

TECHNOLOGICAL INNOVATIONS AS A COMPETITIVE ADVANTAGE IN PAPER INDUSTRY

Knežević S. Rade

Faculty of Strategic and Operational Management, Belgrade, Serbia
rade.knezevic@fsom.edu.rs

Mrdak Gordana

Higher Professional School of Applied Studies, Vranje, Serbia

Krgović Milorad

Faculty of Technology and Metallurgy, University of Belgrade, Serbia

Knežević Željko

Novi Sad, Serbia

Abstract: *In the business development special place belongs to the technology, because it shows the influence of different factors that significantly impact the creation of competitive advantage of countries and companies within the world and the global economy. One of the main generators of competition are technological development and technological achievements. In the first part of the paper technical and technological development of the technology of paper to this day are represented chronologically, showing how certain ideas in a certain period can be revolutionary and useful for the development of technology. Through a practical example, with desire to improve the technological process, improve the quality of the final product, reduce production costs, achieve financial savings, achieve competitive advantage, et al., the actual impact of work on improving the technological process of the paper is given in this paper.*

Key words: *paper, technology, innovation, constant part.*

1. INTRODUCTION

Modern business conditions impose the constancy of change and the adoption of the innovation spirit as a business orientation of all market participants. Consequently, it leads to improvement of many business philosophies and creation of completely new ones, which are trying to respond to the challenges and obstacles of the turbulent environment. A special role in the new business environment belongs to the technology. It shows the influence of different factors that significantly impact the creation of competitive advantage of countries and companies within the world and the global economy. One of the main generators of competition are technological development and technological achievements. The real state of modern business is constant and rapid scientific and technical progress accompanied by dynamic changes. The dynamics and technology changes occur at accelerated rate [9] and its influence on all spheres of life, work and business has made the resolution of questions of management technology particularly topical. Very fast dynamic changes, as well as intensifying scope of new technologies, lead to the rapid appearance of

new generations of technologies, which particularly affects intensive changes in technology products, services and processes, together with the creation and development of new technological areas. Innovation, creativity and inventiveness are in the forefront of the development of human civilization and the development of technical culture from pre-historic times to the present day. In most cases, it begins with individuals, talented people in some area, with the desire to create something new, hitherto unknown, which brings technical and cultural development. In the history of mankind, creative individuals have created miracles, which even today are not fully understood. If we start from 260 giant sculptures on Easter Island (some reaching heights of up to 12m), the largest astronomical atlas of the world made by the Incas, and the embalming process in ancient Egypt, so far none of these has been explained. 15th century was a period when some scientific areas began to develop, when the first printed book appeared, the famous „Bible of 42 lines,” which pages had two columns of 42 lines, Figure 1 [8]. Printing in Europe begins with the discovery of mobile lead characters. The first trial of casting letters and printing was done by Gutenberg in 1445, and this year is considered to be the year of the invention of printing, when around 200 copies of the Bible in two volumes were printed, of which to this day 49 copies are preserved and which are considered one of the most valuable works of typography.



Figure 1: Gutenberg's Bible [8].

The technological development of the global industry over the past 200 years occurred in cycles in different areas of the industry, as seen in Figure 2 [11].

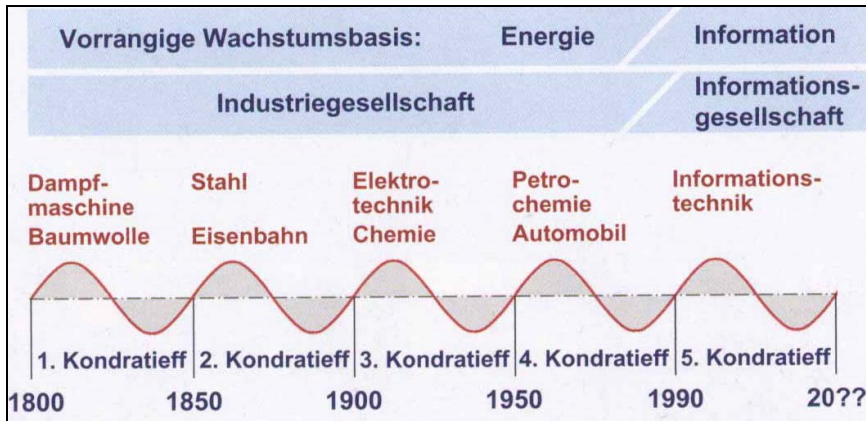


Figure 2: Technology development in the world from the year 1800 to the year 2000 and onwards [11].

