ISSN: 2278-3369
International Journal of Advances in Management and Economics
Available online at www.managementjournal.info

RESEARCH ARTICLE

Innovation Management Models in the Metallurgical Sector

Adrian Dumitru Tanțau, Silviu Matee*sescu**

Bucharest Academy of Economic Studies 6, Romana Square, 1 st district,Bucharest, Romania.

*Corresponding Author:E-mail: ***Matesilviu@yahoo.com***

Abstract

The innovation management models refer to the discipline of controlling and coordinating the intentional introduction and application within a job, work team or organization, of ideas, processes, products or procedures which are new to that job, work team or organization and which are designed to benefit the job, the work team or the organization. We identified three innovation management models (blue ocean, four systems, one-off) and a hundred and eighty companies from the metallurgical sector which were divided into three groups of sixty. Every group of companies applies a different innovation management model and our study tries to verify whether or not there is a significant relationship between the model used and the number of innovative projects generated.

Keywords: *Blue ocean, Innovation, Innovation management model, Red ocean, Utility map.*

Introduction to Innovation Management Models

Innovation represents a particular category of change, that is intentional, designed to benefit and it's new to the unit of adoption [1]. Innovation management is all about taking over and guiding the key processes from initial idea through to product launch [2]. It is defined using three important factors, namely (a) Product, (b) Process and (c) Organization. In principle, product and process are the two most crucial components of innovation, while the process of managing the innovation depends on the organization [3]. Product is characterized by new functions with additional or simplified features designed for commercial exploitation [4, 5]. On the other hand, process refers to the creation of the product or the materialization of new ideas to create innovation. This component facilitates the creation of innovation giving the product fluid features and adaptable characteristics according to the existing consumer needs derived from the existing market [5]. The third component is organization, that focuses on the creation of support functions, such as human resource management, finance and accounting management, that support the research and development of innovations, introduction to the market, and marketing activities to support the product promotion [6].

The organization managing the innovation idea from its conception up to its materialization also incorporates the structure, motivation, culture, and strategy to the innovation [7]. This principle explains culture-defined innovations (e.g. the American hotdog brand Sabrett) wherein traces of the organization's culture and structure can be seen in the characteristics of the innovated products. To put it simply, the creation of a new product is the outcome of an innovation, while the handling of the newly created product is supported by the organization. Organizations that break barriers of product stereotypes are able to take the advantage of creating and introducing innovation designs. Schermerhorn [8] identifies the key indicators of an ideal organization to manage innovation, namely: (a) organizations that use strategic development of innovation, (b) possesses strong sense of cultural appreciation, (c) provides support from an established department structure (e.g. HR department support, Research & Development support, etc.), (d) organizations that employ knowledgeable staffs to manage innovation, and (e) organizations that allocate for research and development programs.

Famous Innovation Management Models

The blue ocean strategy centers in value innovation that requires the total commitment of the company to create and to provide the best utility possible for the consumers [9]. Gonclaves [10] state that the identification of need is only the initial phase, following the identification of the necessary idea to resolve, to enhance or to materialize the solution for the identified need. The authors of the strategy introduce a so-called "buyer utility map", which outlines the levels companies can pull in order to provide utility to their customers, and at the same time, aid companies in identifying the full range of utility proportions that a product and/or service can offer[11]. The six stages of the buyer experience cycle focus on the buyer's total experience starting from the (1) purchase, (2) delivery, (3) use, (4) supplements, (5) maintenance, and (6) disposal, while the six utility levers, namely (1) customer productivity, (2) simplicity, (3) convenience, (4) risk, (5) fun and image, and (6) environmental friendliness, cut across these stages and describes how the companies may unlock utility for their customers according to each buying phase [12].

