St. Petersburg University
Graduate School of Management

Master in Information Technologies and Innovation Management

DETERMINANTS OF INNOVATION PERFORMANCE IN RUSSIAN COMPANIES

Master's Thesis by the 2nd year student

Concentration — Master in Information Technologies and Innovation Management

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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

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Описание цели, задач и основных результатов	Цель исследования состоит в определении детерминант инновационной продуктивности в Российских компаниях. Для достижения поставленной цели, на основе теоретического бекграунда была разработана теоретическая модель взаимосвязи между инновационной продуктивностью компании и рядом детерминант. Тестирование теоретической модели было проведено на основе многофакторной регрессионной модели. Эмпирическое исследование было основано на выборке из 148 Российских компаний, имеющих разный размер и отраслевую принадлежность. Регрессионный анализ показал, что имеет место положительная взаимосвязь между затратами на НИОКР, маркетинг, характеристиками инновационной стратегии компании и продуктовой инновацией в компании, а также отрицательная взаимосвязь между затратами на обучение сотрудников и продуктовой инновацией в компании. Кроме того, имеет место положительная взаимосвязь между характеристиками инновационной стратегии компании, затратами на обучение сотрудников и процессовой инновацией в компании.
Ключевые слова	Инновации, модель инноваций на уровне фирмы, детерминанты инновационной продуктивности

ABSTRACT

Master Student's Name	Artemii Uverskii
Master Thesis Title	“Determinants of innovation performance in Russian companies”
Faculty	Graduate school of management
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Year	2016
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Description of the goal, task and main results	The goal of the research is to identify determinants of innovation performance in Russian companies. To achieve this goal, the theoretical model was constructed on the basis of thorough review of existing studies. The model outlined relationship between the company’s innovation performance and a set of determinants. Theoretical model was tested using multiple linear regression analysis on the sample of 148 Russian companies of different size and industry. The regression analysis identified positive correlation between the company’s R&D expenses, marketing expenses, features of innovation strategy and product innovation, as well as negative correlation between expenditures on employees training and product innovation. Furthermore, there is a positive correlation between expenditures on employees training, features of innovative strategy and process innovation.
Keywords	Innovation, model of innovation at the firm’s level, determinants of innovation performance

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INTRODUCTION

Innovation is important for companies and economies. It makes the company more competitive, creates new markets and helps to reduce costs. Innovation is a source of competitive success (Drucker 1985). Crepon, Duguetb and Mairessec (2006) created and tested a model that proved that firm productivity is positively correlated with the company's innovation performance. Consultancy companies, for instance, PwC recognize innovation as a driver for rapid revenue grow and a factor to maintain long-term enterprise growth (PwC 2013). The economy of the country also benefits from innovations. Many years ago, Schumpeter (1942) explained that innovation is a force that help the economy to progress: innovation incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. Even though Russia was not so rapid in understanding of importance of innovation, our country nowadays pays more and more attention to it. For instance, the Russian government will soon introduce the law that will oblige state-owned companies to implement innovations and order research projects in Russian educational and scientific centers. Moreover, the success of innovation programs in the state-owned companies, such as Aeroflot, RZD, and Gazprom, will affect at least 10% of total executives' bonus (Kommersant 2016).

This rearches aims to understand what factors are correlated with the company's innovation performance. Since the 1950s, there has been a proliferation of innovation models, each purporting to explain and/or guide the process of innovation within industrial firms. Rothwell (1994) analysed of state-of-the-art models of innovation processes at the firm level and classified these models into five generations in his article "Towards the Fifth-generation Innovation Process". He identified several points of weaknesses in these models. First, previous models provide one best way of innovation process, eliminating alternative paths that do exist. Second, most of the models assume that the companies behave too rationally, being able to hypothesize a solution to an innovation problem, such as a new product development, and then systematically solve the problem, using a standard toolkit such as design thinking, prototype testing and market research – the assumption that does not always met. Third, the models lack a coherent theoretical base, which is important because it can help to put innovation within the wider organizational and strategic context in which it belongs. Forth, all the models deal with innovation leaders, neglecting latecomers. This fact is especially important for scientist who research innovation in developing countries, e.g. Russia, since many companies there do not develop innovations themselves, but rather adopt them from abroad. Fifth, the majority of models deals describe processes in the large corporations, not paying attention to medium and small companies, where innovation process usually do not have any formal stages and domain.

In order to address the issues with previous models, the attributive model of innovation (AMI) was created. This model outlines what qualities the company should have to be successful in innovation. The main difference with the previous models is that the attributive model does not aim to depict any particular process that companies should follow, but rather identify key attributes that the company should have to be successful in innovation. For instance, a small company may not even have R&D department. Therefore, for such companies it is definitely inappropriate to apply existing models. The attributive model fits both innovation leaders and latecomers, and both large corporations and small companies, because the determinants of AMI neglect organizational structure and encompass sources of innovations far beyond only R&D department.

In order to prove the attributive model statistically, a linear regression was conducted in IBM SPSS on cross-sectional data about 148 Russian companies. The regression identified correlation between some determinants of innovation performance (company's spending on R&D, training, and marketing preparation for innovative products; efficiency of the company's innovation strategy) and the company's innovation performance (product innovation, process innovation). However, additional studies are required to establish causality besides correlation.

1 THEORETICAL RESEARCH ON DETERMINANTS OF INNOVATION PERFORMANCE

1.1 Nature, definition and taxonomy of innovation

In order to study innovation successfully, we need to come up with common definition of this phenomenon first, since there is no common definition of innovation neither abroad, nor in Russia. For instance, Maryanenko (2008) provided the results of the survey conducted among managers: the definition of innovation varied from manager to manager: 26% of respondents considered innovation a solution that identifies and address unsatisfied customer needs, 23% - a progress or advancement that enables to do something better, and 5% - a discovery or something connected with scientific revolution. Not only practitioners have in mind different definitions of innovation, but also scientists. To solve this problem, some scientists conducted research on innovation definition. For example, Cumming (1998) conducted a survey in which he analyzed definitions of innovation that were published from the end of 1960s. He came up with two broad groups of definitions, each of which used the following basis: first, something new - invention, idea or concept; second, something sellable - implementation or commercialization of the added value. Since there are a great number of opinions what exactly innovation is, but we need to be precise in this discussion, for the theoretical discussion the definition of innovation as "something new" was chosen.

Rycroft and Kash (2000) outlined three types of innovations based on their strength and influence: incremental, major and fundamental. These three types and their influence on industry performance dynamic is depicted on Figure 1.

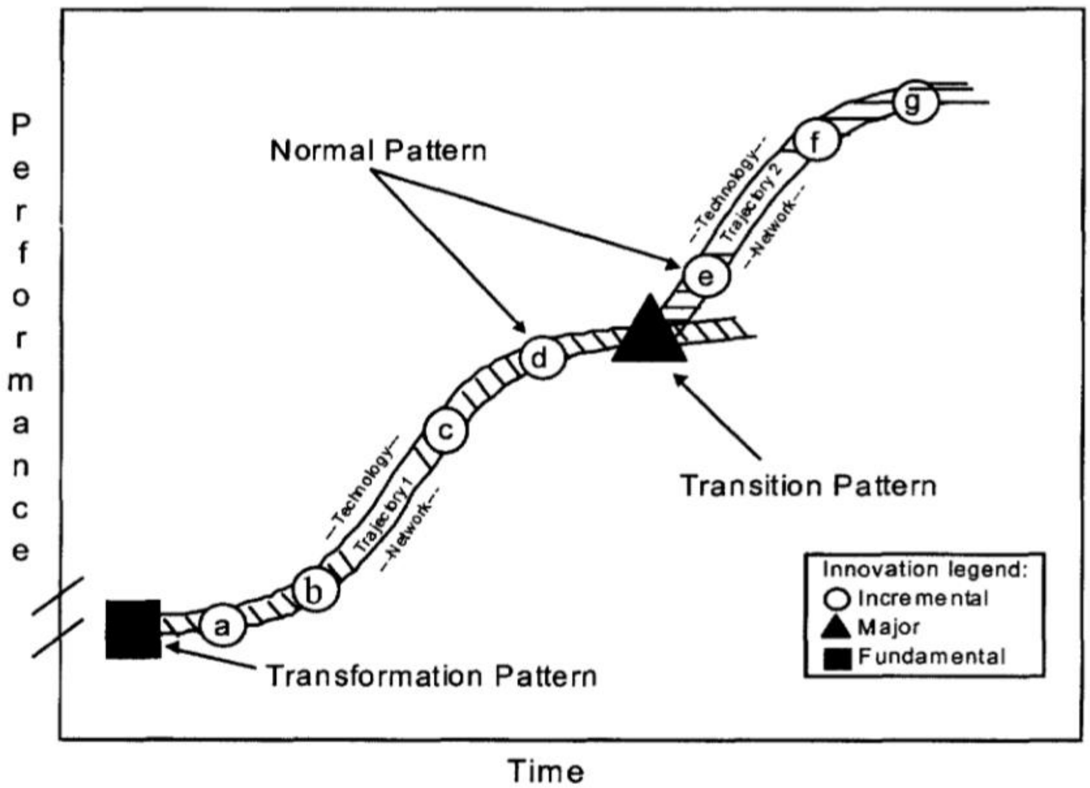

Figure 1. Three types of innovations. Source: Rycroft and Kash (2000)

First, incremental innovations. These are gradual development of existing technologies and goods. These innovations are not an outcome of a purposeful full-scale research, but rather some enhancement of existing technologies. Despite these innovations increase productivity that leads to competitive advantage, they do not change production and marketing dramatically.

Sandeep Kishore uses iPhone as an example of incremental innovation in his article "The power of incremental innovation", published in Wired magazine:

> One of the most successful and recent examples of incremental innovation is the iPhone. While smartphones existed before Apple entered the market, it was mostly the incremental innovations of a larger touchscreen, the app store, various ease of use and an improved overall experience, which enabled the iPhone to be the first in making smartphones mainstream.
>
> Apple then created a whole new ecosystem which made the iPhone a preferred medium for accessing the internet, sending e-mail, finding directions, playing games, conducting online transactions and generally becoming a central part of our daily

> lives. Last year, it shipped 125 million iPhones. Incremental innovation has brought a fundamental change in our behavior and created a market that will be worth $1.6 trillion by 2018.

Uber is another example of incremental innovation. Uber is a taxi company that enables customers to order a taxi through the mobile app. It is much cheaper and convenient than traditional taxi service: the waiting time usually is less than eight minutes, whereas it is around twenty minutes for traditional taxi; the fare is around half as much as that of the traditional taxi. Moreover, you can use Uber even if you do not have neither cash nor a bankcard with you: Uber charges your bank account without physical contact with your card like off-line store, but rather like on-line store, using the card's data.

Incremental innovation contributes much into the global economy development. Bain and Company (2011) estimates contribution of incremental innovations to global GDP by 2020 as $5 trillion. Moreover, Bain regards this incremental innovation, or "soft innovations" in Bain's terms, as one of the eight macro trends that will propel global economic growth over until 2020 by "changing our basic habits, from the way we drink coffee (think mochaccinos rather than drip brew) to the way we buy clothes (with matching outfits delivered to our doorstep rather than shopped for piecemeal in stores)".

Second, major innovations. These are substantial for science evolution inventions or discoveries, but they are one-offs, not systematic ones. Despite they can considerably change market power of existing technologies or create new market leaders, radical innovations cannot significantly affect the entire economy of even any particular industry to elicit technology paradigm shift. E-mail, search engines such as Google and Yandex, social networks, and Wi-Fi illustrate the concept of major innovation. These technologies redefine the competitive landscape, but not as much as to reshape the whole economy or industry.

Third**,** fundamental innovations**.** These innovations lead to technology system changes and elicit drastic changes of existing technologies. These changes influence entire technology clusters, crowding out whole product categories and their producers, and provide particular companies with sustainable competitive advantage through excessive added value.

Heather Whipps diligently describes the impacts of steam engine, which is an example of fundamental innovation, on the world's economy and history in his article "How the Steam Engine Changed the World", published in Live Science on June 16, 2008:

> The simultaneous perfection of the steam engine and the beginning of the Industrial Revolution is a chicken and egg scenario that historians have long debated. The world was becoming an industrialized place before the advent of steam power, but would never have progressed so quickly without it, they argue.
>
> Factories that still relied on wind or waterpower to drive their machines during the Industrial Revolution were confined to certain locales; steam meant that factories could be built anywhere, not just along fast-flowing rivers.
>
> Those factories benefited from one of the world's greatest partnerships — that of Watt and Matthew Boulton, a British manufacturer. Together, they tailored Watt's steam engine to any company that could use it, amassing great fortunes for themselves but also sharing research over vast distances.
>
> Transportation was one of those important beneficiaries. By the early 1800s, high-pressure steam engines had become compact enough to move beyond the factory, prompting the first steam-powered locomotive to hit the rails in Britain in 1804. For the first time in history, goods were transported over land by something other than the muscle of man or animal.

Another example of fundamental innovation is the invention of an airplane. An airplane significantly reduced travel time, enabling more rapid logistics of goods and people. This increase in speed affected not only international trade and economy, but also the perception of speed of life by a mankind, the fact frequently mentioned in belles-lettres.

Major and fundamental innovation concepts are highly connected with the idea of creative destruction, proposed by Schumpeter (1942) in his book "Capitalism, Socialism and Democracy" to explain how the economics is developed under capitalizm. Creative destruction is a "process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one". Schumpeter provides the example of his concept, using retail industry, in which "the competition that matters arises not from additional shops of the same type, but from the department store, the chain store, the mail-order house and the supermarket which are bound to destroy [traditional stores] sooner or later”. Here something new (supermarkets) destroys something old (traditional stores), whereby revolutionizing the economic structure from within. Another example to illustrate the concept of creative destruction is invention of personal computers: introduction of personal computers, led by Intel and Microsoft, destroyed many mainframe computers companies, but revolutionized the whole industry and advanced the whole economy.

Definition and classification of innovations by Oslo Manual, which was used for the research, were created to be used in standardized surveys of firms. According to Oslo Manual, “an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations (OECD 2005)”. It does not matter whether the company created something new in-house, or adopted it from outside (e.g. through patent acquisition). What matters is that the company should implement this “something new” to consider it innovation. The manual distinguishes four different types of innovation: product, process, marketing and organizational innovations. These types and their definitions are outlined on the Figure 2. Since this research was restricted in time and resources, only product and process innovation in Russian companies were studied.

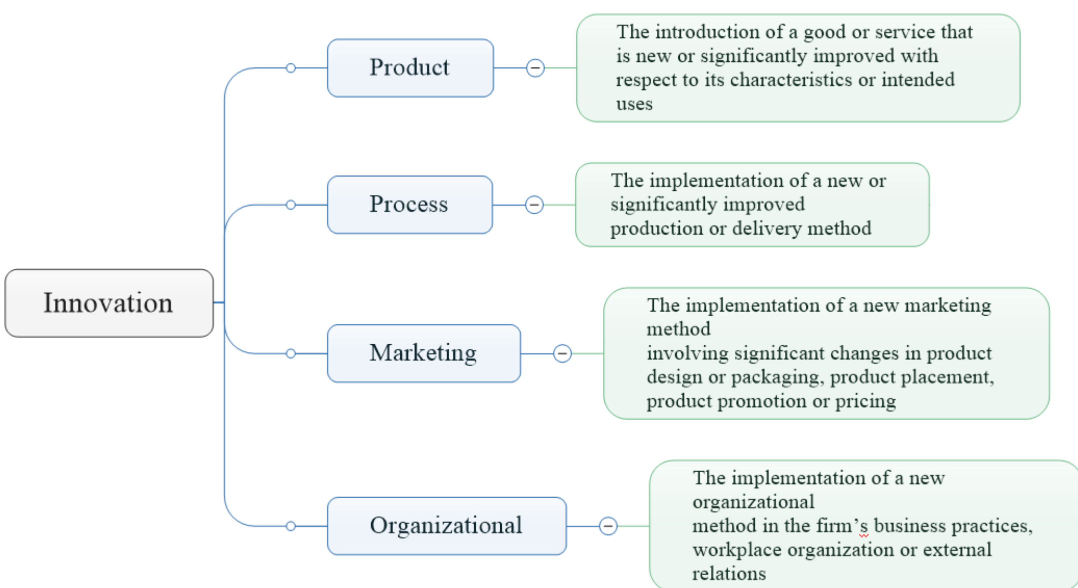

Figure 2. Four types of innovation. Source (OECD 2005)

1.2 Diffusion of innovation

Rogers (1962) proposed a theory that explains the diffusion of innovation through cultures. In his book "Diffusion of innovations", he offers three valuable insights: what qualities make the innovation interesting to population, the importance of communication among peers for, and undertanding of the needs of five different segments of adopters. To begin with, let us discuss the process of individual adoption (see Figure 3).