In the period from 1800. to 1850. the development of steam engines and textile industries is noticeable, from 1850. to 1900. the development of the industry for the production of steel and railroads was dominant, from 1900. to 1950. development of the electrical and chemical industries, from 1950. to 1990. development of the petrochemical and automotive industries, from 1990. to date electronic – information systems. In Figure 2 are also shown the sinuous conjuncture and depression of these industries. Further development of innovative activities was concentrated in countries with major economic power, which used it in order to expand their influence in the world.

2. INNOVATIVE STEPS IN THE PRODUCTION OF FIBERS AND PAPER

The innovative activity, from the idea to its realization, has its flow, as shown in Figure 3 [1].

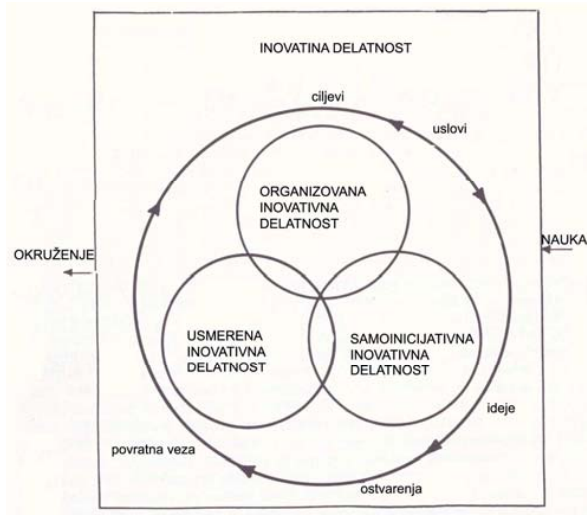


Figure 3: Innovation system [1].

By using this scheme in a favorable environment, in practice, great successes in the implementation of innovations are achieved. This means that with the right idea, knowledge and creation, and implementation of that idea in practice, significant financial results can be achieved, among other things. However, it is not uncommon that many inventors, whose inventions changed the world, earn nothing or almost nothing from their inventions. That was the case with Douglas Engelbart, the inventor of the computer mouse, who has recently died. Although this is one of the best selling inventions, the inventor has not earned a dime.

This prompted the BBC to make a list of inventors who lived modestly, some even poor, but the whole world has benefits from their inventions. Not to mention all of them, we will mention only their inventions, without which this world would not be the same: the study of bacteria, the world's global network, aircraft, LEDs, light bulbs, paper, the wheel, antibiotics, Morse code, a transistor, a compass, a Kalashnikov. As you can see, paper is in this list, which is an invention which has been given special attention in the next section of the article. The paper „borrowed” its name from the papyrus plant, marsh plant that grows on the banks of the rivers of Central Asia and Egypt. Babylonians, Egyptians and Romans made from this plant paper like material by pressing the interlacement parts of stems and leaves. Real paper, obtained by filtering of fiber from the water, was found in China at the beginning of a new era, Figure 4[8].