Results in the study of Gloet and Terziovski [13] suggest that the process of business innovation greatly depends on the available innovation ideas, the present management, and the available human capital responsible for research and development. The feasibility of a business depends largely in the global markets along with the external variables, and these external factors are categorized in varying levels starting from the individual level (e.g. customer preferences, employee competence), the industry level (e.g. codes of conduct, industrial standards, etc.), and society level (e.g. market regulations, cultural aspects, etc.) [14]. The business ontology of Osterwalder and Pigneur [15] considers that business models consists four pillars, namely (1) product innovation, (2) customer relationship, (3) infrastructure management, and (4) financial aspect. The pillar of Product Innovation pertains to the valued commodities offered by the establishments to its consumers. The idea of product innovation lies in the consistent pursuit of organizations to develop new products and/or redevelop existing products to provide upgraded features and specifications. The Customer Relationship pillar describes the characteristics of the target consumers, the channels of communication systems used to reach out the consumers, and the type of relationship an establishment aims to build with a customer. Meanwhile, Infrastructure Management pillar describes the organization's capabilities, configuration of value, and the partnered networks necessary in order to create the product and/or service value that meets the consumers demand. Lastly, the Financial Aspect focuses on the facilities available and responsible in generating monetary resources that support and finance the entire operation of the organization.

On the other hand, Value Innovation model explains the shaping of an industry's condition by introducing value to buyer through innovation instead of being dictated by the circumstances and conditions presented by the business industry [16]. Value innovation logic enables organizations to consider strategic innovations different from the existing traditional approaches in order for them to dominate the existing market in an unoccupied market space. Contrary to the common misconception, the new market is not born from the application of new technology, but by the application of strategic innovation, which is the capability of an establishment to redefine its customer base and its market position vis-a-vis its rivals [17]. In fact, in the key concept of blue ocean strategy, value innovation, is achieved by both the buyer and the company in their simultaneous pursuit of differentiation and low cost .

According to Christensen & Raynor [18], there are two different kinds of value innovations: (1) sustaining innovations or the so-called incremental innovations, and (2) disruptive innovations also known as radical innovations. The nature of a Sustaining Innovation targets the demanding, high-end customers with better performance than what were previously available using incremental innovations (e.g. annual improvements of designs of mobile phone companies, etc.) and creating significantly differentiated product propositions in the same industry [19]. Tallman [20] views incremental innovation as a strategy of maximizing or improving the current features or designs of an existing product. Most R&D division of a company handles incremental innovation management; although, it varies from industry to industry and the type of innovation can immediately be replicated by pursuing competitors. The division of R&D following incremental innovations must be well updated on the changes happening in the market, especially with the different introductions of technology innovations [4].

On the other hand, disruptive innovations offer new benefits in value propositions and at the same time disrupt original-market to the new-market by the creation of entirely new value network [21]. According to Spithoven [22], radical innovations influence the chain of business enterprises through a disruptive character largely affecting the existing competition because it immediately introduces innovation that creates an alternative demand to the existing product. One good illustration is the introduction of iPod by Apple, that immediately made Discman and Walkman players obsolete in the market. Bassett-Jones [22] states managing radical innovation must incorporate highly complex organizational structure in order to embrace diversity and prevent loss of competitiveness.

Another innovation management model, the Four Systems Level in the Innovation Management Model, by Bean and Radford [23], demonstrates interrelated subsystems that must create something of value to its market place or society, otherwise, the other phases becomes nullified and irrelevant. In System I, the base subsystems are comprised of product development teams, process development team, and manufacturing teams which conduct the function of the operations. In System 2, the subsystems focusing on provision of shared resources in terms of human capital, monetary and information resources are comprised of legal, human resources, information service providers, library, accounting, communication networks, advertising and promotions team, market researchers, and others more. In System III, the subsystems in charge of strategic and managerial decisions focus on activities, such as operational goals, operational strategies, negotiation and compliance function, resource allocation decision and common decisions. System III is the base of innovation management that provides direction, resolves conflict and provide appropriate decision-making for resource budgeting. Lastly, in Systems IV, the purpose of the subsystems is to create the environment for innovation through activities involving long-term goals, long-term strategies, policies and organizational values. The systems III and IV sometimes perform combined functions depending on the company size – multinational firms normally segregate the tasks of Systems IV, while smaller organizations merge the two subsystems.

One-Off Innovation is the model followed mostly by multi-product companies, and those engaged in trial-and-error product development. The concept of One-Off Innovation believes that an innovation must be profitable enough for its own development and at the same time, for any past failures encountered [24]. The process must target innovations with high profit earning capacity in order to finance all the probable failures. Some organizations would create a risk buffer on their cost margins as a cushion in case their innovations fail to succeed. According to this model, innovation breaks away from a known reference, such as competition, operating cost increases, etc., yet the existence of innovation can be sustained through basic languages known performance, technology, and others [25].A single firm or those with extended frameworks, such as partnerships and others, practice one-Off Innovation Model. One example of this is the story of Nylon discovery wherein the innovator would have to first rent for the materials before he led to the discovery of nylon, which is now under continual improvements in the performance of both product and manufacturing [24].