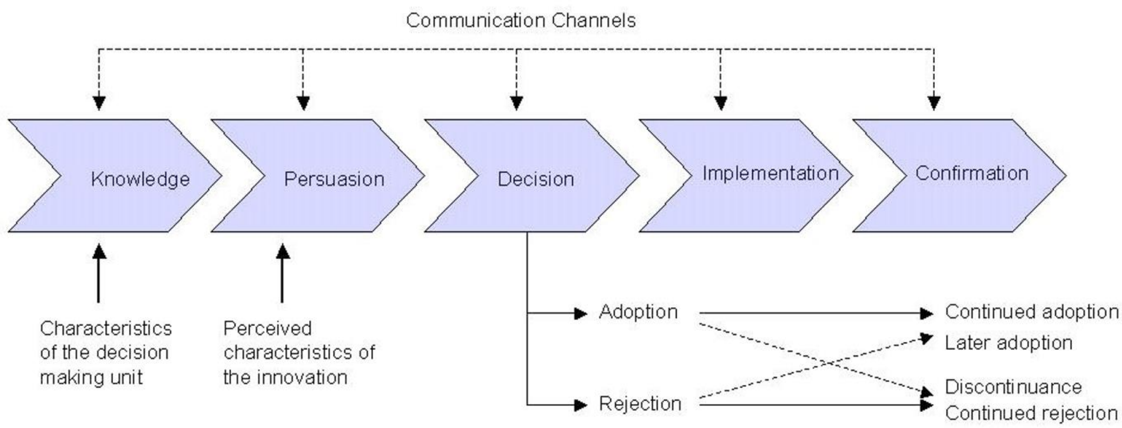

Figure 3. Innovation-decision process. Source: Rogers (1962)

At knowledge step, a person sees the innovation, but does not know a lot about it. Moreover, he is not willing to find out more. However, due to instant information flow about innovation, at persuasion step, the individual becomes interested and starts seeking the information about the innovation. Here play the major role five factors, that affect the individual's perception of the innovation: relative advantage, compatibility, complexity, trialability, and observability (see **Table 1).** At decision step, the individual weights pros and cons of the innovation and make a decision whether he adopts it. Since it is hard, or even impossible, to predict individual behavior, it is hard to get any empirical evidence on this stage. If the person acceps the innovation, he moves on to the implementaion step, at which he individual uses the innovation and evaluates its usefullnes. If the individual considers the innovation still useful, he finalize his decision to use the innovation at confirmation step.

Table 1. Five main factors that influence the innovation adopters. Source: Rogers (1962)

Factor	Describtion
Relative advantage	The benefits of adopting the new technology compared to the costs and in relation to other alternatives
Compatibility	The extent to which adopting and using the innovation is based on existing ways of doing things and standard cultural norm
Complexity	The difficulty involved in using the new product
Trialability	The extent to which a new product can be tried ona limited basis
Observability	The extent that benefits of the new product are observable to everyone

We have discussed the process of adoption – the stages that the individual undergoes to adopt the innovation; now let us discuss the process of diffusion – the group phenomenon that describes how the innovation spreads among whole population. According to the diffusion theory, a population can be broken down into five different segments, based on their willingness to adopt the innovation: innovators, early adopters, early majority and laggards (see Figure 4). For the innovation to be successfully adopted, it should address the needs of these five successive segments. Robinson (2009) explains the characteristics of these segments and provides ways to reach them:

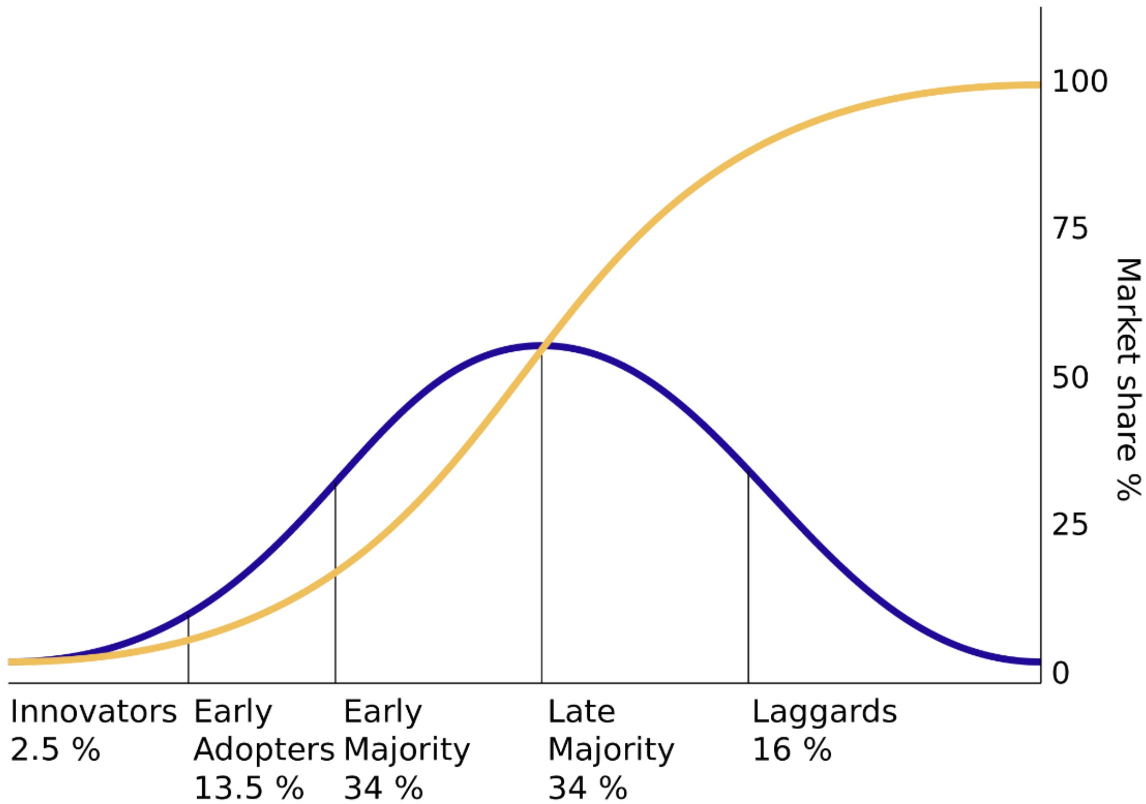

Figure 4. The diffusion of innovations according to Rogers. Each adopters' category accounts for a certain percentage of the market. Source: Rogers (1962)

Innovators are people who love innovation for its newness. They are willing to take risks and have sufficient financial resources to buy new innovative products at the time of their introduced, even if these products have not proved their efficiency and workability. The innovator has to do little, if anything, to capture this type of customers.

Early adopters love innovation for its efficiency. They usually are step ahead of their peers, more successful and wealthy than their peers are. They also like discussing their success and be in the spotlight. There are several ways to get early adopters. The innovator can offer face-to face support, ask their opinion as experts about the product, reward their egos with media coverage and promote them as fashion leaders.

Early majority are pragmatists who want to use innovation, but only if it has been approved by other people who are similar to them. They are risk-averse and cost sensitive, so they value proven, easy-to-use solution. The innovator should stimulate the buzz around product to reach early majority: he can set up competitions among users, use mainstream advertisements that features endorsements by similar folks. Moreover, he should make the product convenient and guarantee its performance.

Late majority art pragmatists who hate risks and are not comfortable with new ideas and products. They follow mainstream standards because they fear not to fit in. That is why the innovator should promote not only product benefits, but also social norms that foster use of the new product. Moreover, the innovator should emphasize that the-state-of-are product is free of any risks.

Laggards are people who see high in adopting a new product. They usually adopt product only if there are no other alternatives. The innovator should restrict their influence on the population.

Rogers' book was a great advancement in the science; however, it was very literary and did not include mathematical representation. Bass (1969) solved this problem in his article "A new product growth for model consumer durables", which became one of the most highly cited papers in the marketing literature. He created Bass Diffusion Model, a simple equation that describes the process of how new products are adopted in a population, to mathematically represent a life-cycle sales curve of innovative product over time.

$$a\ (t) = Mp + [q - p]A(t) - \frac{q}{M}A^2(t), \qquad (1)$$

where

a(t) - adopters (or adoptions) at t (measured in years);

A(t) - cumulative adopters (or adoptions) at t;

M - the potential market (the ultimate number of adopters);

p - coefficient of innovation;

q - coefficient of imitation.

The adoption curve is fully defined by M, p, and q. M can be obtained by market definition and analysis. P and q can be obtained from two sources: analysis of historical data for similar products or regression analysis based on actual sales of the new product during the beginning of the cycle. If neither is available, you can use average (for different historical products) p and q coefficients: p = 0.003 and q = 0.38. When M, p and q are obtained, the equation predicts future sales of the product. For instance, the potential total market for on-line streaming services in Russia (M) and predicted sales in subsequent years were calcualated, using standard coefficients (p, q) (see Figure 5). Knowing the percentage of the market covered in a particular year, it can be predicted when each type of adopters start adopting, so the company can adjust the product's marketing strategy to the needs of the "current" segment. For example, from 2015 to 2019, it is time for early adopters, who make up 13.5% of the total market right after innovators who make up 2.5%, so during this time the on-line steaming company should offer face-to face support, reward early adopters' egos with media coverage and promote early adopters as fashion leaders. These actions help to make the adoption of the product successful.

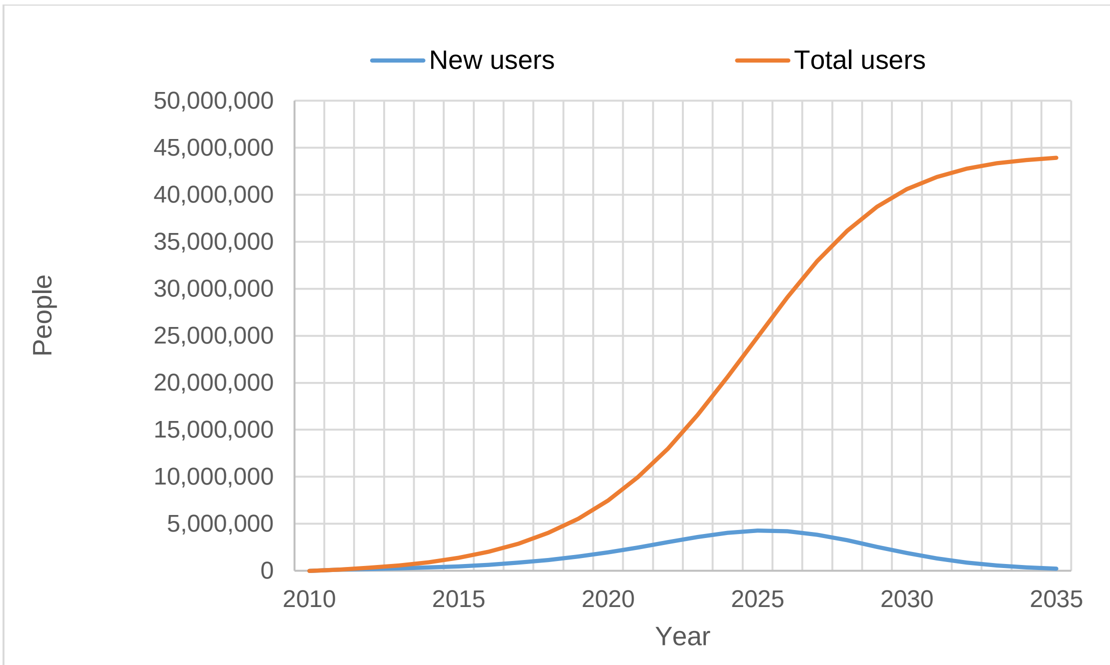

Figure 5. Curve of adoption of on-line streaming services by Russian market

Bass model is widely used in marketing. However, you should keep in mind several caveats while using it. First, it accounts for the adoption of the product, not a particular brand: it may predict the adoption of the mobile phone, but not that of Nokia. Second, q and p coefficients vary across geographic locations. Van den Bulte (2005) argues that the average coefficient of innovation p in Europe and Asia is roughly half of that in the U. S, and the average coefficient of imitation q in Asia is roughly a quarter less than that in the U. S. and Europe. Neglecting this variation may cause severe mistakes in the predictions.

Some scientists believe that there is a "chasm" between early adopters and the early majority users in a product's life cycle (see Figure 6) into which many promising products fall, unable to make the leap. This situation happens because early adopters and early majority value different things in the products and because representatives of different segments generally look at their peers as references, rather than at representatives of the other segment. In order ot overcome the chasm, an innovatior should target a specific niche, “beachhead”, from which he can easier expand into the whole market (Moore 1991).

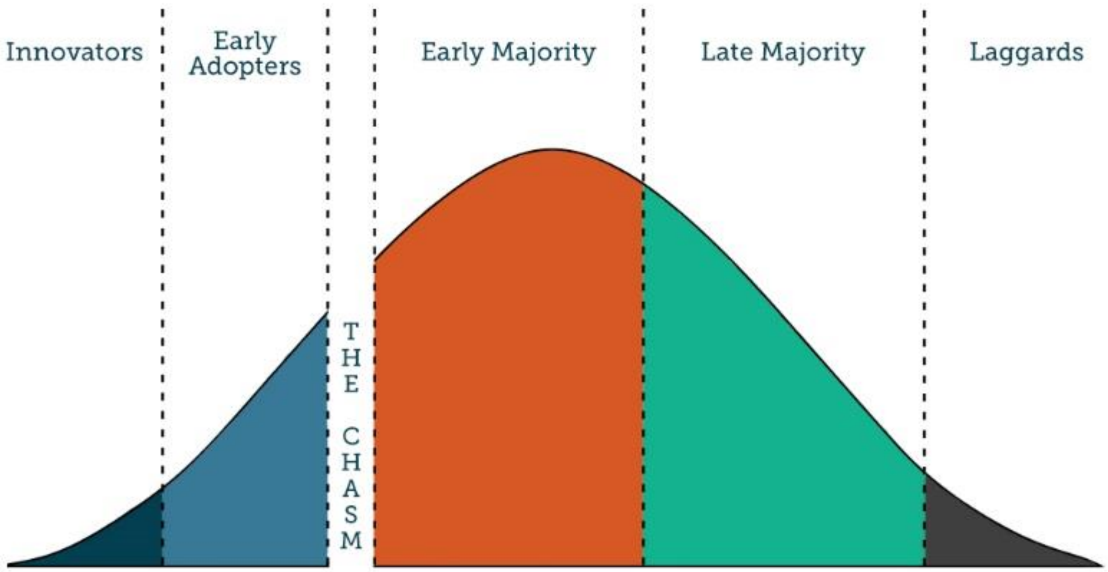

Figure 6. The chasm. Source: Moore (1991)

It is interesting to mention that the creator of diffusion theory, Rogers, denies the chasm. Nethertheless, the existence to the chasm was proven by several researches, one of which is a research by Chandrasekaran and Tellis, conducted in 2011 to study the other related phenomenon called saddle. A saddle is a “phenomenon characterized by a sudden, sustained, and deep drop in sales of a new product, after a period of rapid growth following takeoff, followed by a gradual recovery to the former peak ”. One type of this phenomenon is presented on the Figure 7.

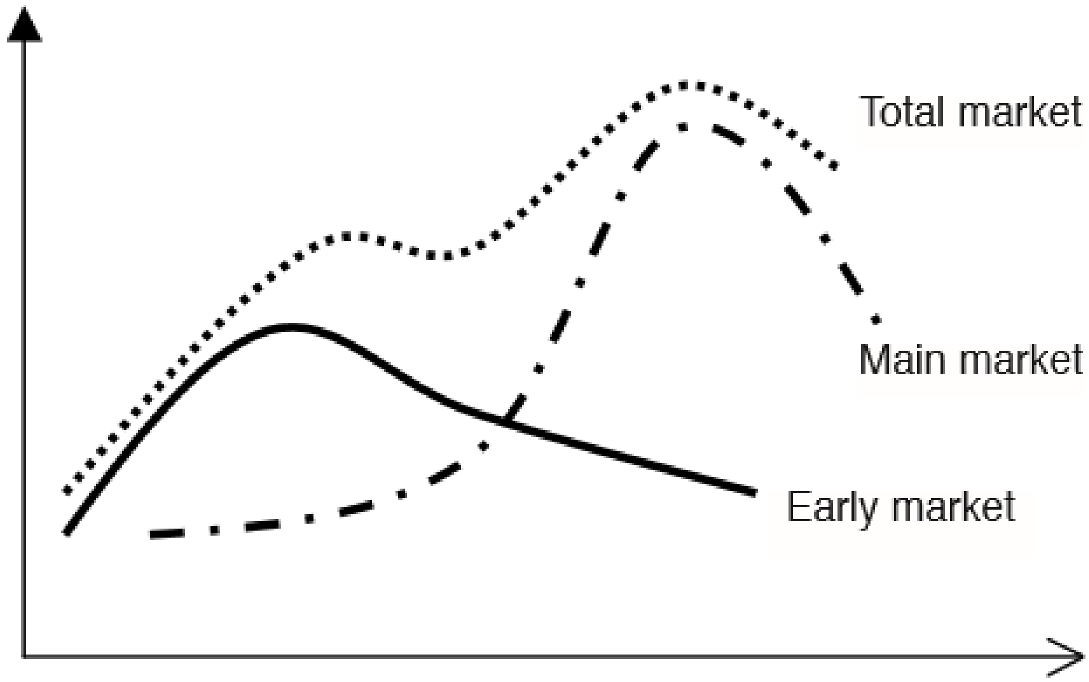

Figure 7. Saddle caused by chasm. Source: Chandrasekaran and Tellis (2011)

The authors collected time series data on sales and market shares of six kitchen/laundary and four infromation/entertainment products in 16 European countries from 1950 to 2008. After the analysis they found out that saddle is pervasive across countries. They also found out that the cause of saddle is different for kitchen/laundary and infromation/entertainment product categories: for regular products, such as kitchen/laundary products, the explanation is covered in business and technological cycles, whereas for innovative products, such as infromation/entertainment products, the explanation is covered in differences among adopter segments, i. e. in chasm, proving that chasm actually exists.