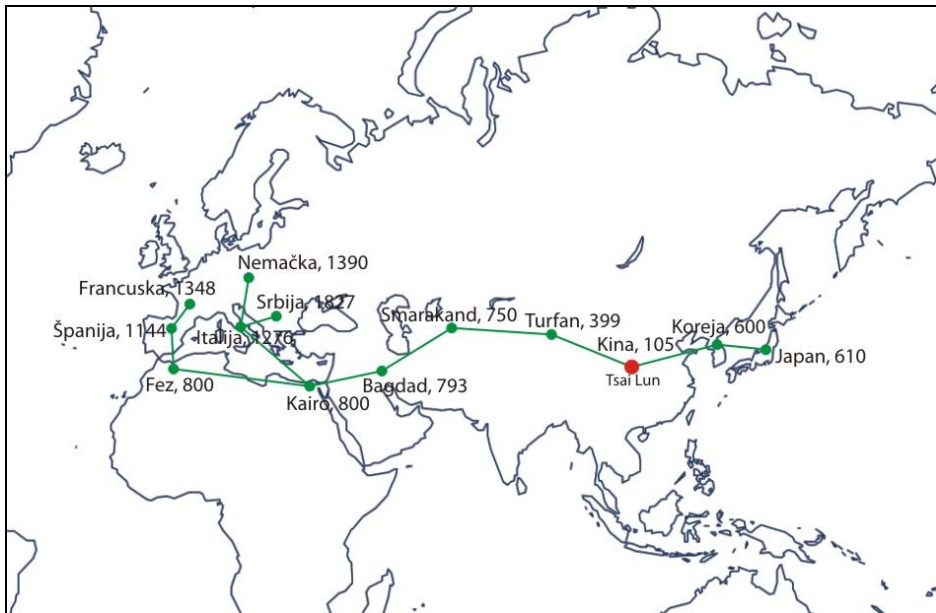


Figure 4: The road of paper [8]

Ts'ai Lun, born in 105 AD, made the first paper of textile waste and bark of mulberry tree. Before that, the material made of bamboo, animal skin and silk fibers, on which one could write, was used. Manual production of paper in Japan started in V century. Chinese stationers soon found the type of paper that was resistant to insects, which was a big ad-

vantage compared to existing materials for writing. The continuous increase in the need for paper led to the fact that the Chinese got fibers for making paper from plant materials, eg. bamboo. But, old textiles remained the main raw material for making writing paper until the 19th century. The Arabs took over the technique of making paper around 700 AD. Through Spain and Italy, this technique arrived in Germany, France and the Netherlands. First German paper mill was designed in Nürburgring in 1390. by Ulman Stromer, after which followed Ravensburg in 1392. and Chemnitz in 1398. and the first paper mill in Switzerland appeared in Basel in 1410. Next important technological step was made by stationers from Zaan in 1672. who constructed new grinding machine Holender (“Hol-länder”). Holender enabled accurate milling with the possibility of reproduction of the same degree of milling, which improved the quality of the paper. Complicated crusher was replaced by this, and „soaking container” was also thrown out of use. Grinding in Holender made possible to process a sufficient amount of paper pulp of balanced quality. Its principle of milling was used for a long time, until the the 80 ,s of the last century. When the Frenchman Robert in 1798. found, and on 18th January 1799. patented a paper machine, it made a breakthrough in the pursuit of further mechanization of papermaking. At that time the paper machine was still put into work manually, Figure 5 [8].

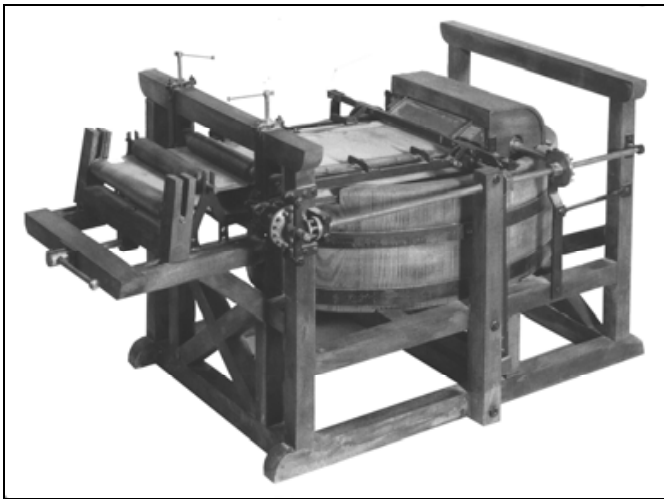


Figure 5: The first manual paper machine [8]