The laissez-faire model considers the processes that result to idea of developing an innovation are beyond the capacities and skills of the collective management [29]. The model distinguishes two types of actors: (1) the Entrepreneurs and (2) the Managers. The concept of innovation is handled more efficiently by the entrepreneurs and innovators present in the organization. On the other hand, the managers are the ones tasked to perform innovations in terms of strategies, enterprising, marketing, and basically, managing the innovations. In this model, the performance and success of innovations solely stem from the entrepreneur, and that the managers play little credit in the totality of innovation's success. The model is rarely used in the contemporary innovation management not only because of its little recognition to the top management, but most importantly, its limiting view on innovation as solely a technological innovation [25]. Clearly, there are other forms of innovations that arise according to other innovation models (e.g. Blue Ocean Strategy, Value Innovation, etc.), and these innovations are dependent on various factors not only the innovators can provide.

In another model of innovation known as the Black Box model, by Rosenberg in 1982, the fundamental belief states that it is possible to act on the innovation process as if it is a black box without actually describing itself. In this model, the process of innovation is seen as a black box, which implies simplicity in viewing and considering the details of innovation management. Questions like "how the innovation is to be financed?" and "how to encourage private research?" become irrelevant in this model, since the idea is to assume the means of action without having to go through the details about the subject [25]. To show an example of this model, various studies have been conducted to determine the exact correlation between the growing R&D expenditures whereas the productivity remains stagnant. According to Le Masson [25], throughout the context of the study conducted, it may be difficult to actually determine the quantifiable correlations of these two forces: (1) R&D operating expense and (2) production; although, there is an existing reality stating that such is a part of innovation. Therefore, following this model, it is best to move following the assumptions present in the reality when details are not entirely available or possibly obvious.

Lastly, the Aachen Innovation Management (AIM) Model, introduced by Fraunhofer, represents a framework for the issues of innovation management that enables identification of gaps and focuses of readjustments. AIM model views innovation management as a step-by-step process that starts from a philosophy of innovation. This is normally true to businesses who build their business concepts on the company's vision and mission statements. The goal of AIM model is to achieve a stable innovation capacity after following different phases of management approaches characterized by their own unique sets of elements [26]. After conceiving the philosophy of innovation, the normative management phase begins focusing on the areas of corporate governance, corporate policy, and corporate culture. This is the foundation of the phases where information on the organization's goal for innovation is formulated, policies are considered, and organizational culture is incorporated. The next phase involves the strategic management phase where the innovating organization starts the planning of innovation following leadership behaviors. Lastly, the operative management phase, wherein the focus is the innovation process and the identification of the market's readiness for the innovation [27].

Innovative Projects in the Metallurgical Sector

There have been various innovations in the metallurgical sector processes that have in many cases established the standard for all metallurgical companies worldwide. Over the recent years, there have been assessments, design, construction and start-up for iron and steel mills. A steel mill is an industrial plant for the manufacture of steel. The innovations in support for innovations in the mills include melting reduction using corex. By avoiding the use of coke, corex makes it possible to save the investment costs of coke ovens. Reheating furnaces has also been saved by using direct rolling and lower thickness slabs. The length of the rolling train is reduced as less reduction is required from the thin slab. Moreover, continuous linking of downstream pickling and cold rolling allow the production cycle to be further compacted [28].

In hot rolling metal services, current innovations include Greenfield site construction, installation of individual new mills and production lines for standalone Greenfield sites, and brown field expansions, upgrades and production optimization. Brownfield sites refers to any abandoned or underutilized site where redevelopment, reuse or expansion has not occurred due to the presence or potential presence of pollution in the soil, buildings or groundwater that requires investigation or remediation before or in conjunction with the restoration, redevelopment, reuse and expansion of the property [28], steel mills which were previously used for business in brownfield sites have been upgraded to achieve superior returns.