Not only sociologists and mathematics cared how technologies are accepted by population, but also information systems professors. Davis (1989) introduced the technology acceptance model (TAM), an information systems theory that models how users come to accept and use a technology (see Figure 8). The model emphasize two factors that highly affect the acceptance of the new technology: perceived usefulness – "the degree to which a person believes that using a particular system would enhance his or her job performance", and perceived ease-of-use - "the degree to which a person believes that using a particular system would be free from effort". It is important to mention that not actual usefulness and ease of use matters, but perceived one. Davis found a correlation of 0,63 between perceived usefulness and actual use, and correlation of 0,45 between perceived ease of use and actual use. In addition to establishment of the basic model, David is credited for development of questionnaires for perceived usefulness and perceived ease of use measurement, an instrument that exhibited validity and reliability.

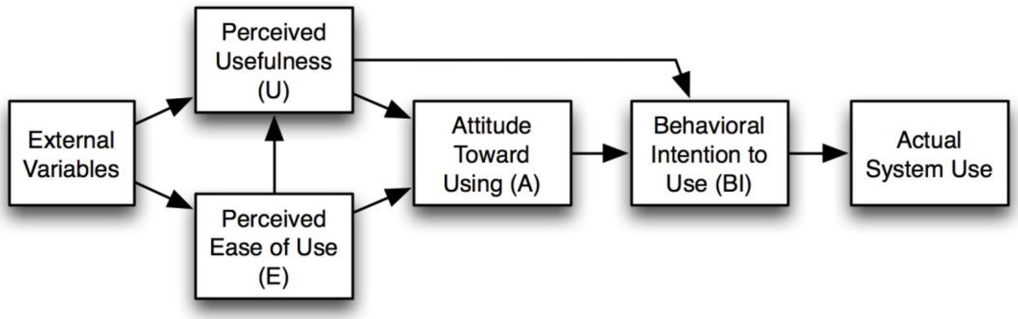

Figure 8. The Technology Acceptance Model. Source: Davis, Bagozzi and Warshaw (1989)

Disruptive innovation is one more important concept that is used to describe the innovation diffusion process. Clayton Christensen (1997) defines disruptive innovation as a “process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors”. The established companies pursue sustaining innovation for the high end of the markets because historically this course of actions helped them to succeed (see Figure 9). However, at point “b”, customers stop valuing enhancements in the product performance, since these enhancements are not necessary. For example, there is no difference for a regular consumer whether his camera has 20 or 25 megapixels. On the other hand, at the point “a”, disruptive innovation enters the low end of the market, where it satisfies the market’s needs. At the point “c”, the disruptive innovation satisfies the needs of the whole market, including the high end of the market. Afterwards, customers cannot see the difference between incumbent and innovator’s product performance, whereas the innovator’s product is cheaper, so the innovator’s product starts to dominate the market.

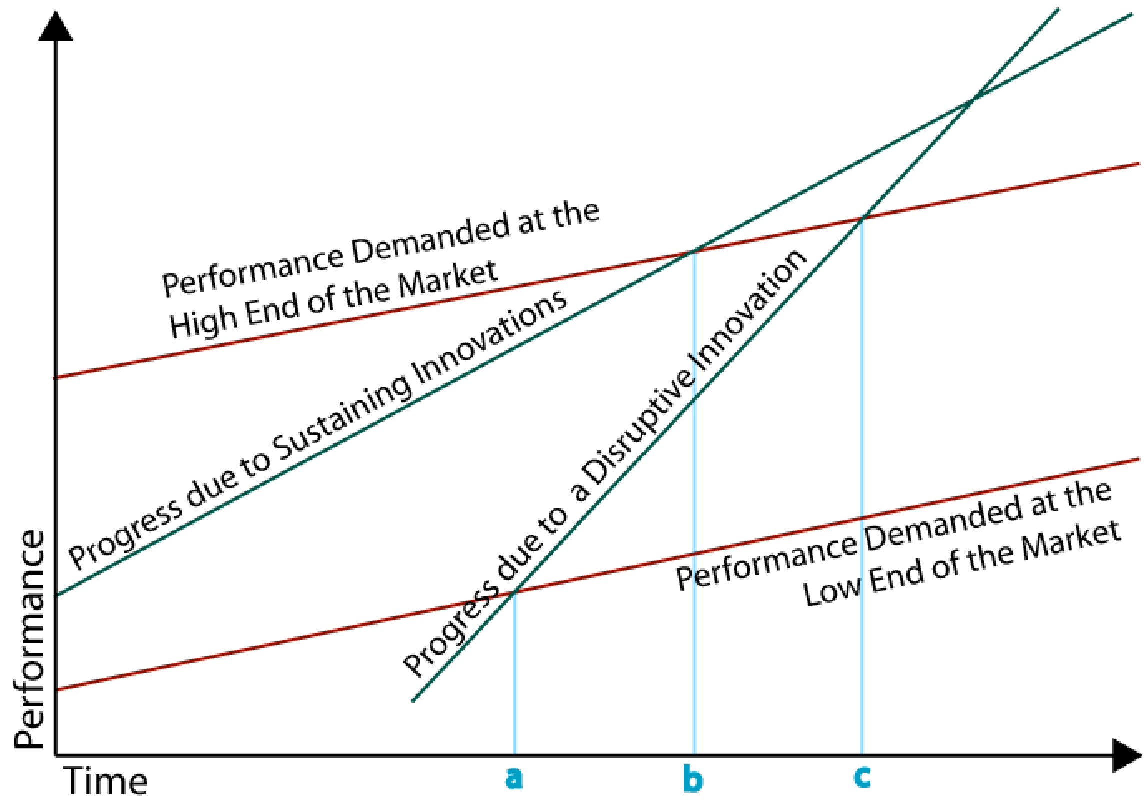

Figure 9. How disruptive innovation wins the market. Source: Christensen (1997)

Christensen provides several examples of disruptive innovations (disruptors) and technologies that were crowded out by these innovations (disruptee) (see **Table 2**). He also argues that established companies do not regard the disruptive technology as a serious business threat until it is too late, since this technology is not mature enough to satisfy the high-end market on which the established company is focused, so the company do not think that the new technology can get its customers. The fact that the new technology wins the low-end market does not matter, since its profitability is too low for established company to be interesting for the established company.

Table 2. Examples of disruptive innovations and incumbent technologies. Source: Christensen (1997)

Disruptor	Disruptee
Personal computers	Mainframe and mini computers
Mini mills	Integrated steel mills
Cellular phones	Fixed line telephony
Community colleges	Four-year colleges
Discount retailers	Full-service department stores
Retail medical clinics	Traditional doctor’s offices

Paap and Katz (2004) provide an alternative explanation regarding how new technologies substitute the old ones in “Anticipating disruptive innovation” article. They argue that technology substitution occurs only when the current technology cannot address the unmet customers’ needs. That is wrong to assume that technology comes first, since customers’ needs and technologies come together. Guiding by this principle, the authors identified can identify three patterns of technological substitution:

1. The old technology cannot effectively address the same need (Case 1).
2. The previous need matures, and a less important need becomes dominant, whereas the old technology cannot effectively meet previously less important need (Case 2).
3. The environment changes, creating a new need (Case 3).

The first case is probably the most common pattern of technological substitution. This type occurs when the current technology cannot longer meet the customers’ need, even if the type of the need remains the same. For example, writeable DVD technology is replacing CD technology because people want greater storage capacity from the disk. Another example is that wideband technologies are replacing dial-up technologies for access to the Internet, since the customers require higher speed. In both examples, customers’ need remains the same (capacity or speed), but the customers want more of it (capacity or speed).

The second case comprised many examples of disruptive technologies. It occurs when customers do not value any further enhancements of a product or service that address a particular need, but their attention shifts to other needs that cannot be satisfied with the existing product. However, incumbents often tend to continue improvement of the existing technology, even though the customers do not value them so much anymore – this is the same situation that was described by Christensen (1997). A historical event when 51⁄4-floppy disks substituted 31⁄2-inch disks is a good illustration to this situation. The main customer need – storage capacity – remained the same for a while. However, when this need reached its limit of 2.5 megabyte, existing, but less important needs (disk size and durability) emerged to drive the future customer behavior, so people switched from 51⁄4-floppy disks to 31⁄2-inch disks.

The third case happens when a new need emerges – exactly new need, not an old, less important need. The new need can appear because of changes in political, economic, social or technological environment. The invention of a wash and wear fabric blend, a new fabric technology, can serve as an illustration to this concept. This invention created a need for washing machines to have a "cool down cycle," which would optimize the performance of the new fabrics. Whirlpool, an American multinational manufacturer and marketer of home appliances, forecasted this need and designed washing machines, featuring a "cool down cycle". These machines meet the new customer need and, therefore, are very successful commercially.

1.3 Innovations in companies

A huge number of factors influences innovation success of organization. In order not to get confused in their variety, it is advisable that we have a framework that categorize these factors. The Organization for Economic Co-operation and Development in Oslo Manual (1997) suggests "Innovation policy terrain" framework that distributes all these factors into four major categories: innovation dynamo, transfer factors, science and engineering base and framework conditions (see Figure 10). These categories concern business companies, science and technology institutions, and issues of transfer and absorption of technology, knowledge and skills. In addition, the range of opportunities for innovation is influenced by the surrounding environment of institutions, legal arrangements, macroeconomic settings, and other conditions that exist regardless of any considerations of innovation.

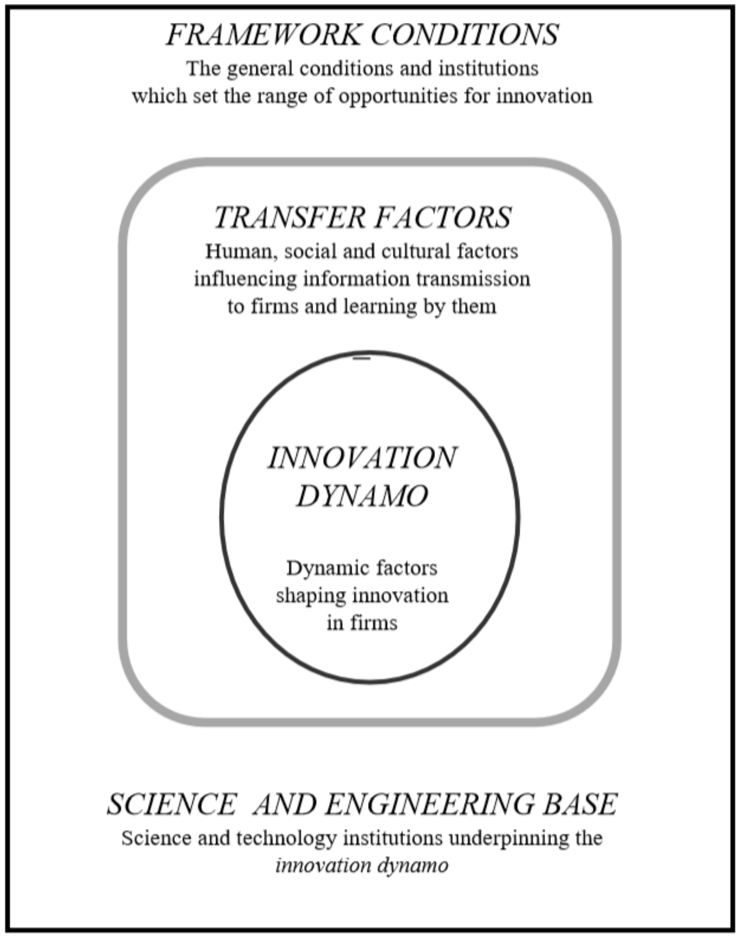

Figure 10. The innovation policy terrain - big picture view. Source: OECD (1997)

Each of four domains comprises a set of factors that are outlined on the Figure 11. The components of three domains – framework conditions, science and engineering base, and transfer factors - are thoroughly explained, whereas the components of the last one - innovation dynamo – are not. That is because the scientific world have not already agreed on a particular model that describes factors that shape innovation at the firm level. As Oslo Manual explains, “Many attempts have been made to construct models to shed light on the way innovation is generated within firms and how it is influenced by what goes on outside firms... However, some serious question marks hang over all the available models”.

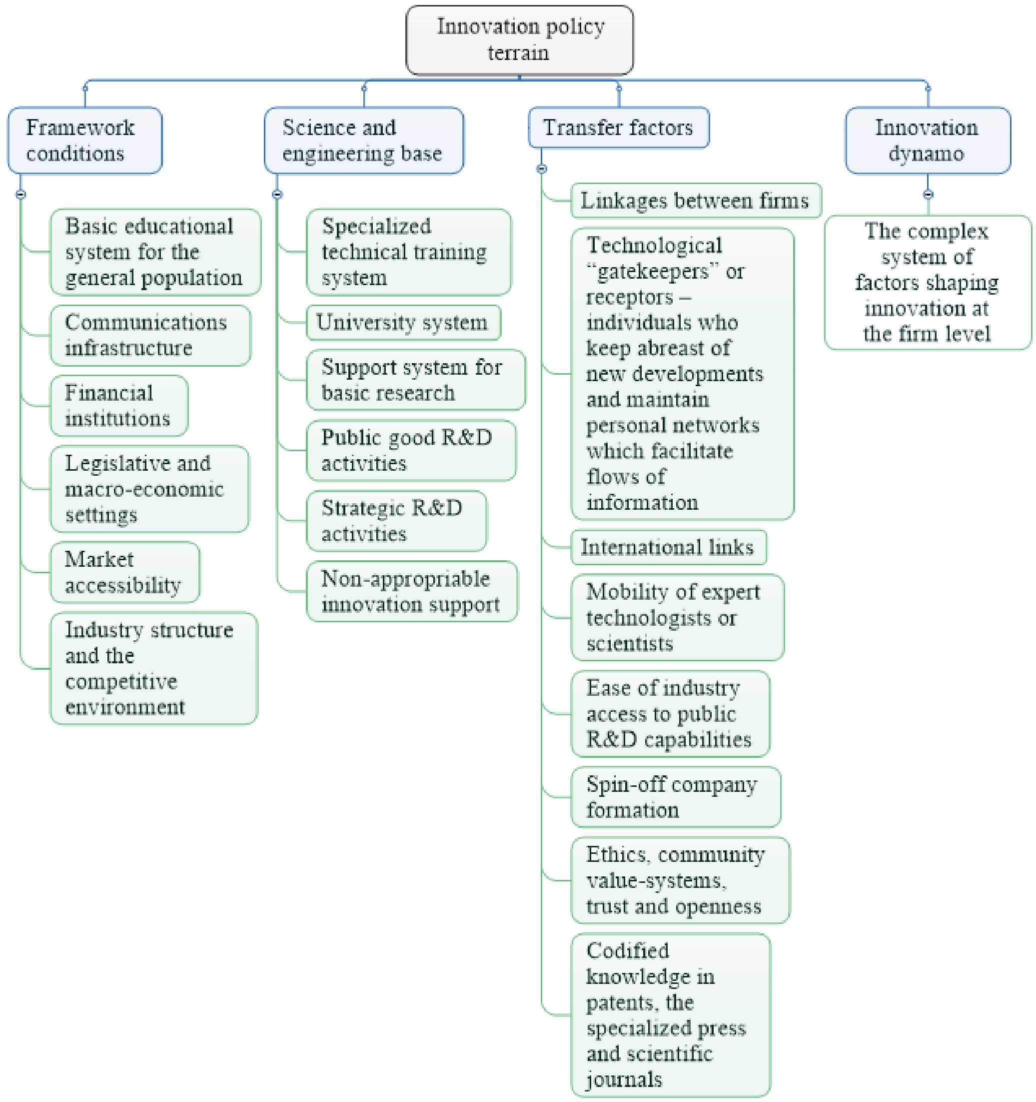

Figure 11. The innovation policy terrain - detailed view. Source: (OECD 2005)

Since the 1950s, there has been a proliferation of innovation models, each purporting to explain and/or guide the process of innovation within industrial firms. Rothwell (1994) analysed of state-of-the-art models of innovation processes at the firm level and classified these models into five generations in his article "Towards the Fifth-generation Innovation Process".

First Generation Models: Technology Push (1950s–Mid 1960s)

These models, so called technology push models, were simple and linear (see Figure 12). They were developed in 1950s and consider innovation successive process that begins from R&D stage. Because these models put significant emphasis on R&D, companies and governments used them to justify additional R&D spending to stimulate innovativeness and, in turn, business growth.

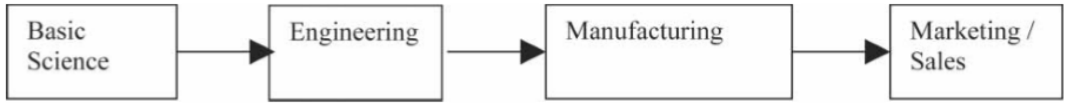

Figure 12. First generation technology push models. Source: Rothwell (1994)

Second Generation: Demand Pull Models (Mid 1960s–1970s)

Demand pull models were also simple and linear (see Figure 13). They were different from technology push models because they implied that innovation process started not from R&D, but from customer needs. However, R&D was the next step, since it realized spoted market needs.