The geniality of the new idea was in the conversion of a discontinuous process, which was carried out in steps, in a continuous process. The first production line was discovered and after 12 years of work Luis Robert defined the production of paper, which still is the base of the paper production, Figure 6 [8]. In the turmoil of revolutionary wars, this patent ended up in England, where it was further developed. The first paper machine was put into operation at the facility for the production of paper of the merchant Fourdrinier, in Fragmor. The supplier of this and other paper machines was machine factory of Brano Donkin. Donkin built 250 paper machine till his death.

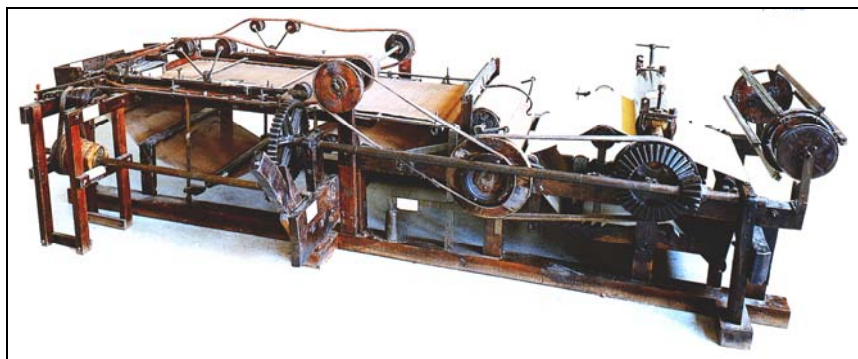


Figure 6: The first mechanical machine Louis Robert [8]

The first production of mechanical wood pulp was developed by Keller, chemical pulp by Mitscherlich and Dal, and Escher Vis and JM Voith developed preparation of pulp and paper machine. The first paper machine was designed by Donkin in 1820. Keller (1816–1895) patented a device for grinding wood pulp in 1845, and his idea was transformed into commercial machine by JM Foyt (1803–1874.) in 1847 in Heidenmheim. At first the fibers of hemp and wool were used, and later wood. American Benjamin Tilghman patented cellulose production by the sulfite process in 1867.

Swede Carl Daniel Ekman patented procedure for the production of cellulose by magnesium – bisulfate process in 1874. and the same year he organized a production of 100 tons per month. Meller began research of production of kraft pulp in 1854. and Dahl patented this process as sulphate or soda process in 1884. The patent for alkaline decomposition of wood in paper mass, with NaOH, was assigned in 1858. to Fa. Watt und Burgess. In 1876. The production of cellulose by chemical decomposition of wood was discovered by the Mitscherlich – process, with Ca – bisulfite, and almost at the same time in 1878. by Ritter – Kellner process. Then followed the sulphate method, defined by Dresel and Dahl in 1879. which entered into production in 1885. In this way the lignin could be removed by boiling by chemicals.. A wide range of raw materials caused a stormy development of the paper industry. At the same time the need for the paper for books and newspapers appeared, which was increased by the discovery of the telegraph, and the need for packaging of many new products. The sudden development of paper industry starts from 1950. When it was produced app. 30 millions of tons, and for example, approximately 409 millions of tons were produced in 2011. [6]. All of the above, starting from the first paper to introduction of the latest technology in the production of paper and paperboard, is the result of innovative work, the desire to discover something new, better, more modern, with gaining a competitive advantage in market as the primary goal.