Specialized know-how and patented technologies to enhance safety in handling metallurgical facilities, more environmentally friendly that is more competitive in terms of minimum capital and operating costs per unit of output have also been invented. For instance, the introduction of tantalum surface alloy technology produces the most corrosion resistant material that is commercially available today in the metallurgical sector. This technology has solved the problem of project engineers safety and cost by minimizing chances of corrosion. Other technologies are namely water-cooled elements for furnace walls and roofs, electrode columns, slipping systems and hydraulics, feed systems, transformers and bus, water-cooled tap holes and power control computer systems. The different types of furnaces include the submerged electric arc furnaces, flash smelting flash converting, rotary furnaces among others that are still under development [29].

Logistics simulation was recently introduced in the metallurgical sector. Logistics simulation is the management of the predictable flow of resources in order to meet the requirements of customers or corporations. This was facilitated by the competitive nature of business in the metal industry that is mostly capital intensive which combines metallurgical and mechanical processing steps to produce a wide range of products [30]. Simulation is used to accurately quantify plant capacity to maximize project returns for both Greenfield site plants and brown field retrofits. In addition, simulation is also used to optimize capital expansion plans and operating strategies.

Iron ore pelletizing, which refers to the act of forming iron pellets or small rounded or spherical iron balls, provide that provide the lowest capital investment and operating costs has been invented and adopted in the sector [31]. Technology selection and process definition in the design of pellet plants aid in assisting clients to develop the best investment options in terms of pellet demand, raw materials and energy availability.

In mining and mineral processing, high specialized services in the area of resource geology, mine engineering, data management, mine technical computing and mineral processing are offered. The sector now provides a complete range of services to the mining industry and allows integrated application of all aspects of resource project development through geological modeling to mine optimization and design, process optimization and mill design

Primary non-ferrous smelting technologies that have been developed are used in the world today besides using brush-arc operation of electric smelting technologies. Moreover, the sector provides a detailed equipment designs for pyrometallurgical and hydrometallurgical processes, such includes the world's highest powered electric ferronickel smelting furnaces and autoclaves [31].

Case Study of Innovation Management Models in the Metallurgical Sector

We selected 180 companies which were divided into three equal groups, each group using a different model of innovation management (the models identified as being used are blue ocean strategy, four systems level, one-off innovation). All the firms which were taken into consideration belong to the same sector of activity, the metallurgical one, which deals with the technology of metals that involves studying the physical and chemical behavior of metallic elements, their inter-metallic compounds and their mixtures which are called alloys. It also entails studying he way science is applied in their practical use. After applying a certain model of innovation management, each company has initiated a number of innovative projects over the last three years (2010-2012 is the period used in doing the necessary computations). The reasons why these companies were selected are that they are from the same sector of activity, they are very innovative and because they were compatible in such a way that each group uses a different model of innovation management and all the firms from the same group use the same model. Our study tries to identify if there is a significant connection between the type of model used and the number of successful innovative projects. The data was collected by email. The method we used is called ANOVA, which tests the difference between the means of more than two means. So, in our case, the research hypothesis is that the number of innovative projects is significantly influenced by the type of innovation management model used. The null hypothesis is that the number of innovative projects is not significantly influenced by the type of innovation management model used. In figure 1, we presented the graphical interpretations of the research hypothesis and of the null hypothesis. If the null hypothesis is true, this means that the three groups come from the same population, so the three means are equal ($\mu_1=\mu_2=\mu_3$) and the distributions are overlapped (fig1). If the research hypothesis is true, the three groups are different ($\mu_1\neq\mu_2\neq\mu_3$) and they come from different populations (fig1).

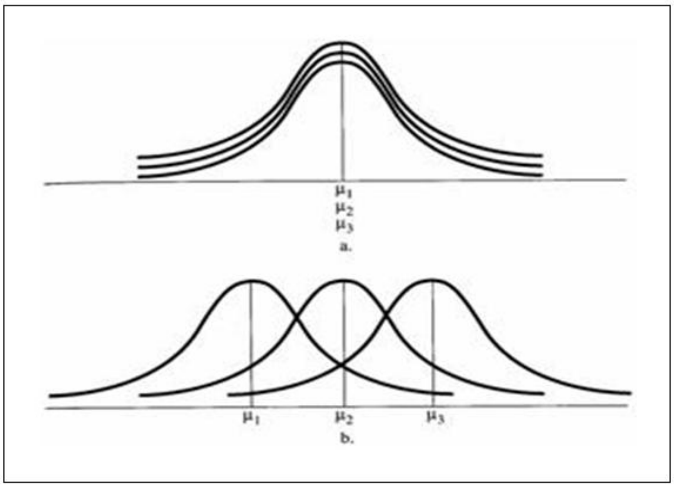

Fig. 1: the graphical interpretations of the research hypothesis and of the null hypothesis. If the null hypothesis is true, this means that the three groups come from the same population, so the three means are equal ($\mu_1=\mu_2=\mu_3$) and the distributions are overlapped (fig1.a). If the research hypothesis is true, the three groups are different ($\mu_1\neq\mu_2\neq\mu_3$) and they come from different populations (fig1.b).