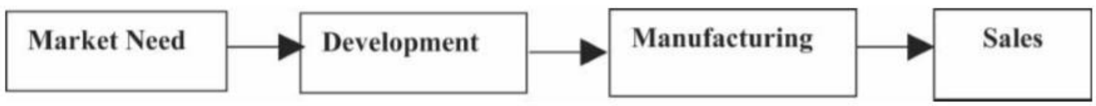

Figure 13. Second-generation demand pull models. Source: Rothwell (1994)

First and second-generation innovation models were widely criticized for several reasons. First, unlike models, innovation process in real companies is usually non-linear. Many innovation activities happen simultaneously, not one by one, and there is much more feedback among the stages that the models suggest. For example, product prototype may be returned to design department for re-design if a marketing department think that customers will not buy such a product. Moreover, sometimes innovation process is chaotic, especially in the early stages when a new product concept is being generated and tested. Second, the models neglect to consider the influence of external factors (environment, suppliers, customers, etc.) on the company’s innovation performance. Participation in technological conferences, university lectures, exhibition, as well as discussion with buyers and supplies contribute significantly to the innovation process. Third, the models do not outline what happens on each stage in details – only very big-picture sequence of activities is given. Forth, the innovation process is regarded as rigid, allowing no variation for the companies in their ways to be innovative.

Third Generation: Coupling or Interactive Models (1970s)

Coupling or interactive models illustate the idea of interaction between science and technology and the market (see Figure 14). The process of interaction comprise complex communication paths both within and outside the organization; this process may not be continuous but discrete. Rotwell also noted, that unlike the first and second generation models, third generation models explicitly connect the marketplace, science and technology community and the decision making of the firms.

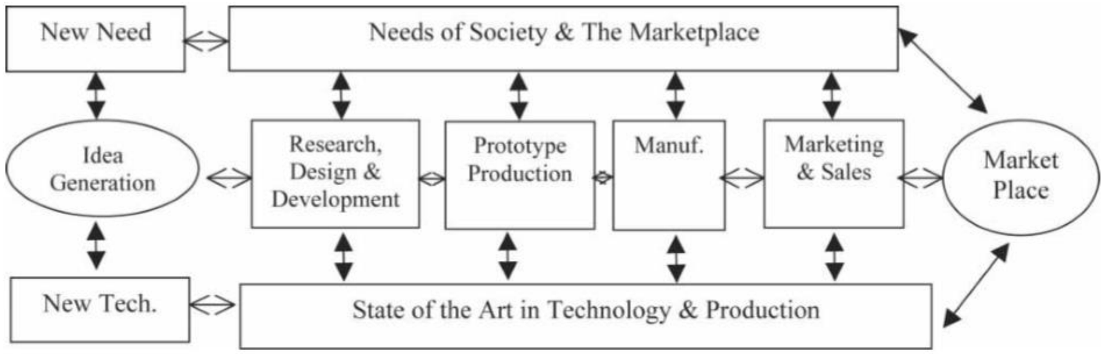

Figure 14. Third generation coupling or interactive model of innovation. Source: Rothwell (1994)

The authors of third generation coupling models made a great advancement, addressing weaknesses of the previous models. For example, paying attention to external environment, these new models take into account feedback from the diffusion stage and companies' need to improve its product quality and decrease costs to overcome competition. Nevertheless, they do not incorporate external factors, such as country's legal environment or technology regulations, sufficiently enough.

Fourth Generation: Integrated Models (1980s)

Compared to third generation models, forth, so called integrated models, incorporated more and more feedback loops and communication (see Figure 15). Japanies automobile companies during 1980s led the scientist to the development of the new models, which included considerable functional overlaps between activities of different departments, as well as companies' external integration with activities in other companies including suppliers, customers and, in some cases, universities and government agencies.

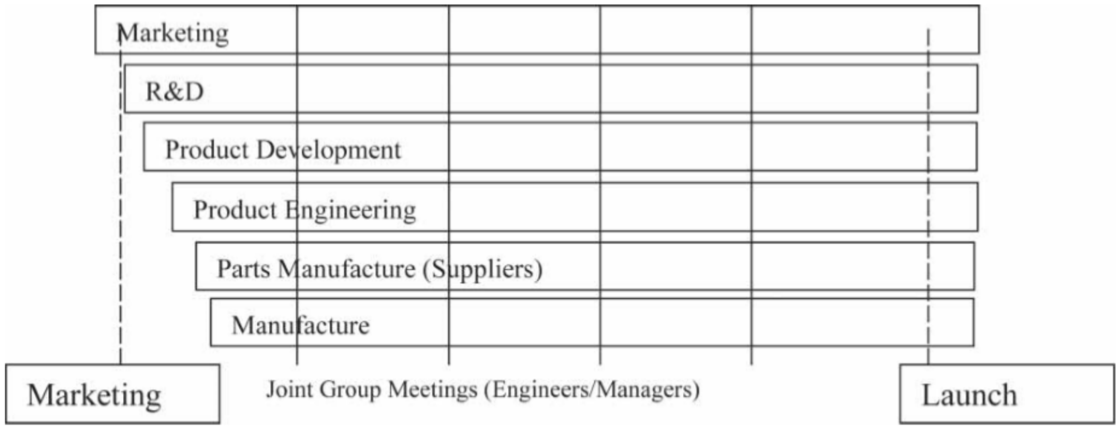

Figure 15. Fourth Generation: Integrated Models (1980s). Source: Rothwell (1994)

Fifth Generation Systems Integration and Networking Models (Post 1990)

Fifth generation systems integration and networking models underscored that innovation relied on learning and networking, both of them within and between firms. Partnerships among companies, joint ventures and corporate alliances, which were popular during 1980s and 1990s, directed researchers towards models that emphasised vertical relations, such as strategic alliances with customers and suppliers, and collaborating competitors. Rotwell argues that time pressure on leading edge innovations also affected the development of fifth generation models: in order to increase new product development speed and efficiency, the models suggested to use complex IT tools. According ot Rothwell, use of complex electronic tools that operates in real time and automates the innovation process within the company is actually a defferentiating factor between forth and fifth generation models. He also holded that cost and difficulties associated with intoduction of complex IT solution were offsetted by obtained benefits, such as speed of innovation and attaining market leadership.

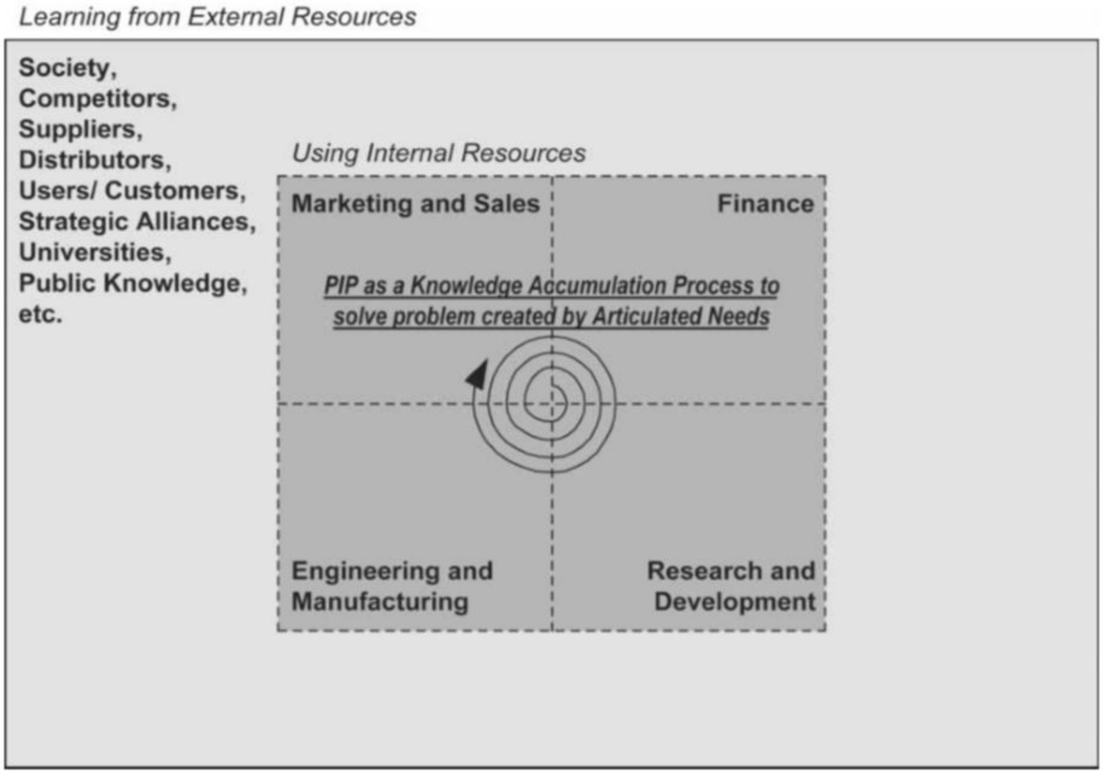

Figure 16. An example of a fifth generation systems integration and networking model. Source: Trott (1998), cited in Hobday (2005)

However, there is little evidence that companies have adopted fifth generation models of innovation and that increased use of IT benefits compensate its drawbacks. Some studies showed the negative sides of IT, such as difficulties of adoption by employees, and high up-front costs to set up the system. They also emphasized that organizations need to be prepared to implement electronic tools for complex topics such as innovation, otherwise IT may hamper the company's performance. Moreover, the usefulness of IT solution in innovation process depends on the nature of the product and technology in question. While electronic tools may support lower level tasks, they are unlikely to substitute human interactions, team building, group work and the leadership required for complex tasks.

Not only criticized particular generations of models, but also all of them for several reasons. First, Mahdi points out that the models usually provide one best way of innovation process, eliminating alternative paths (2002, cited in Hobday (2005)). That is not a bad thing, but many companies tend to revert their innovation process to the simple stages that were proposed in the models, and this simplification does not always affects business positively. Mahdi argues that evidence demonstrates that major differences in innovation process exist within and across different industries. Moreover, these differences persist over time and are not a deviation from a norm. That is, any generalized model of innovation process is misleading, as innovation process is determined by a set of historical and external factors. To illustrate his ideas, Mahdi brings the example of software industry, in which software development process usually goes iteratively, “first a rough specification of the software requirements is made, then a prototype is developed that is then tested and modified”.

Let us have a look at Stage-Gate model by Cooper (2008). According to this model, product innovation starts with an idea that goes through severlas stages and gates towards its market launch (see Figure 17). The project team works on the product at stages, while the management team makes decision whether product moves on to the next stage at gates. The Stage-Gate model is extremely popular in business: 85% of North American companies use it for product development, increasing efficiency and decreasing cost of development. Nevertheless, such a stict process limits innovation in certain cases, since innovation may be spontaneous and creative process that cannot be fully formalized.

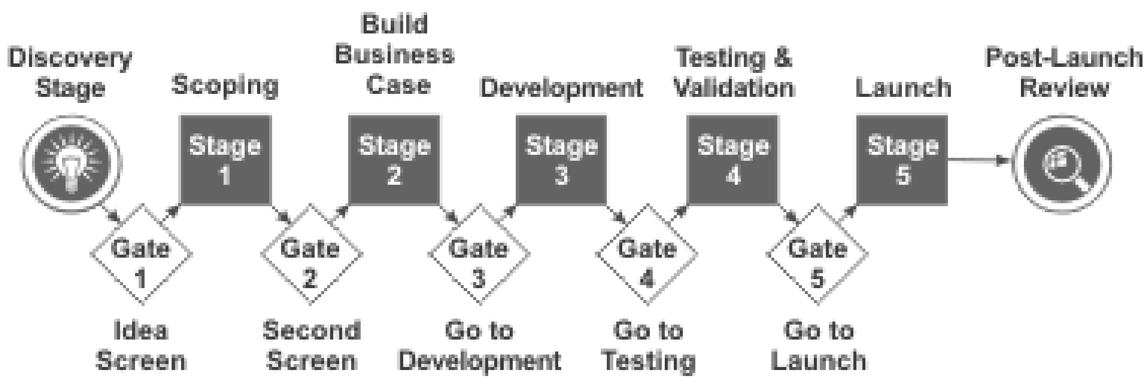

Figure 17. Stage-gate model. Source: Cooper (2008)

Second, most of the models assume that the companies behave too rationally, being able to hypothesize a solution to an innovation problem, such as a new product development, and then systematically solve the problem, using a standard toolkit such as design thinking, prototype testing and market research. However, this case is only possible when companies have enough experience to make an educated guess about the potential solution, otherwise, they have to use iterative approach, experimenting, making mistakes, and trying again. Therefore, the models in question may be applicable only to experience firms that have enough experience in the field.

Third, the models lack a coherent theoretical base, which is important because it can help to put innovation within the wider organizational and strategic context in which it belongs. Indeed, the state-of-the-art models treat innovation is separate process, failing to understand that it is tightly connected with the firm's strategy, culture and capabilities. This idea is upheld by empirical evidence (Hobday 2005).

Forth, all the models deal with innovation leaders, neglecting latecomers. This fact is especially important for scientist who research innovation in developing countries, e.g. Russia, since many companies there do not develop innovations themselves, but rather adopt them from abroad. Therefore, the models for developing countries should be different from those for developed ones.

Fifth, the majority of models deals describe processes in the large corporations, not paying attention to medium and small companies, where innovation process usually do not have any formal stages and domain. For instance, a small company may not even have R&D department. Therefore, for such companies it is definitely inappropriate to apply existing models.

In order to address the issues with previous models, an attributive model of innovation was created. This model outlines what qualities the company should have to be successful in innovation. The main difference with the previous models is that the attributive model does not aim to depict any particular process that companies should follow, but rather identify key attributes that the company should have to be successful in innovation. The analogy can be a good illustration for the new model ides. Both Figure 18 and Figure 19 present the models of a successful exam. However, they use a different approach to model the phenomenon. Figure 18 depicts a sequence of actions that a student should do to get a good grade. This sequence resembles the-state-of-art innovation models, especially first and second generation. On the contrary, Figure 19 does not say a word about the optimal process, but points out key components of a successful exam: knowledge, student's condition at the exam day, and his relationship with the professor. Needless to say, the later model is much more practical the former one.

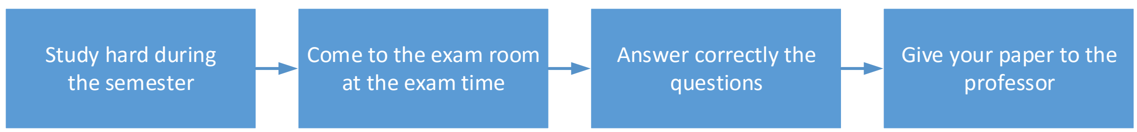

Figure 18. Illustration of the new model idea: a sequence of action to pass an exam successfully

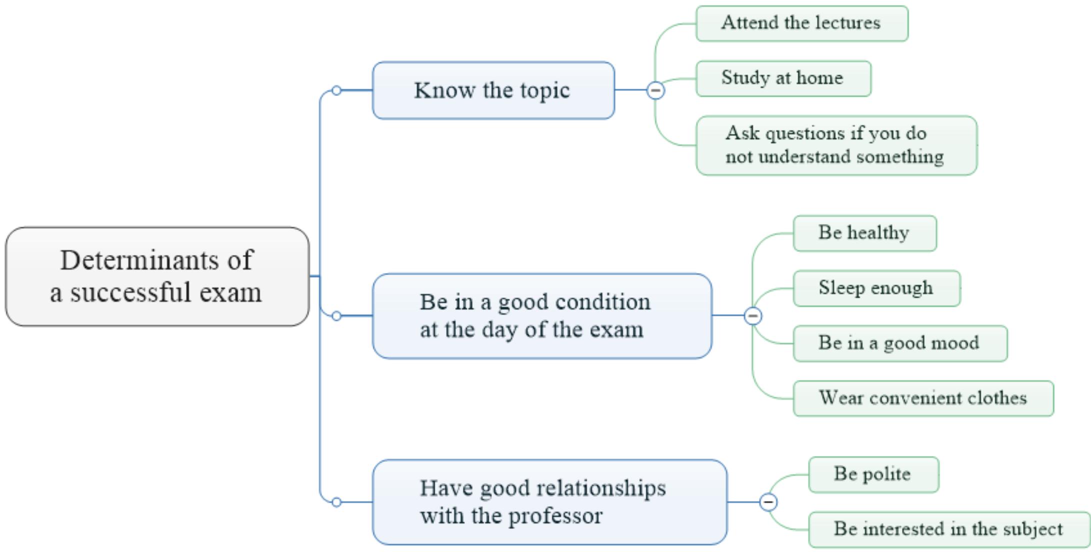

Figure 19. Illustration of the new model idea: determinants of a successful exam

Let us come back to the innovations in Russian companies. The attributive model of innovation is presented on the

Figure 20. According to the model, a set of monetary and non-monetary determinants is correlated with the innovation performance of the company. All these determinants, except “Marketing preparation for product innovation”, are relevant to product and process type of innovation.

