ideality. In overall, the product decomposition and analytical process was helpful in understanding the development strategy of the metal can industry, in forecasting future design directions and in assessing the potential of competitive products, as plastic containers.

As TRIZ was initially proposed as a methodology for solving technical problems and providing creative solutions in design, and more recently has been deployed as a strategic tool for technology forecasting, it is also envisaged here to employ this theory combined with patent information as an effective rationale for studying the product development process.

In general, the proposed methodology can be used to analyse the current evolutionary position of any product or technology and to evaluate its future development prospects, or can be applied to a specific product of a firm to define its development strategies and to compare competitive advantages and strategies with other enterprise’s products.

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