Popa [32]

We applied ANOVA in three different years (2010, 2011, 2012), but we did it separately for each year. The reason why we did not go for ANOVA with repeated measures is that there is no connection between the number of innovative projects and the time passed since a certain innovation management model has been adopted, so there's no point in taking into consideration the evolution of the number of projects over the time, we're only interested whether or not the numbers of projects varies according to the model. The reason why ANOVA has been done three times is to have a more solid ground for our final conclusions.

Analysis for 2010

Table 1: The "Descriptives" table displays the figures for total population, blue ocean group, four systems group

	N	Mean	Std. Deviation	Std. Error
Blue ocean	60	5.8000	.75465	.09742
Four systems	60	3.6000	.80675	.10415
One-off	60	.8000	.75465	.09742
Total	180	3.4000	2.19089	.16330

The "Descriptives" table displays the figures for total population, blue ocean group, four systems group, one-off group and their corresponding means, standard deviations and standard errors. There are three equal groups of sixty companies, therefore the total population counts a hundred and eighty members. The average number of innovative projects generated by the blue ocean group is 5.8, which is the biggest mean from this year, considering that the other values for four systems group and one-off group are 3.6 and 0.8. The average number of projects for the whole population is 3.4.

Table 2: Test of homogeneity of variances (Nr_projects)

Levene Statistic	df1	df2	Sig.
.894	2	177	.411

The significance value (Sig.) for the test of homogeneity of variances(Levene Statistic) is 0.41, which is bigger than the significance level(5%), this means that our data allows us to apply ANOVA.

Table 3: ANOVA (Nr_projects)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	753.600	2	376.800	631.568	.000
Within Groups	105.600	177	.597		
Total	859.200	179			

The significance value is below the confidence level(0<0.05), this means that the research hypothesis is accepted for 2010, so there is a significant connection between the number of innovative projects and the innovation model applied, Table 3.

Post Hoc Tests

Table 4: The post hoc tests reveal the fact that there is no statistical difference between the number of projects generated

	(I) Model	(J) Model	Mean Difference (I-J)	Std. Error
Tukey HSD	Blue ocean	Four systems	2.20000*	.14102
		One-off	5.00000*	.14102
	Four systems	Blue ocean	-2.20000*	.14102
		One-off	2.80000*	.14102
	One-off	Blue ocean	-5.00000*	.14102
		Four systems	-2.80000*	.14102
Scheffe	Blue ocean	Four systems	2.20000*	.14102
		One-off	5.00000*	.14102
	Four systems	Blue ocean	-2.20000*	.14102
		One-off	2.80000*	.14102
	One-off	Blue ocean	-5.00000*	.14102
		Four systems	-2.80000*	.14102
Bonferroni	Blue ocean	Four systems	2.20000*	.14102
		One-off	5.00000*	.14102
	Four systems	Blue ocean	-2.20000*	.14102
		One-off	2.80000*	.14102
	One-off	Blue ocean	-5.00000*	.14102
		Four systems	-2.80000*	.14102

The post hoc tests reveal the fact that there is no statistical difference between the number of projects generated by the companies which apply four systems and one-off models, but there is a difference between these companies and the ones that implement blue ocean.