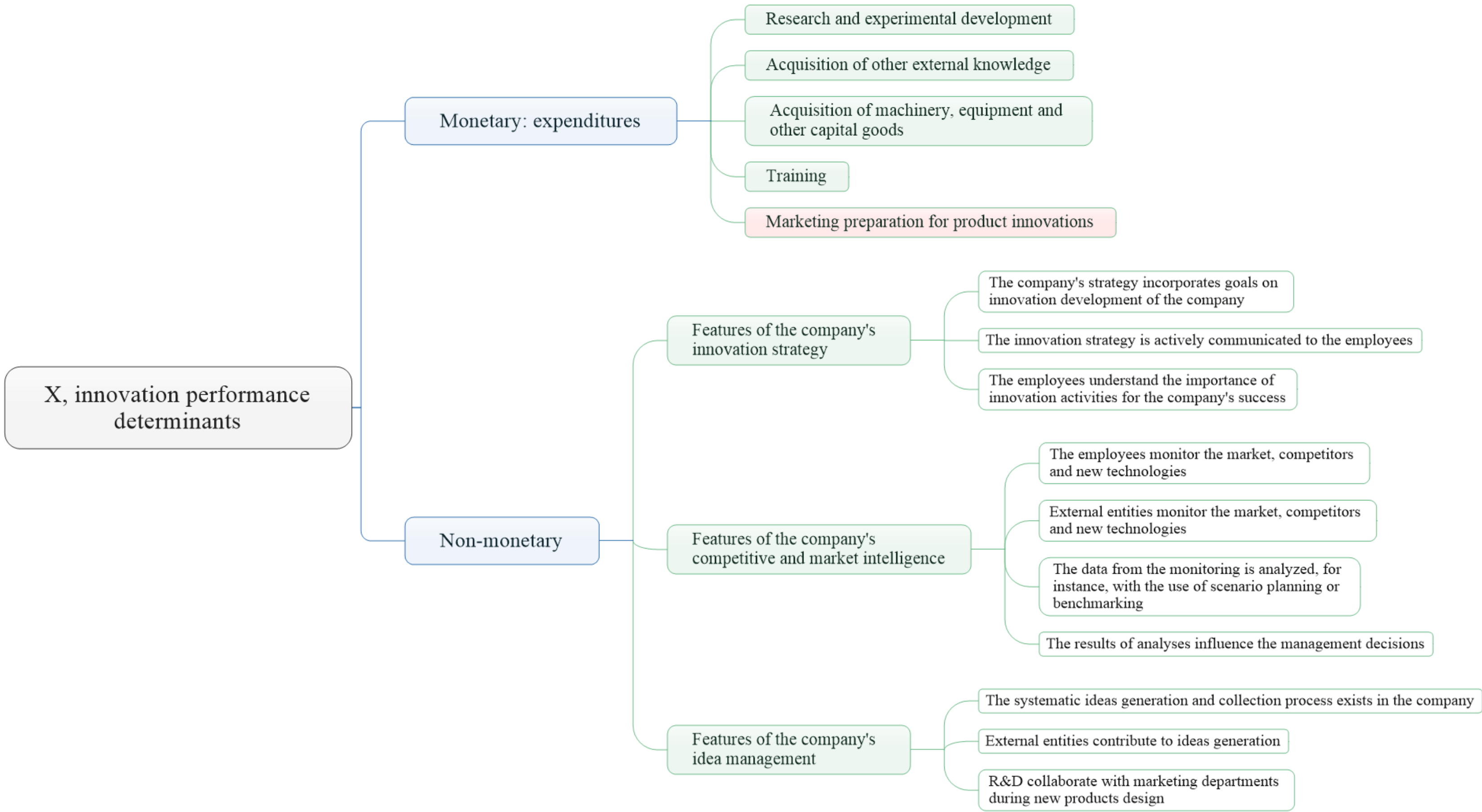

Figure 20. Conceptual model of determinants of product innovation performance. The model for process innovation performance is the same, except it does not have “Marketing preparations for product innovations” element.

How AMI addresses issues of the previous models? First, unlike previous generations of models, AMI does not provide one best way of innovation process, eliminating alternative paths, but rather enlist drivers that make the company successful in innovation. In AMI model in does not matter whether, for instance, market need or technological development comes first, since its non-sequential nature. What matters is that the company does have to pay attention both to market needs and technology development, and this idea is addressed in the model (in "competitive and market intelligence" branch).

Second, non-sequential nature of the model eliminates issues with hype-rationality, because non-sequential nature allows for trial-and-error experimentation and rudimentary activities.

Third, AMI model rests on a solid theory, namely modern resource-based theory. Teece, Pisano and Shuen (1997) in their article "Dynamic Capabilities and Strategic Management" highlights three domains that afferct the company's competitive advantage – the company's processes, positions and paths. The authors define these components as follows:

> By managerial and organizational processes, we refer to the way things are done in the firm, or what might be referred to as its routines, or patterns of current practice and learning. By position we refer to its current specific endowments of technology, intellectual property, complementary assets, customer base, and its external relations with suppliers and complementors. By paths we refer to the strategic alternatives avail- able to the firm, and the presence or absence of increasing returns and attendant path dependencies.

The AMI model's determinants represent positions and processes as sources of competitive advantage (see **Table 3**).

Table 3. The connection between AMI model and competitive advantage elements

Resource-based theory	**AMI model**
Processes	Innovation strategy of the company, competitive and market intelligence, and ideas management
Positions	The amount of expenditures of innovation
Paths	-

Forth**,** AMI model fits both innovation leaders and latecomers, and both large corporations and small companies, because the determinants of AMI neglect organizational structure and encompass sources of innovations far beyond only R&D department. If the company acquire external inventions, or just copycat the technology using competitive intelligence, the AMI model still works.

1.4 Justification of AMI model determinants

This group of determinants is based on Oslo Manual taxonomy (OECD 2005). However, the ideas from Olso Manual, which were created for studies in developed countries, were simplified and adjusted to Russian realms and companies' structures, making it possible to apply general ideas of Oslo Manual for studies in Russia, which is not as developed as OECD countries are. From this point onwards, here are presented not the original Oslo Manual ideas, but the adjusted ones.

Research and experimental development (R&D) comprises creative work undertaken on a systematic basis in order to increase the stock of technical knowledge in the company. Acs and Audretsch (1988) created and tested a model that suggests that innovation performance is influenced by R&D expenditures. The results showed that innovation performance is influenced by R&D expenditures. Crepon, Duguetb and Mairessec (2006) studied the links between productivity, innovation and research at the firm level. They found that innovation output of the company increases with its research effort. Thus, it is assumed that expenditures on R&D are positively correlated with product and process innovation.

Hypothesis 1a: There is a positive relationship between expenditures on R&D and product innovation.

Hypothesis 1b: There is a positive relationship between expenditures on R&D and process innovation.

R&D is not the only way for the company to obtain new technologies and know-how. The company may also purchase patens, inventions and know-how from the other companies, external research institution, abroad and so on. The idea of getting knowledge from outside is highly appreciated by Chesbrough (2003) in his book “Open innovation: The new imperative for creating and profiting from technology”, which set up a new trend in innovation studies and is widely cited in different papers on innovation. Chesbrough argues that companies should seek the opportunities to get external innovative ideas into practice to be successful in innovation. For instance, Suzlon and Goldwin, India and China’s leading wind turbine manufacturers, acquired licenses for technologies to produce wind turbine (Lewis 2007). Acquisition of external knowledge enhance innovation productivity, as it broadens the company’s knowledge that company can use in product development and operations. Moreover, it increases the company’s understanding of the market and technological trends (Yli-Renko, Autio and Sapienza 2001). Maurer (2010) found a correlation ($p \leqslant 0.001$) between knowledge acquisition and product innovation. Thus, it is assumed the following:

Hypothesis 2a: There is a positive relationship between expenditures on acquisition of external knowledge and product innovation.

Hypothesis 2b: There is a positive relationship between expenditures on acquisition of external knowledge and process innovation.

Besides spending on R&D and external knowledge, there one more way to facilitate innovation in the company. The company can buy “capital goods, both those with improved technological performance and those with no improvement in technological performance [, but] that are required for the implementation of new or improved products or processes (OECD 2005)”. This category includes machinery, instruments, equipment, computer software, and other capital goods. The up-to-date infrastructure and equipment are particularly important in case of Russian companies, many of which work with outdated infrastructure and very old equipment. For instance, at the age of 3D printers, some industrial companies operate on 70-year-old equipment obtained from after-war Germany. Given this condition, the main concern of the managers is not how to innovate more, but how to make these machine tools not break down.

Opposite, if the company uses modern equipment, the managers have time to think about innovation. Thus, it is assumed the following:

Hypothesis 3a: There is a positive relationship between expenditures on acquisition of machinery, equipment and other capital goods and product innovation.

Hypothesis 3b: There is a positive relationship between expenditures on acquisition of machinery, equipment and other capital goods and process innovation.

We have talked about physical objects so far. No let us switch to the employees. Now much company invests in their education is important for its innovation success. However, in case of developing countries, we have a caveat about the effect on training on innovations. In order to understand it, we should go to the theories proposed by Utterback and Abernathy (1975) and Kim (1980).

Utterback and Abernathy (1975) found out the relationship between the type of innovation, the competition type and technological processes development level. As it presented on Figure 21. Innovation and stage of development. Source: Utterback and Abernathy (1975)**Error! Reference source not found.**, the more developed technological process is, the less product innovation the company has, and vice versa. This situation occurs because of the nature of competition for innovative products: at the beginning, companies compete based on product variety, but at the end – based on production process efficiency. It is important for the production processes to be flexible at the beginning, since the company experiments with products to find the type of product that customers like most, so the processes should be easily adjusted to the ever-changing products. Even if some technological processes improvements happen at this stage, they tend to be rare and simple. On the other hand, then the companies finally understand the product that customers value most, the locus of competition moves to the production: the companies want to save money on production, improving technological processes through process innovation.

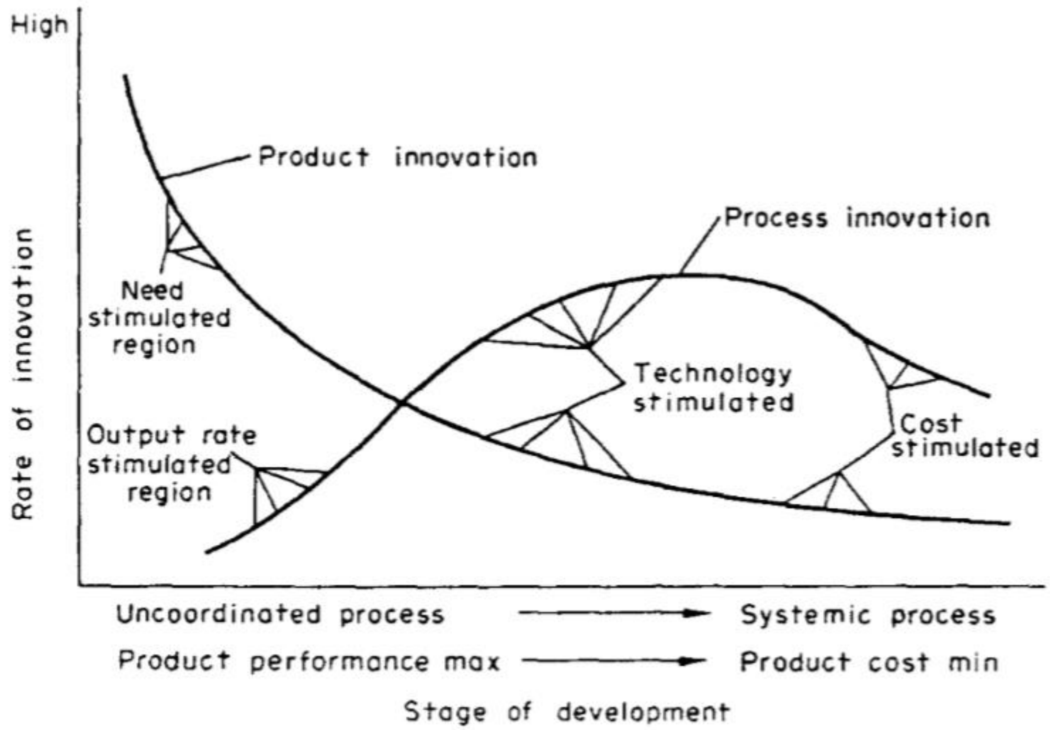

Figure 21. Innovation and stage of development. Source: Utterback and Abernathy (1975)

Utterback and Abernathy studied developed countries. The attempt to understand the process of innovation in developing countries was made by Kim (1980) in his article “Stages of development of industrial technology in a less developed country: a model”. The author suggested a three-stage model, in which developing countries moving from acquisition of foreign technology, to assimilation and eventually to improvement. First, the companies buy developed foreign technologies that include packaged assembly processes that require only very limited interventions from the buyer. Second, the companies acquire not the new technologies itself, but technologies how to develop processes and design new technologies. Third, companies start producing new and innovative products. To summarize, the sequence of events is opposite of that of developed countries. The connection between these two sequences was depicted in the work of Lee, Bae and Choi (1988) (see Figure 22).

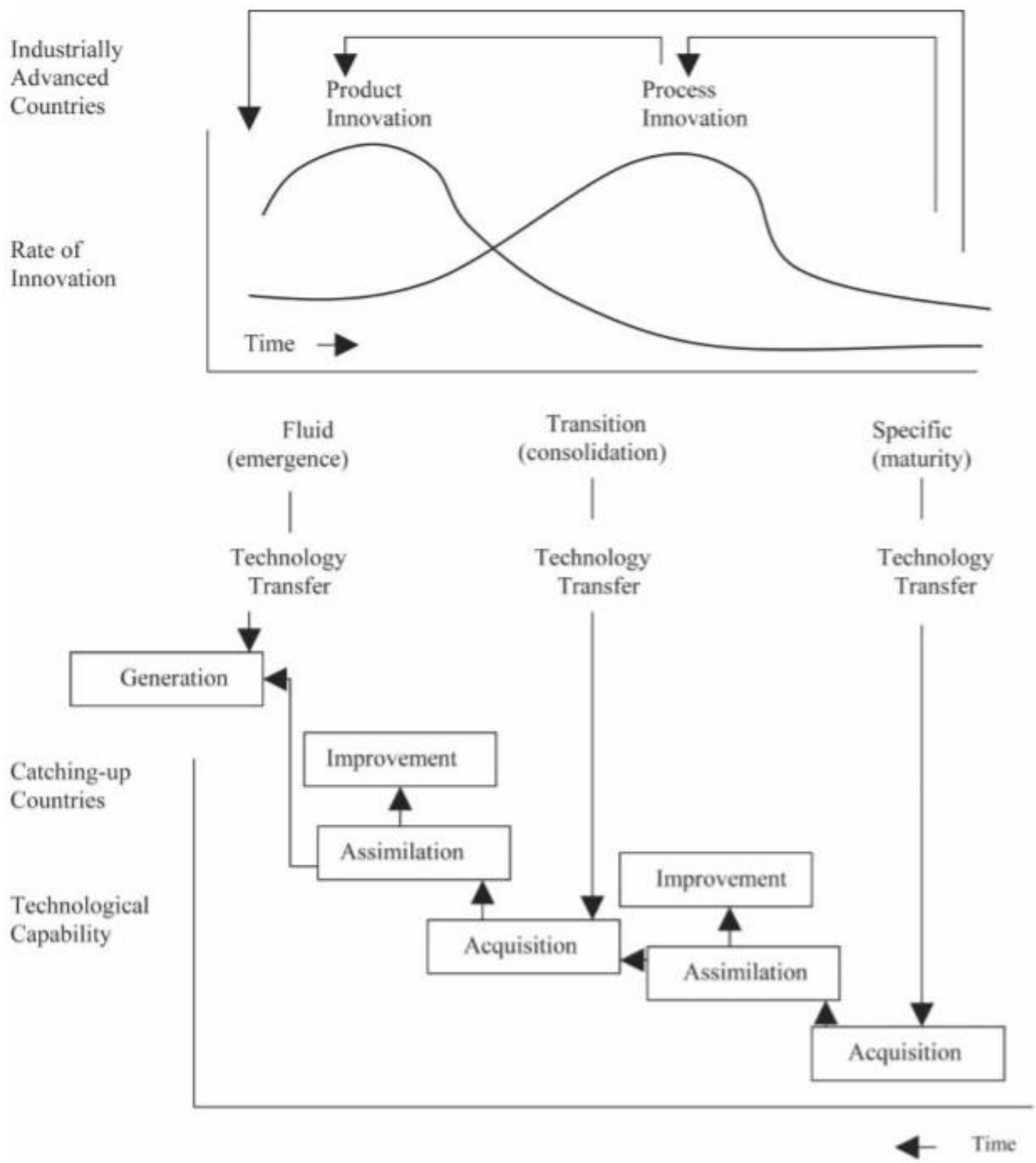

Figure 22. Innovation process in developed (the top of the picture) and developing (the bottom of the picture) countries. Source: Lee, Bae and Choi (1988)

According to and Abernathy (1975) and Kim (1980), the process of innovation starts with process innovation in developing countries, and the process innovation may hamper product innovation, since in order to be effective, the processes have to be rigid and hard to change. Like the adoption of foreign technologies, that enables producing something more efficiently, but in a standardized and rigid way, training of employees teaches them to work efficiently, using standardized techniques and technologies, making them more creative in process domain, but less creative in product domain. A training usually makes employees focus on how to make the production process more efficient; however, since the attention of employees is limited, and they start paying more attention to production processed, they also start paying less attention to product improvements. This attention switch as well as increased process rigidness increase the level of process innovation in the company, but decrease the level of product innovation. Thus, it is assumed the following:

Hypothesis 4a: There is a negative relationship between expenditures on employee training and product innovation.

Hypothesis 4b: There is a positive relationship between expenditures on employee training and process innovation.

Product innovation occurs when market needs are coupled with technological developments (Paap and Katz 2004), since no matter how good the product is, somebody has to buy, if the company wants to be successful. In order to convince the customers to buy an innovative product, the company has to invest in market preparation for the innovative product. According to Oslo Manual, "market preparation for product innovations can include preliminary market research, market tests and launch advertising for new or significantly improved goods and services (OECD 2005)." These activities are designed to make the new product sellable, the condition required to make the innovation not only created, but also implemented. The product's success of failure heavily depends on the quality of marketing managers product launch preparation (Bearda and Easingwood 1996). Bonnin, Segard and Vialle (2005) argue that in order to ensure the company's long-term surival, the company should be able to successfully introduce new products into marketplace. This capability is even more importnant today, since the rate of technological and customer needs changes has risen drastically. Thus, it is assumed the following:

Hypothesis 5a: There is a positive relationship between expenditures on marketing preparations for product innovation and product innovation.