3. PRACTICAL EXAMPLES OF THE APPLICATION OF TECHNOLOGICAL INNOVATIONS

Pulp paper industry is technically and technologically complex industry, where nearly all of the technologies from various scientific fields are present. Newly built pulp and paper factories must be reconstructed every 5 to 7 years in order to reduce costs of production

and implementation of new technologies. The desire to improve some process, to improve the quality of the final product, reduce production costs, achieve financial savings, achieve competitive advantage, etc. are driving forces for innovators around the world, and the practical use of these solutions represents closing the circle between science and the environment, from concept to implementation. The example of the improvement of technological process in paper production is done in Lepenka Novi Knezevac, where some ideas were implemented. Also, in this paper the following idea will be briefly presented : reconstruction of the continuous part of the paper machine. This technological complex in the paper production is a very important part of the machine and technological process, for these reasons requires very meticulous and efficient planning, with the adequate choice of optimal equipment, techniques, calculations of all parameters and precise execution of the system. Any failure in planning or performance negatively influences on the stable operation of the system, since all parameters must be constant during the production. By reconstruction of the constant part the following has been accomplished:

1. visual appearance of the paper is much better and meets the requirements of the market, which was the goal of the reconstruction,
2. solid particles are removed from the paper,
3. fresh water consumption is reduced and exploitation of raw materials is increased,
4. the mechanical properties of paper and capacities of paper machine are increased,
5. reconstruction was performed with domestic equipment completely,
6. investment costs are approx. 8 to 10 times lower as compared to the new equipment,
7. investment returned in 3 months.

By this effects, the factory achieved desired goals and a certain advantage in global market, where the competition is large and unfair.

4. CONCLUSION

Very fast dynamic changes, as well as intensifying scope of new technologies, lead to the rapid appearance of new generations of technologies, which particularly affects intensive changes in technology products, services and processes, together with the creation and development of new technological areas. As well as in every field, technology global trends and developments must be followed and applied in our production processes.

The technological development of the global industry over the past 200 years occurred in cycles in various fields of industry. Further development of innovative activities is now concentrated in the countries with major economic power, which they use in order to expand their influence in the world. However, the „small ones” must fight with their inventiveness in order to survive in all business conditions.

The desire to improve the technological process, to improve the quality of the final product, reduce production costs, achieve financial savings, achieve competitive advantage, etc, was the driving force in this practical example as well.

REFERENCES

- [1] Figurić, M., Mikulić, J. & Palčić, I.: Vrednovanje Inventivnog rada. *Zagreb: Radničke novine* (1981), pp. 7–13.

- [2] Hain, T. & Muller, M.: Nachhaltigkeit als Schlüssel für eine effiziente und wirtschaftliche Papier- und.
- [3] Jovanović, S. & Krgović, M.: *Pomoćna sredstva u proizvodnji papira*. Beograd: Tehnološko-metalurški fakultet, 2010.
- [4] Kersten, A., Hamm, U., Putz, H. J. & Schabel, S.: Zur Diskussion um die Migration von Mineralöl in Lebensmittel und das Altpapier – Recycling. *Wochenblatt für Papierfabrikation*, (2011), No. 1.
- [5] Kohler, A.: Successful start-up of Nantong PM 1. *Voith Paper TWOGETER*, (2010), No. 31.
- [6] Krgović, M.: Nove metode za efikasnije sušenje papira u cilju štednje energije. *Doctoral dissertation*. Tehnološki fakultet Sveučilišta u Zagrebu, 1983.
- [7] Krgović, M.: Štednja toplinske energije pri proizvodnji papira. *Master thesis*. Tehnološki fakultet Sveučilišta u Zagrebu, 1977.
- [8] Krgović, M.: Grafički materijali. Beograd: TMF, 2005.
- [9] Levi Jakšić, M.: *Menadžment tehnologije i razvoja*. Beograd: Čigoja štampa, 2006.
- [10] Maier, J.: Optimierung von Qualität und Wirtschaftlichkeit durch innovative Konstantenteile. *Wochenblatt für Papierfabrikation*, (2011), No. 2.
- [11] Putz, H.-J.: Altpapier-Recycling-Stiefkind der Bioökonomie?. *Wochenblatt für Papierfabrikation*, (2013), No. 12., pp.881–886.
- [12] Turunen, T., Heinonen, L. & Banecki, R.: 17 Thesen zur Steigerung der Energieeffizienz. *Wochenblatt für Papierfabrikation*, (2011), No. 3.