Means Plots

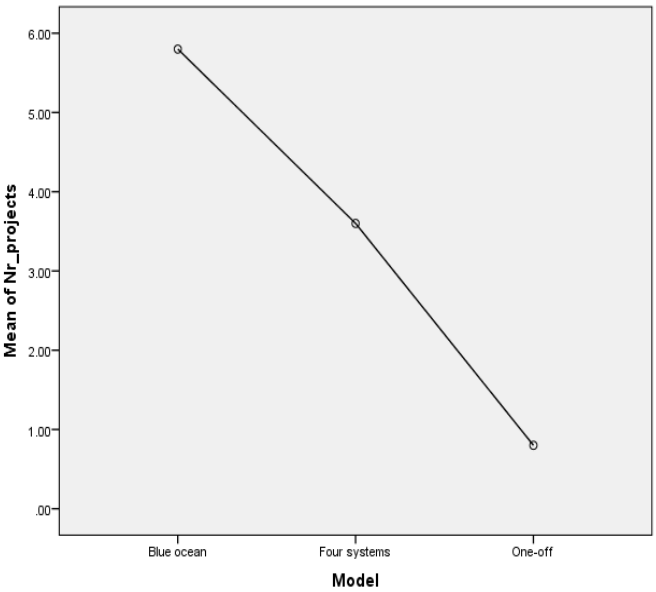

Fig. 2: The means plots represent the graphical interpretation of the means computed in the descriptive table. The blue ocean and one-off groups are the extremes, with the biggest and the lowest mean of projects.

Analysis for 2011

Table 5: The population and the groups are the same but we can see that the means are bigger than the ones from the previous year for all the groups, but the hierarchy is still the same: blue ocean, four systems and one-off.

Table 6: Test of homogeneity of variances (Nr_projects)

Levene Statistic	df1	df2	Sig.
.683	2	177	.507

The significance value is bigger than 0.05, so the data collected for 2011 is compatible with ANOVA.

Table 7: ANOVA (Nr_projects)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	910.000	2	455.000	206.500	.000
Within Groups	390.000	177	2.203		
Total	1300.000	179			

The significance value is smaller than 5%, so the null hypothesis is rejected again.

Post Hoc Tests

Table 8: Post hoc tests (Regarding the post hoc tests, it's the same situation as in the previous year)

	(I) Model	(J) Model	Mean Difference (I-J)	Std. Error
Tukey HSD	Blue ocean	Four systems	2.50000*	.27101
		One-off	5.50000*	.27101
	Four systems	Blue ocean	-2.50000*	.27101
		One-off	3.00000*	.27101
	One-off	Blue ocean	-5.50000*	.27101
		Four systems	-3.00000*	.27101
Scheffe	Blue ocean	Four systems	2.50000*	.27101
		One-off	5.50000*	.27101
	Four systems	Blue ocean	-2.50000*	.27101
		One-off	3.00000*	.27101
	One-off	Blue ocean	-5.50000*	.27101
		Four systems	-3.00000*	.27101
Bonferroni	Blue ocean	Four systems	2.50000*	.27101
		One-off	5.50000*	.27101
	Four systems	Blue ocean	-2.50000*	.27101
		One-off	3.00000*	.27101
	One-off	Blue ocean	-5.50000*	.27101
		Four systems	-3.00000*	.27101