There is no 5b hypothesis, since in process innovation company does not sell anything.

It is important to make every employee understand how important innovation is to make the company successful in innovation. Everyone from CEO to the worker at the factory or in the office should realize the importance of innovation and try to be innovative. In the article “Five Ways to Make Your Company More Innovative”, Kanter (2012) wrote, “Put innovation at the heart of strategy, and tout it in every message (Emmons, Hanna and Thompson 2012)”.

For company to be successful in innovations, the company should not only carry out innovation activities, but also integrate them under the umbrella of a single innovation strategy. Cassiman and Reinhilde (2002) provided empirical evidence of this idea, using data on Belgian manufacturing companies. The company should clearly define its strategic goals in order to achieve them efficiently. Companies that fail to articulate their innovation strategy clearly often have difficulties with everyday operations because innovation teams scruple from one opportunity to another, being not concentrated on a single defined goal.

Whereas employees of companies abroad usually take pains to be innovative, Russian employees may concerned with more basic things, such as overcoming problems with public officers, inspections or fixing broken printer. For example, as far back as in 1989, Japanese companies got on average 38 ideas per employee, despite the average reward for idea was set to be $2.83 (Gupta and Tyagi 2008). Since $2.83 were not big money, the employees were motivated by other factors. No matter what exact factors motivate them to innovate; they would not have achieved such a good performance, unless they had realized how important innovation was for their company. At the same time, in Russian environment, in which employees face a great deal of unexpected problems and administrative obstacles, it is necessary that employees instantly be reminded of the importance of innovativeness for the company’s well-being. It order to be innovative, the company should have points regarding innovation in its strategy, communicate them to its employees and make them believe that innovation is important. Thus, it is assumed the following:

Hypothesis 6a: There is a positive relationship between features of innovation strategy and product innovation.

Hypothesis 6b: There is a positive relationship between features of innovation strategy and process innovation.

According to Oslo Manual, something new is only considered innovation, if it is implemented (OECD 2005). For product innovation, it means that the innovative product should be welcomed by the customers. In the second section of this thesis, “Diffusion of innovation”, was said a lot about how customers adopt a new product and what the company should do to facilitate the diffusion process, so these points will not be discussed again here. It will be just pointed out that in order to achieve market success, the company has to perform marketing intelligence.

Many innovations failed because the companies did not pay enough attention to customer needs and external environment. Cinerama, the very first widescreen projection format and prototype of IMAX, is one of the examples of such a failure. Projecting a Cinerama film meant projecting three synchronized 35mm projectors simultaneously onto a gigantic curved screen. The results were visually astounding and far ahead of any other method of the time. The drawback of this technology was its price and complexity to execute. Three projectionists had to project the film from three projectors synchronously that requires projectionists to be extremely high skilled. Since it was hard for cinemas to find so skilled projectionists and Cinerama technology was so expensive, only few theaters were willing to pay for this technology. As a result, only a couple of dozen films ever used the Cinerama format (Floorwalker 2013). Thus, if the company fails to understand its customers, the innovative product may fail to be adopted, even if it is amazing.

One more important activity the company should be involved in to be successful with innovations, and, particularly, with disruptive innovations is competitive intelligence. While market intelligence is used to gather data on external environment, competitive intelligence as a process of gathering actionable information on competitive environment. Entrepreneur magazine describes competitive intelligence as follows:

> Competitive intelligence essentially means understanding and learning what is happening in the world outside your business so you can be as competitive as possible. It means learning as much as possible - as soon as possible - about your industry in general, your competitors, or even your county's particular zoning rules. In short, it empowers you to anticipate and face challenges head on.

Competitive intelligence is different from marketing intelligence in its proactive nature: it looks for weak signals in external environment to predict market trends and competitors’ actions.

Gilad, one of competitive intelligence guru, explains that competitive intelligence is a three-step procedure - risk identification, competitive monitoring, and management actions (2003).

First step is risk identification with war games. During this stage, competitive intelligence specialists have to do the following:

1. identify key drivers in the industry, assess their probability and create scenarios;
2. obtain the information about the competitors;
3. understand strengths and weaknesses of competitors and their company;
4. identify blind sport of the competitors' and our company management;
5. play war game to assess the potential competitors' reaction to the changes it the industry.

After that stage, competitive intelligence specialist will understand the areas of major risks - e.g. mass introduction of a new production technology that boost production process efficiency, but so far is too expensive to implement - competitive intelligence specialist can find the indicators that the company should follow afterwards to understand when the company should react to the risk. In case of the new production technology the significant drop in implementation price may serve as such indicator, since when it occurs, the competitors may implement this technology faster than your company do, gaining competitive advantage over your company.

Second step is competitive monitoring. During this stage, the company should monitor the environment if any risk is carried out. There should be a team responsible for the monitoring. The team should include interior and exterior experts. Interior experts should have access to the information they need to monitor. They should be able to understand deeply the information and face this information during their regular work, not only for monitoring reasons. That helps to avoid superficial analysis. External experts should be included in the monitoring team, as their vision is not distorted by work in particular company and as they may know some information that employees of the particular company do not know.

Third step is management actions. It is important to mention that competitive intelligence should only deliver insights to management and be persuasive, not to implement created recommendations that is management responsibility. At this step, Gilad recommends that competitive intelligence specialists give conclusions and preliminary plans of actions to management rather than raw data. That is because competitive intelligence specialists know the data better than managers, who did not collect the data, and because managers sometimes use raw data not for the analysis, but for support of their opinion that they have already had. In case of the introduction of a new production technology, which was used as an example of previous stages, the managers have to implement this technology rapidly in their business in order not to lose to the competition. Since marketing and competitive intelligence features are important for the company's innovation success, it is assumed the following:

Hypothesis 7a: There is a positive relationship between features of market and business intelligence and product innovation.

Hypothesis 7b: There is a positive relationship between features of market and business intelligence and process innovation.

Idea generation should not be treated as if it was only R&D business. Every employee in the company, of even entities outside the company may help the company to be innovative.

Let us start from idea generation within the company. As it was previously mentioned, as far back as in 1989, Japanese companies got on average 38 ideas per employee (Gupta and Tyagi 2008). This example illustrates how creative employees can be. In Russia, unfortunately, culture of many companies does not facilitate idea generation: neither people are motivated to share their ideas, not the formal idea collection processes exist. However, there are some exceptions from this defective practice. For instance, Sibur, Russian largest integrated gas processing and petrochemicals company, has an established process of collecting ideas from its employees. There are special boxes at Sibur's plants, in which employees can put notes, including anonymous notes, with their ideas. Every week, this box is emptied and the notes are put on the board, on which everyone can write what he thinks about the proposed ideas. If any idea is upheld by the colleagues, this idea goes to managers. If the managers like the idea, it is implemented and the author is paid. The company should leverage the opportunity to benefit from its employees' idea. Kanter (2012) explains how Verizon, the largest wireless telecommunications provider in the United State, benefits from ideas of its employees from all levels of company's hierarchy:

> Think of innovation strategy as a pyramid: big bets at the top, a few projects in development in the middle, and a broad base of continuous improvements, incremental contributions, and early-stage new ideas at the bottom. For example, Verizon has placed big bets on Google's Android for smartphones and on fiber optics for landlines, and now is seeking new ways that wireless networks could run everything, including cars and refrigerators. It has projects in development with GM's OnStar and in cloud computing. In addition, Verizon CEO Lowell McAdam sees small "pots of gold" everywhere in the business, even in the traditional landline side, preaching process innovations to technicians.

Not only employees can generate useful ideas, but also external parties. Chesbrough (2003) created a special term for this situaion – open innovation, that is "a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology". He argues that companies cannot remain competitive if they rely only on centralized internal R&D processes, since a number of "erosion factors" have changed the business environment. This idea rests on several principles, but for the sake of concision only the most important principle will be restated in this research - not all smart people work for one single company, so the company must seek knowledge from external sources. For example, it can set up a competition among our customers, so they can tell the company how it should improve its product. This way of obtaining knowledge is cheap and effective.

Hippel (2006) in his book "Democratizing Innovation" goes even further. He speculates why and how product users develop and freely reveal innovations they make by themselves and how companies can capitalize on this phenomenon. Since standardized products do not fully fullfil customer needs, up to 40% of users modify these products. The users have two options: either to hire a specialist, who modifies the product, or does modification by themselves. People usually prefer doing modification by themselves because this way they can avoid agency costs and enloy the modification process. Furthermore, after the modification is over, they usually share the result of their work with people around, since the sharing improves their reputation, creates positive network effect and facilitate innovation diffusion. Because of the emergence this new customer-led innovation, companies should shift their attention from designing of new products to better commerzialization of lead users innovation. Hippel views are novel and progressive, however, they are too radical, especially in Russian case. However, Chesbrough's views on open innovation suits Russian context to some extent. For this research, it is assumed the following:

Hypothesis 8a: There is a positive relationship between features of the company's idea management and product innovation.

Hypothesis 8b: There is a positive relationship between features of the company's idea management and process innovation.

Based on literature review, eight hypotheses regarding the determinants of innovation performance was put forth (see **Table 4**). "+" means that there is a positive relationship between the determinant and the type of innovation. "-" means that there is a negative relationship between the determinant and the type of innovation. The absence of the sign means that no hypothesis about the relationship between the determinant and the type of innovation was proposed.

Table 4. Stated hypotheses

Hyp. #	Determinants	Product innovation	Process innovation
1	Research and experimental development	+	+
2	Acquisition of other external knowledge	+	+
3	Acquisition of machinery, equipment and other capital goods	+	+
4	Training	-	+
5	Marketing preparation for product innovations	+	
6	Features of the company's innovation strategy	+	+
7	Features of the company's competitive and market intelligence	+	+
8	Features of the company's idea management	+	+

The conceptual model of relationship between product innovation performance and its determinants is presented in the following equation:

Product innovation performance = f (Research and experimental development, Acquisition of other external knowledge, Acquisition of machinery, equipment and other capital goods, Training, Marketing preparation for product innovations, Features of the company's innovation strategy, Features of the company's competitive and market intelligence, Features of the company's idea management) *(2)*

The conceptual model of relationship between process innovation performance and its determinants is presented in the following equation:

Process innovation performance = f (Research and experimental development, Acquisition of other external knowledge, Acquisition of machinery, equipment and other capital goods, Training, Features of the company's innovation strategy, Features of the company's competitive and market intelligence, Features of the company's idea management) *(3)*

1.5 Methodology

The insights from the literature review was helpful to build the conceptual model. However, the conceptual variables should be operationalized to be used in the regression analysis. All the conceptual variables and their operational proxies are depicted on the Figure 23. Two types on the company's innovation performance types are measured in this research - product innovation performance and process innovation performance. Their measurement and its justification is provided below.

As a starting point for operationalization of the conceptual variables, the article by Albaladejo and Romijn (2002) was used. This article studies innovation capabilities in small electronics and software firm in southest Engand, since the article provides a solid operational framework to study innovation capabilities in the companies. The authors were focused only on product innovation, since this type of innovation prevailed in their sample. They used three dependent variables to measure the company's innovation performance: incidence of major product innovation, the number of patents, and product innovation index.

First, incidence of major product innovation. This variable is a simple binary variable that indicates whether a company had accomplished at least one major product innovation during the 3 years preceding the survey. Being binary, this variable can only capture the existence of innovativeness, but cannot capture the degree of innovativeness. In order to make this research able to capture the differences in innovativeness, binary variables were not used in this research.

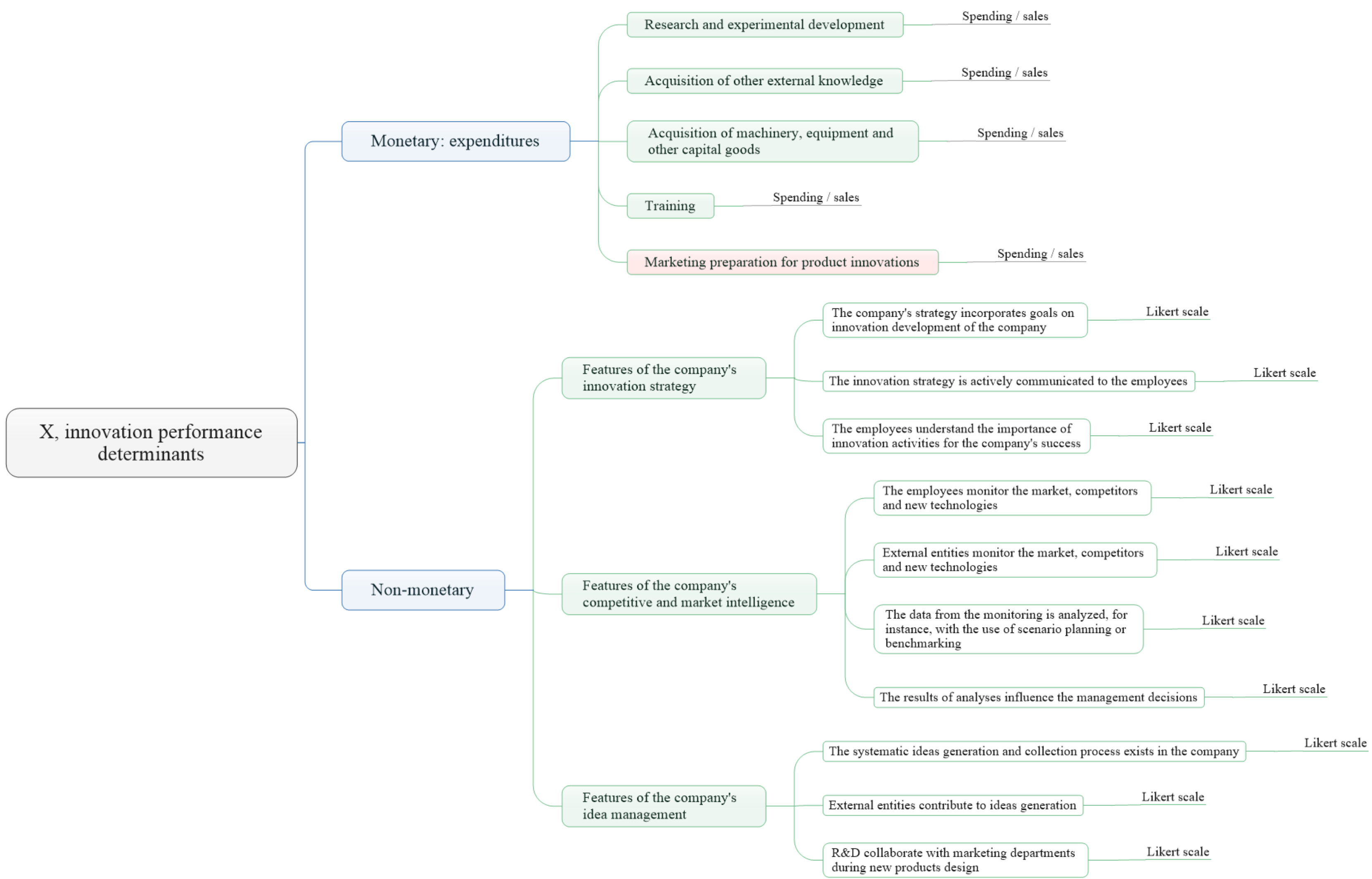

Figure 23. Operational model of determinants of product innovation performance. The model for process innovation performance is the same, except it does not have “Marketing preparations for product innovations” element.

Second, the number of patents that the company filed during a limited period of time. The weakness of that variable is that many innovations that small firms come up with are never patented, especially in small companies and if the speed of technological advance in the industry is high. The expense and effort needed to apply for patent protection and to deal with patent infringements may be beyond the firm's limited capacity; the pace of technological advance may be so fast that it is not considered worthwhile to pursue patenting. Moreover, some innovations may not be so fundamentally new as to qualify for patenting. Number of patents is not used in this research because of its this variable's disadvantages.

Third, product innovation index. The product innovation index can be a way to get around the drawbacks of the previous indicators to some extent. It is based on extensive qualitative information about the extent and significance of each firm's innovative outputs generated within a certain period of time. The table (see Figure 24) was used to assign scores to the company. For example, if the company had fundamentally new to the world innovation, featuring low scientific involvement, the firm got four points for its innovativeness.

Degree of novelty (major product innovations)	Degree of science intensity	
	Low 'clever gimmick'	High science-intensive
(a) Fundamentally new to the world	4	5
(b) Similar innovations adopted in other industries	3	4
(c) Similar innovations adopted in firm's own industry, but its innovations differ in identifiable ways from other companies' innovations	3	4
(d) Same or very similar innovations adopted by competitors	2	3
(e) No major innovations at all	1	1

Figure 24. Scale used for product innovation index in survey by Albaladejo and Romijn (2002)

However, it is questionable why science-intensive innovations should be valued more than not science-intensive innovations. Being scientific is not a goal of innovation. Roughly, the goal of innovation is to help the company to win the competition in the ever-changing world. If some new marketing gimmick can help the company to achieve this goal, it should be consider a true innovation. The product innovation index is not used in this research because of this variable's disadvantages.