Means Plots

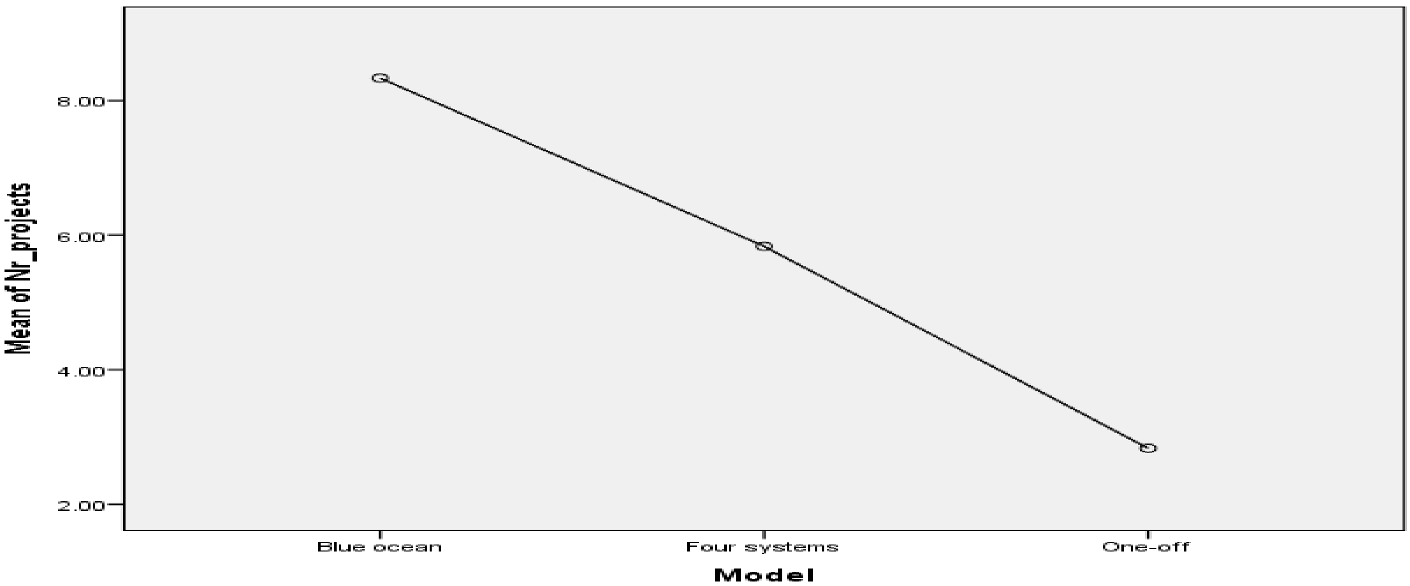

Fig. 3: The blue ocean generated the biggest number (8.3), but the four systems group had the biggest increase(2.2) in comparison with 2010.

Analysis for 2012

Table 9: The population and the groups are constant. Regarding the means, we have the biggest mean for the whole population so far, mainly due to the average number of projects generated by the companies which apply the one-off model

	N	Mean	Std. Deviation	Std. Error
Blue ocean	60	6.5000	1.72224	.22234
Four systems	60	8.0000	1.54042	.19887
One-off	60	11.0000	1.93101	.24929
Total	180	8.5000	2.55115	.19015

Table 10: Test of homogeneity of variances (Nr_projects)

Levene Statistic	df1	df2	Sig.
.527	2	177	.591

Since the significance value (0.59) is bigger than 5%, we can proceed to ANOVA.

Table 11: ANOVA (Nr_projects)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	630.000	2	315.000	104.215	.000
Within Groups	535.000	177	3.023		
Total	1165.000	179			

Our research hypothesis is accepted due to the fact that the “Sig.” value is below the significance level.

Post Hoc Tests

Table 12: Post hoc test (This year, there is no significant difference between the number of projects generated by the companies which apply blue ocean and four systems, but there is a difference between them and the one-off group

	(I) Model	(J) Model	Mean Difference (I-J)	Std. Error
Tukey HSD	Blue ocean	Four systems	-1.50000*	.31742
		One-off	-4.50000*	.31742
	Four systems	Blue ocean	1.50000*	.31742
		One-off	-3.00000*	.31742
	One-off	Blue ocean	4.50000*	.31742

		Four systems	3.00000*	.31742
Scheffe	Blue ocean	Four systems	-1.50000*	.31742
		One-off	-4.50000*	.31742
	Four systems	Blue ocean	1.50000*	.31742
		One-off	-3.00000*	.31742
	One-off	Blue ocean	4.50000*	.31742
		Four systems	3.00000*	.31742
Bonferroni	Blue ocean	Four systems	-1.50000*	.31742
		One-off	-4.50000*	.31742
	Four systems	Blue ocean	1.50000*	.31742
		One-off	-3.00000*	.31742
	One-off	Blue ocean	4.50000*	.31742
		Four systems	3.00000*	.31742

Means Plots

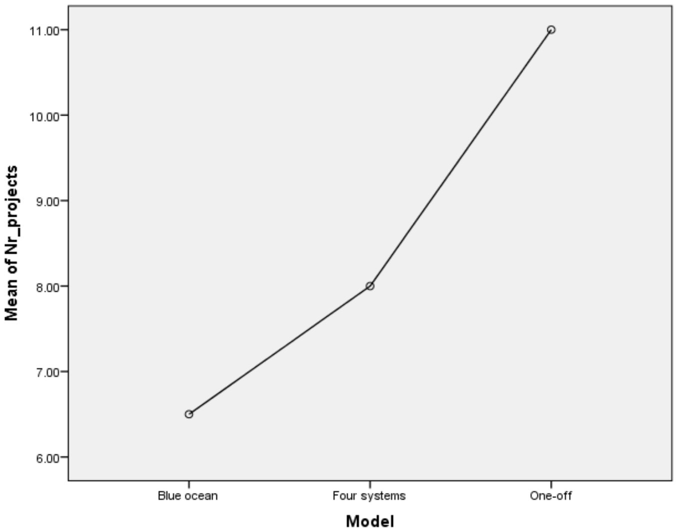

Fig. 4: In 2012, the companies which apply the one-off model have the highest mean of innovative projects. We can also see that the four systems group has always been in the middle from this point of view and this year is no exception.

Results and discussion

In the "Descriptives" tables we can see that our population counts 180 members, which are divided in three groups, each one belonging to a different innovation management model(the first one to Blue ocean, the second one to Four systems and the third one to the One-off model). The "Descriptives" also provides the values for the mean, standard deviation and standard error. The values of the means are graphically presented in figures 6, 11, and 16, the so-called "Means plots", where the three models are on the horizontal axis and the their correspondent mean value(average number of projects generated inside each group) is located on the vertical axis. Before we check whether or not our research hypothesis is true, we must see if the data which was collected passed the test of homogeneity of variances. In order to do that, we must take a look at figures 3, 8 and 13 and observe that the significance value(Sig.) is bigger than 5%, the confidence interval(fig.3: 0.41>0.05; fig.8: 0.5>0.05; fig 13: 0.59>0.05). Therefore it's obvious that the set of data passed the homogeneity tests for all the periods taken into consideration and we can move forward with the ANOVA procedure. It is also important to specify that in the "Test of homogeneity of variances" tables, the software computes the degrees of freedom (df1 and df2). Df1 are the intergroup degrees of freedom which are calculated as the number of groups minus one and df2 are intragroup degrees of freedom (total population minus number of groups). Their values remain constant during all the periods because the number of the total population and the number of groups don't suffer any changes. Going back to ANOVA, we should take a look at figures 4, 9 and 14 and observe that in all three cases the significance value(Sig.) is below 5%, meaning that the research hypothesis is true, so the number of innovative projects a company from the metallurgical sector generates, is significantly influenced by the innovation management model it applies. This implies that there are at least two means μ_i and μ_j($i \neq j$ and $i,j \in [1,3]$) which are different($\mu_i \neq \mu_j$), but ANOVA doesn't specify which these means are, so there are four scenarios: $\mu_1 \neq \mu_2$, $\mu_1 \neq \mu_3$, $\mu_2 \neq \mu_3$ or $\mu_1 \neq \mu_2 \neq \mu_3$. A Post Hoc analysis should be done next by applying some tests: Tukey, Scheffe and Bonferroni. In 2010 and 2011(fig. 5 and 10) we can see that there is no statistical difference between the number of projects generated by the companies which apply Four systems and One-off models, but there is a difference between these two groups and the group of companies which apply Blue ocean. In 2012(fig. 15), there is no statistical difference between the number of projects generated by the companies which apply Four systems and Blue ocean models, but there is a difference between these two groups and the group of companies which apply One-off.

Conclusion

The significance of innovation management for the modern business organization cannot be overemphasized. There is a growing recognition of the key function played by innovation in the stimulation of modern businesses. Business innovation cuts across various sectors of the world's economy and plays a major role toward developing and fostering growth opportunities. The evolution of businesses across time has necessitated managers not only to invest heavily in research and development, but also to generate innovations that will revolutionize the existing corporate structure. Many innovative ideas in the business world have come up as a result of thorough research and development. Each business wants to stay ahead of its competitor or wants to be unique in a given way in order to achieve recognition or a given status in the modern world. Merging entrepreneurial approach with business innovation will instill a climate of economic growth in the corporate market. Currently, the businesses without innovation initiatives are inclined to underperform and, because of this cycle, to remain cornered. In order to adapt to the new transition of internet era, modern businesses must serve the individual customer speedily, entirely, and on an initial contact basis, appreciate and have an awareness of global electronic commerce, and develop a unique organizational culture. It is also important to realize that innovation management in the modern businesses presents differences due to factors such as company's management style, maturity of the industry or dynamics of the market, and business techniques. The society that we are presently in has shifted from the agricultural approach to include production of goods and services. The new economy has been mainly propelled by information technology and internet, coupled with business management. These two characteristics have made the global economy highly competitive for. Hence, innovation management will continue to rapidly change as modern businesses respond to radical changes in the business environment.

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