The good measure of the company's product innovation performance is the amount of revenue coming from innovative products. However, the amount of revenue from innovative products depends not only on the company's innovativeness, but also on the company size. In order to eliminate the dependence on the company size, the amount of revenue from the innovative products should be divided by the measure of the company's size, for instance, revenue.

This reasoning was also used in papers of famous scientists before. Cooper and Edgett (2012) in their paper on benchmarking, argue that percent of revenue coming from new products is a good measure of the company's new product performance. The only difference a new product and an innovation product is the degree of novelty. Thus, the percent of revenue from innovative products can be also used as a proxy of the company's product innovation performance. Furthermore, this reasoning can be also applied to process innovation measurement. A portion of savings initiated by process innovation implementation from the total company's revenue was decided to be used as a measure of the company's process innovation performance. Information about the dependent variables is presented in the **Table 5.**

There are two groups of determinants of the company's innovation performance: monetary and non-monetary. The justification of their measurement is presented below.

Monetary determinants pertain spending on different things in the companies. Therefore, their measurement is relatively trivium task: the researcher should just find out how much money the company spends on different things. However, since the company's size influence the spending, the amount of spending has to be divided by the measure of the company's size. Total company's revenue was used for this role. Therefore, to measure monetary determinants, a percent of sales that is spent for something was used.

Non-monetary determinants are the features of the company's processes and policies. Because of time and financial constraints of this research, no field studies in the companies were conducted, but rather the employees were asked to answer sets of questions regarding particular processes, and then their answers were transformed into the measure of the processes or policy quality. The employees were asked to identify their level of agreement with certain statements, such as "The innovation strategy is actively communicated to the employees", using 1-5 Likert scale. Then, the median of the scores was calculated to get scores for the quality of the company's certain processes or policy. For example, when the quality of the company's competitive and market intelligence was measured, the respondents were asked to identify their level on agreement to the following statements:

- The employees monitor the market, competitors and new technologies
- External entities monitor the market, competitors and new technologies
- The data from the monitoring is analyzed, for instance, with the use of scenario planning or benchmarking
- The results of analyses influence the management decisions

If the respondent assigned 4 points for the first statement, 2 points for the second, 5 points for the third and 5 points for the forth, the quality of the company's competitive and market intelligence got 4,5 scores, since the median of (4, 2, 5, 5) is 4,5. This method was borrowed from the work on political science by Manheim and Rich (1995).

For your convenience, all dependent and independent variables with their discription are presented in the **Table 5**.

Table 5. Variables in the regression model

#	Concept	Measurement	Variable type	Name in SPSS
	Dependent variables			
1	Product innovations	Portion of revenue from innovative products to the total from the total company's revenue	Numerical	ProdRev
2	Process innovations	Portion of savings initiated by process innovation implementation from the total company's revenue	Numerical	ProcRev
	Independent variables			
3	Research and experimental development	Total R&D expenditures / sales	Numerical	ResandDev
4	Acquisition of other external knowledge	Spending on acquiring of external knowledge / sales	Numerical	Patents
5	Acquisition of machinery, equipment and other capital goods	Spending / sales	Numerical	NewEquip
6	Training	Total training expenditures / sales	Numerical	Training
7	Market and other preparation for product innovations	Spending / sales	Numerical	Marketing
8	Features of the company's innovation strategy	Median of responses measured with Likert scale	Numerical	StrategyMedian
9	Features of competitive and market intelligence	Median of responses measured with Likert scale	Numerical	BIMedian
10	Features of ideas management	Median of responses measured with Likert scale	Numerical	IdeasMedian

The operational model of relationship between product innovation performance and its determinants is presented in the following equation:

$$ProdRev_i = \beta_0 + \beta_1 * ResandDev_i + \beta_2 * Patents_i + \beta_3 * NewEquip_i + \beta_4 * Training_i + \beta_5 * Marketing_i + \beta_6 * StrategyMedian_i + \beta_7 * BIMedian_i + \beta_8 * IdeasMedian_i + \varepsilon_i \quad (4)$$

The operational model of relationship between process innovation performance and its determinants is presented in the following equation:

$$ProcRev_i = \beta_0 + \beta_1 * ResandDev_i + \beta_2 * Patents_i + \beta_3 * NewEquip_i + \beta_4 * Training_i + \beta_5 * StrategyMedian_i + \beta_6 * BIMedian_i + \beta_7 * IdeasMedian_i + \varepsilon_i \quad (5)$$

The data that needed for this research were not available in any database, so primary data had to be collected. Electronic questionnaire, created using Google Forms, were used to obtain the data. Several ways to attract respondents to answer the questionnaire were used: first, the researcher asked 600 acquaintance to participate; second, he publicized the need for cases in GSOM alumni Facebook group (https://www.facebook.com/alumni.gsom); third, he publicized the need for cases several publics connected to innovations on vk.com (https://vk.com/sciseek, https://vk.com/public9464801, https://vk.com/innovationnews, https://vk.com/innovative_thoughts).

In order to make the questionnaire more understandable and to uncover any potential problems, five people tested it before the launch. After they completed the questionnaire, they were asked for feedback, which was analyzed and used to make final adjustments. The questionnaire was strived to be as short as possible because if the questionnaire is long, people often either do not participate in the survey at all or answer the last questions at random, since the people get tired and bored by the length of the questionnaire. The final version of the questionnaire was five pages long and could be answered in less than ten minutes.

The questions in the questionnaire can be divided into three group: general questions about respondents and companies they represented, questions about financial ratios, and questions about the company's processes. General questions sought to gain brief understanding of the person who took part in the survey and of the company that he represented (see Figure 30). Questions about financial ratios seek to understand how much company spent on something or got from something (see Figure 31). In order to make it easier for people to answer these questions, intervals was used instead of just blank space in which people could white their estimate. The range of possible answers was created based on how much the companies usually spend on such activities. Nevertheless, if the respondent's company was out of the range, the answer choice "other" with blank space for the response was also available. The questions about the company's processes seek to understand the several processes in the company (see

Figure 32). Several statements were grouped in blocks on the basis of their topic. The respondents were asked to identify the level of their agreements with the statements.

This research aims to draw conclusions about all Russian companies. Since the number of Russian companies is too large to question all of them, a sample was used as a proxy for the whole population. Self-selection sampling method was chosen from the variety of sampling methods to collect cross-sectional data. Self-selection sampling method is a sampling method, in which individuals take part in the survey voluntarily. Saunders, Thornhill and Lewis (2009) say that participants often take part in the survey because they are interested in the research topic, and this phenomenon may positively affect the survey. In case of this research, this feature of self-selection sampling is indeed beneficial, since in order to answer correctly the questions in the questionnaire, the respondent should be interested in innovation and, particularly, in the innovations in his company. Otherwise, he cannot know the data required to answer the questionnaire.

Self-selection sampling is a non-probability sampling method. This feature makes it tougher to generalize about the population. However, it is not rational and almost impossible to use any probability sampling technique in this research. A disadvantage of random sampling technique in Russia is that Russian companies do not want to spend time participating in scientific research, especially if research is conducted by a student for his thesis. This situation leads to very low response rate that makes sample not representative, so this being not representative eats the benefits of being a probability sample.

The number of observations for regression analysis should be at least the number of independent variables in the model multiplied by ten – fifteen (Field 2013). Therefore, product innovation model should include at least 80 observarians, and precess innovation model should include at least 70 observations. Nethertheless, having anticipated that people would not respond to all required questions and that some answers should be excluded from the regression, the researcher collected more that 80 responses: the researcher collected 148 responses. After stepwise exclusion, the product innovation model had 99 observations, and the process innovation model had 82 observations – just as many as were required Feild (2013).

The research was not designed to capture industry-specific differences in innovation performance, so for the sake of concision, questions about the industry of the companies were not asked. The only question that was asked is the question about the company's size. The data about the size of the companies in the sample is presented on the Figure 25.

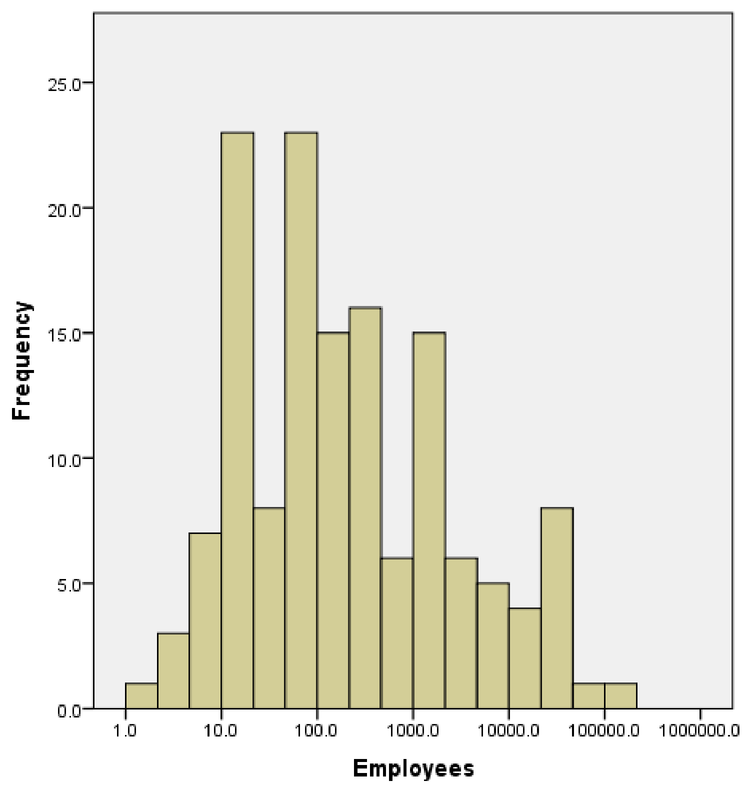

Figure 25. The size of the companies in the sample

The number of men and women was balanced (see Figure 26). However, the sample was dominated by young (20-23 years old) people (see Figure 27), because the researcher mainly asked his acquaintances to participate in the survey. Nevertheless, the domination of young respondents in the sample does not distort the result of the research, since the research is dedicated to study not people, but companies, while people were only sources of the required information.

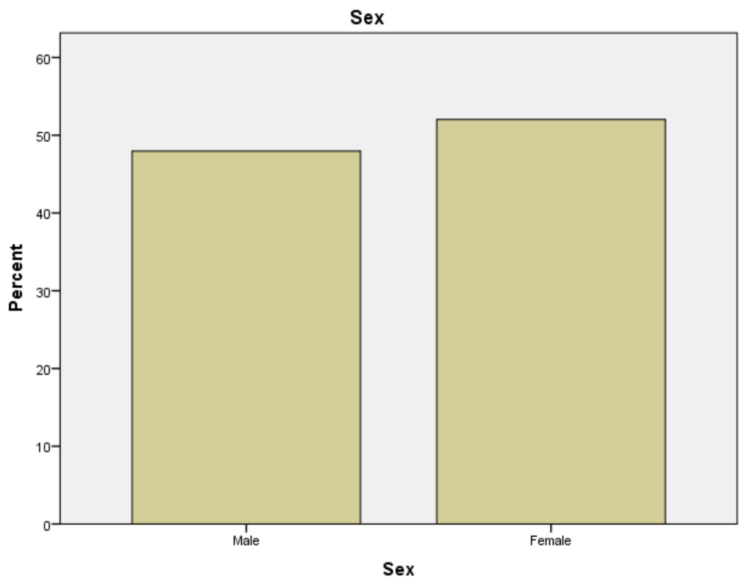

Figure 26. Sex of the respondents

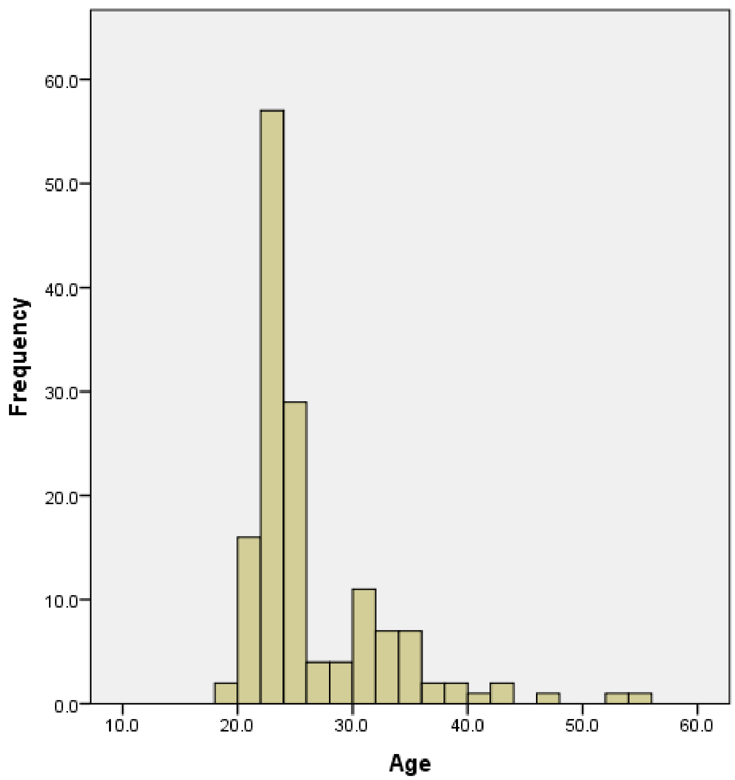

Figure 27. Age of the respondents

2 RESULTS OF THE REGRESSION ANALYSIS, DISCUSSION AND CONCLUSION

2.1 Statistical results of the regression analysis

After data collection, two linear regression models were created in IBM SPSS v. 22 – product innovation model and process innovation model. **Table 6** presents summary statistics for product innovation model. The R^2 and adjusted R^2 of the model (.413 and .361, respectively) are indicative of a reasonably well specified model. Accordingly, the F-statistic for the regression model as a whole is significant (F = 7.992, p = 0.000) at less than the 1 percent level.

Table 6. Cross-sectional regression model of product innovation

Independent variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-3.006	9.795		-.307	.760		
ResandDev	.702***	.180	.335	3.907	.000	.878	1.139
Patents	-.671	.591	-.100	-1.136	.259	.825	1.212
NewEquip	-.023	.373	-.005	-.062	.951	.816	1.226
Training	-1.183**	.515	-.204	-2.297	.024	.822	1.216
Marketing	1.761***	.433	.371	4.070	.000	.778	1.286
StrategyMedian	8.983***	2.409	.394	3.728	.000	.577	1.734
BIMedian	-.149	2.832	-.005	-.053	.958	.643	1.555
IdeasMedian	-2.086	2.598	-.087	-.803	.424	.550	1.819
F-statistic	7.992				0.000		
R^2	0.413						
Adjusted R^2	0.361						

a. Dependent Variable: ProdRev
b. ** coefficients significant at the .05 level
*** coefficients significant at the .01 level

Table 7 presents summary statistics for process innovation model. The R^2 and adjusted R^2 of the model (.231 and .159, respectively) are indicative of a reasonably well specified model. Accordingly, the F-statistic for the regression model as a whole is significant (F = 3.222, p = 0.005) at less than the 1 percent level.

Table 7. Cross-sectional regression model of process innovation

Independent variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	4.593	3.067		1.498	.138		
ResandDev	-.013	.076	-.019	-.177	.860	.846	1.182
Patents	-.121	.182	-.073	-.664	.509	.837	1.195
NewEquip	-.034	.105	-.034	-.325	.746	.924	1.082
Training	.414***	.151	.308	2.738	.008	.808	1.237
StrategyMedian	2.416***	.707	.424	3.420	.001	.668	1.496
BIMedian	-.494	.807	-.072	-.612	.542	.741	1.349
IdeasMedian	-1.228	.781	-.199	-1.571	.120	.642	1.557
F-statistic	3.222				0.005		
R^2	0.231						
Adjusted R^2	0.159						

a. Dependent Variable: ProcRev
b. ** coefficients significant at the .05 level
*** coefficients significant at the .01 level

2.2 Discussion of the results

At the beginning of this research, the model of determinants of innovation performance in Russian companies was created, and eight hypotheses were proposed (see **Table 4**). At empirical stage of this research, these hypotheses were tested, using regression analysis. After the regression analysis, some variables happened to be significant, some not. If the variable was significant, this fact proved or disproved the initial hypothesis. If the variable was not significant, this fact did not mean anything, i.e. it neither proved nor disproved the initial hypothesis. **Table 8** summarizes the information about the results on hypotheses testing. "+" means that the determinant is proved to be positively correlated with the type of innovation. "-" means that the determinant is proved to be negatively correlated with the type of innovation. "Not proven" means that the regression analysis neither proved nor disproved the hypothesis (the variable was insignificant). "No hypothesis" means that no hypothesis about correlation between the variable and the innovation performance was proposed.

Table 8. Proved and not proved hypotheses

Hyp. #	Determinants	Product innovation	Process innovation
1	Research and experimental development	+	not proved
2	Acquisition of other external knowledge	not proved	not proved
3	Acquisition of machinery, equipment and other capital goods	not proved	not proved
4	Training	-	+
5	Marketing preparation for product innovations	+	no hypothesis
6	Features of the company's innovation strategy	+	+
7	Features of the company's competitive and market intelligence	not proved	not proved
8	Features of the company's idea management	not proven	not proved

The regression analysis showed that the more the company invest in research and experimental development, the higher its product innovation performance is. Indeed, if the company regularly develops new products, the chances are high that the company comes up with some innovative product. This phenomenon was noted in many research papers. For instance, Romijna and Albaladej (2002) proved positive correlation between R&D expenditures and product innovation success, using even three different measures of product innovation success: incidence of product innovation, the number of patents held, and product innovation index. Napolitano (1991) and Leblanc et al. (1997) also emphasize the importance of research and development for innovation, and the obtained results proved their views.

Beiersdorf, a personal care company that owns such famous brands as Nivea, relies heavily of internal R&D. Its Hamburg research center employs more than 450 researches, spread across 16000 square meters and has 150 million euro annual budget. Besides Hamburg center, the company has around 120 researches around the world (Perepu 2014). Samsung heavily invests in localized innovation units, called Product Innovation Teams, whose primary responsibility is to create and implement product innovations (Wedell-Wedellsborg and Miller 2014).

The regression analysis identified negative correlation between training expenditures and products innovation performance, and positive correlation between training expenditures and process innovation performance. This fact corroborates the ideas of Kim (1980), Lee, Bae and Choi (1988). The investments in training make employees’ behavior more effective in terms of process, but less effective in terms of creativity, enhancing process innovation performance and hampering product innovation performance. Baldwin and Johnson (1995) point out the importance of training. However, the author claims that training programs are not equally useful for different companies: they are more efficient for the companies with expertise in innovation and quality management and less effective for others.

On the other hand, practical examples show the training may negatively affect product innovation. In 2006, Beiersdorf launched a global consumer connectivity training program called InTouch, in which the employees were taught to understand the customers better. The company used case studies, discussion and practical examples to identify consumer needs that can potentially be incorporated into new products. The training resulted in multitude of product initiatives launched in more than 50 countries (Perepu 2014). Thus, training of market intelligence may positively affect product innovation performance.

The regression analysis showed that the more the company invest in marketing preparation for product innovations, the higher its product innovation performance is. That conclusion is quite intuitive, since thorough marketing preparation of innovative products facilitates the product's adoption by population: it influence knowledge and persuasion steps of innovation-decision process (Rogers 1962).

Marketing plays especially important role than the new product is controversial and induces debates over its usefulness and consequences. Giesler (2013) in his article "How Doppelgänger Brand Images Influence the Market Creation Process: Longitudinal Insights from the Rise of Botox Cosmetic" studies the history of Botox Cosmetics, a remedy against wrinkles. The article explores how contestation between brand adepts and opponents can contribute to brand image and offers a four-step approach to revitalize the brand, using this contestation. The author studies the history of Botox Cosmetics brand, outlining five periods of it. Each period is characterized by unique brand positioning, sometimes mutually exclusive, ranging from "pleasurable play" to "a weapon of liberation".

In order to reinforce the controversial brand positive image, the company should follow four steps: problematization, interessment, enrollment, and mobilization. At problematization step, the company should screen how the brand "restore the harmony" if people use it. For instance, using Botox may underscore the women's belief in science and technology, whereas not using Botox may classify her as being outdated and imbued with prejudices. At the next step, interessmant, the company should enlist the support of experts, such as scientists, doctors and others that will validate the company's propaganda. Then, at enrollment step, the company has to demonstrate the value of the good through concrete customer performance, asking housewives and mothers to speculate about benefits of using the good. At the last stage, mobilization, the company should make its current customers to adopt the current brand image and loose the previous one. To sum up, marketing is important for innovative products, especially if they are controversial.

The regression analysis showed positive correlation between features of the company's innovation strategy and product and process innovation performance. This result supports the findings of previous research. Zien and Buckler (1997) hold that employees and organizational content are the main drivers of innovation performance. Lee and Na (1994) argue that management support and commitment for innovation is crucial to innovation performance, especially in case of radical innovation that may be risky and costly. Without innovation strategy, communicated to and understood by employees, it is hard to induce such radical innovations.

The efficient innovation strategy is especially important when being innovative is harmful for the company in some way. Kodak is a great illustration of this idea: Kodak failed to develop digital photography technology because Kodak thought that digital photography would eat current company's revenues. This situation is called "The Innovator's Dilemma" (Christensen 1997). "The innovators dilemma" is a situation in which a company rejects innovations because today's customers cannot use them. The companies are adhered to customer current needs and disregard innovative ideas that resulting in losing market dominance when customers adopt the innovation that the "successful" companies have let to go. Christensen argues that investing in disruptive technologies is not a rational financial decision for senior managers to make because, for the most part, disruptive technologies are initially of interest to the least profitable customers in a market. Even though Kodak had great developments in digital photography, it failed to profit from them because managers were afraid that digital photography would eat current company's profits that were great. That is why Kodak failed. Kodak could set up new enterprises to deal with digital photography and harness its technical knowledge to excel on the new digital photography market, rather than to let the others do so. In order to avoid such failures, management and employees should follow established and properly delivered innovation strategy.

The correlation between the features of the company’s market or business intelligence and innovation performance was proven neither for product nor for process innovation, despite many researchers suggest that this correlation should exist. As it was mentioned by Atuahene-Gima (1996), the relationship between market orientation and innovation has been debated for decades. Some scholars argue that market orientation negatively influence product innovation since market orientation leads to the development of the products similar to the competitors’, so called "me-too" products, rather than real innovations (Bennett and Cooper, 1981). On the other hand, other scholars hold that market orientation positively affect the company’s innovation performance (Deshpande et al., 1993; Kohli and Jaworski, 1990; Webster, 1988). However, as in this study, the researchers could not prove this claim empirically (Lawton and Parasuraman, 1980).

Atuahene-Gima (1996) found that the company’s market orientation negatively affects product newness because market orientation prevents radical innovations (see Figure 28). Product newness, in turn, is negatively correlated with market success. On the other hand, the company’s market orientation positively affects product advantage, innovation-marketing fit and interfunctional teamwork, all of which are positively correlated with marketing success. To sum up, market orientation makes products less innovative, but more successful on the market.

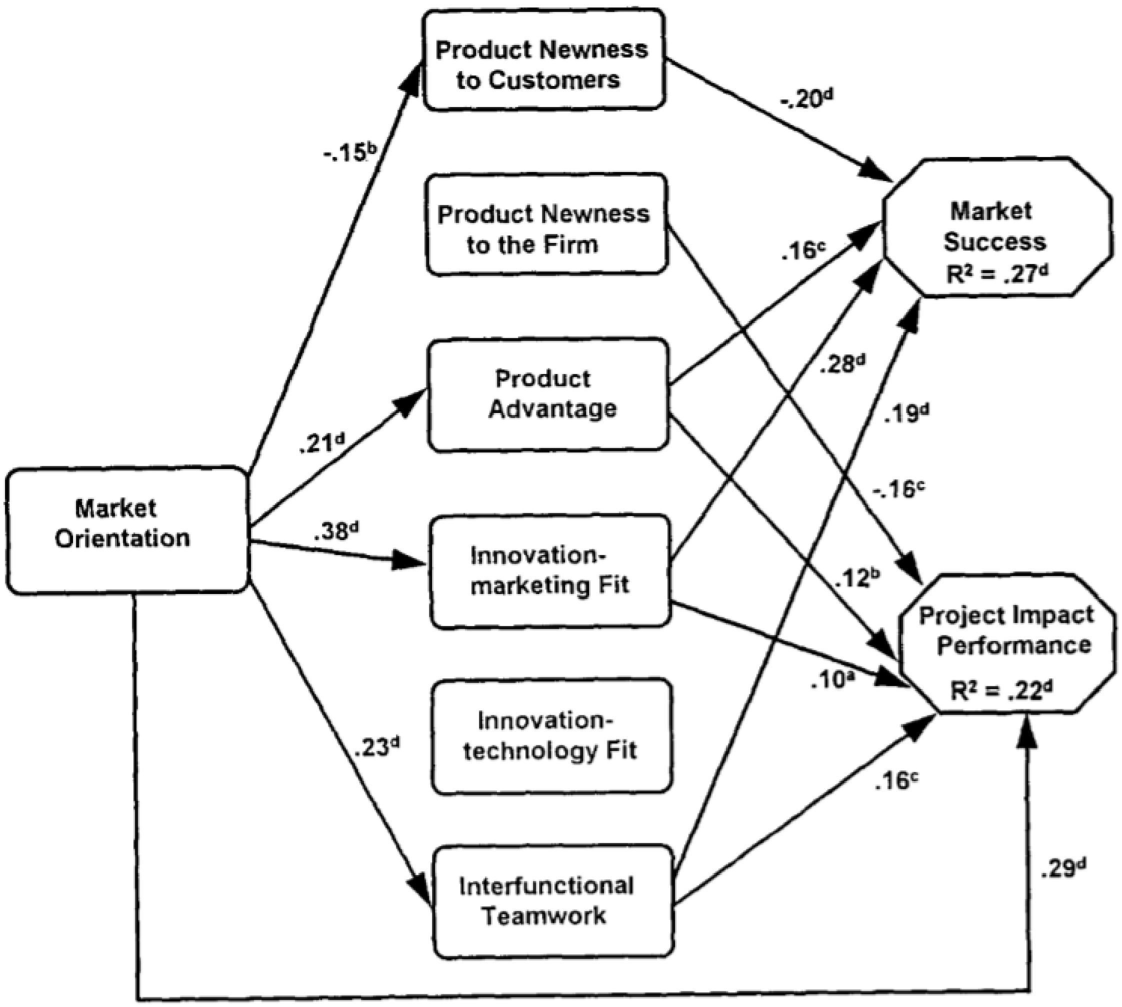

Figure 28. A model by Atuahene-Gima (1996). The numbers on the figure are standardized beta weights.

The correlation between the features of the company's idea management and innovation performance was proven neither for product nor for process innovation, despite almost all researches suggest that this correlation should exist. For instance, Nonaka and Takeuchi (1995) argue that the information sharing stimulates creativity in the organization, and creativity, in turn, helps the company to create more innovative products. Therefore, the companies should motivate their employees to share their ideas.

Prajogo and Ahmed (2006) say that innovation performance requires the context: the company should actively promote the idea of innovation and create idea-friendly environment, that is the companies should "develop managerial practices and actions that function as a stimulus for encouraging and energizing people to innovate through development and accumulation of ideas and knowledge".

Furthermore, the companies should also pay attention to external ideas, taking into account the concept of open innovation (Chesbrough 2003). Laursen and Salter (2006) conducted a vast survey that included a sample of 2707 manufacturing firms in the UK. They found out that the companies that exhibits width and depth in their external idea search tend to be more innovative. However, the correlation is U-shaped (see Figure 29).

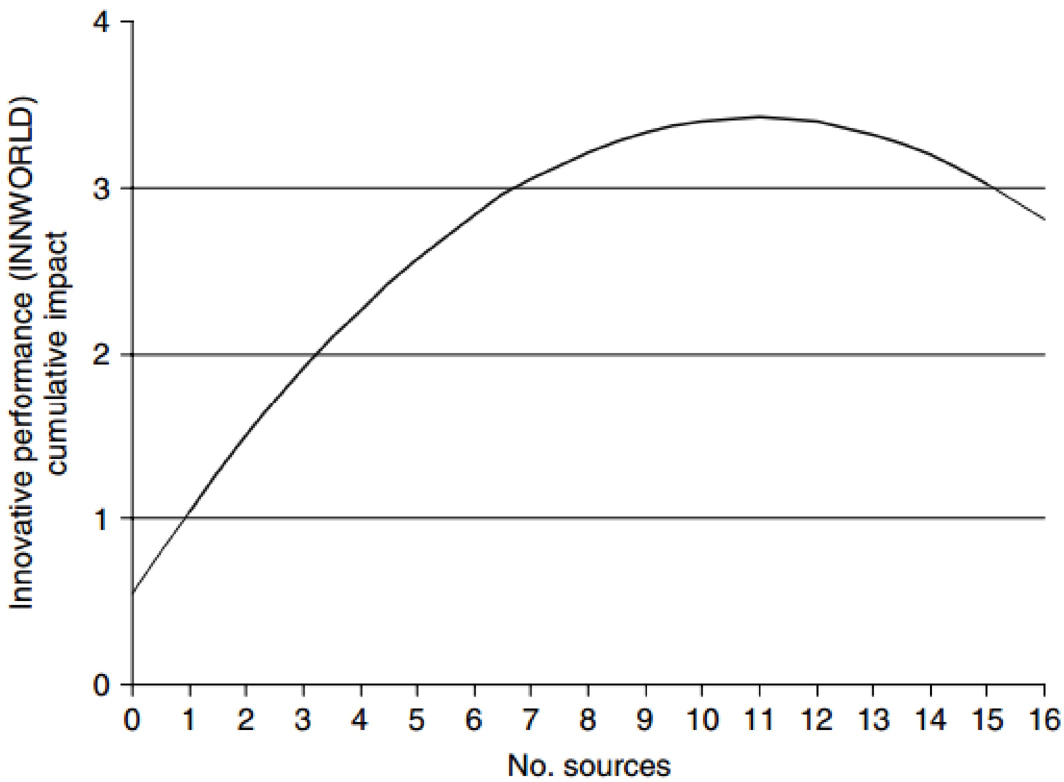

Figure 29. Predicted relationship between innovative performance and the breadth of search through external sources. Source: Laursen and Salter (2006)

2.3 Theoretical contribution, limitations and further research

During this research, the attributive model of innovation at the firm's level was created. This model addresses the following issues of the previous models:

First, previous models provide one best way of innovation process, eliminating alternative paths (2002, cited in Hobday (2005)). Mahdi argues that evidence demonstrates that major differences in innovation process exist within and across different industries. Moreover, these differences persist over time and are not a deviation from a norm. My model does not provide one best way of innovation process, eliminating alternative paths, but rather enlist drivers that make the company successful in innovation. In AMI model in does not matter whether, for instance, market need or technological development comes first, since its non-sequential nature.

Second, most of the models assume that the companies behave too rationally, being able to hypothesize a solution to an innovation problem, such as a new product development, and then systematically solve the problem, using a standard toolkit such as design thinking, prototype testing and market research. However, this case is only possible when companies have enough experience to make an educated guess about the potential solution, otherwise, they have to use iterative approach, experimenting, making mistakes, and trying again. Non-sequential nature of the attributive model eliminates issues with hype-rationality, because non-sequential nature allows for trial-and-error experimentation and rudimentary activities.

Third, the models lack a coherent theoretical base, which is important because it can help to put innovation within the wider organizational and strategic context in which it belongs. Indeed, the state-of-the-art models treat innovation is separate process, failing to understand that it is tightly connected with the firm's strategy, culture and capabilities. The attributive model rests on a solid theory, namely modern resource-based theory.

Forth, all the models deal with innovation leaders, neglecting latecomers. This fact is especially important for scientist who research innovation in developing countries, e.g. Russia, since many companies there do not develop innovations themselves, but rather adopt them from abroad. Moreover, the majority of models deals describe processes in the large corporations, not paying attention to medium and small companies, where innovation process usually do not have any formal stages and domain. For instance, a small company may not even have R&D department. Therefore, for such companies it is definitely inappropriate to apply existing models. The attributive model fits both innovation leaders and latecomers, and both large corporations and small companies, because the determinants of AMI neglect organizational structure and encompass sources of innovations far beyond only R&D department.

The determinants of innovation performance were tested on the cross-sectional sample of 148 Russian companies. The correlation between some variables and innovation performance was proved statistically. That means that the attributive model is grounded not only on the existing theory, but also on the empirical data. However, in this study, causation was not proved, i.e. it was not proved that the determinants elicit innovation performance, not vice versa. The causation proof may be interesting for further studies.

The current analysis was a high-level, not industry specific analysis. However, the differences in innovation processes across the industries do exist, and it may be interesting to adjust the attributive model for different industries.

2.4 Practical contribution

Based on the research, the following recommendation can be given to the management of companies that would like to boost innovation performance. This study produced the model of innovation performance at the firm level. Despite causation between the determinants and the company’s innovation performance has not been proved and in regression analysis, some variables occurred to be insignificant, the attributive model can make it more clear for managers which factors are connected with the company’s innovation performance. The managers may use the attributive model as a starting point if they want to make their companies more innovative. They may use logical reasoning to understand which determinants may be more influential for their industry and their company, identify the weak places in their company (e. g. use of external ideas in the innovation process), and craft a plan to overcome them. To sum up, the attributive model is tool that, after some additional work, managers can use to make their company more innovative.

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4 APPENDICES

Appendix 1

Figure 30. Examples of the general questions

1. **Напишите, пожалуйста, название компании в которой Вы работаете.** ___________________
2. **Сколько примерно сотрудников работает в Вашей компании?** _____________________
3. **Укажите, пожалуйста, занимаемую Вами должность.** ______________________________

Appendix 2

Figure 31. An example of the question about the company's financial ratios

12. Укажите, пожалуйста, какой процент от выручки компании составляют затраты на Научно-исследовательские и опытно-конструкторские работы.

1. 0 - 2%
2. 3 - 4%
3. 5 - 6%
4. 7 - 8%
5. 9 - 10%
6. 11 - 12%
7. 13 – 14%
8. 15 - 16%
9. 17 – 18%
10. 19 – 20%
11. > 20%. Укажите, сколько примерно ______

Appendix 3

Figure 32. An example of the questions about the company's processes

17. Связь инновационной деятельности и стратегии фирмы
Пожалуйста, отметьте, насколько Вы согласны с утверждениями ниже

	Полностью не согласен	Не согласен	Затрудняюсь ответить	Согласен	Полностью согласен
Стратегия компании включает в себя цели по развитию инновационной деятельности					
Инновационная стратегия активно доносится до всех сотрудников компании					
Сотрудники компании понимают значимость инновационной деятельности для успеха компании					