“Features of introducing budgeting for different models of innovation processes: a framework review”

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FEATURES OF INTRODUCING BUDGETING FOR DIFFERENT MODELS OF INNOVATION PROCESSES: A FRAMEWORK REVIEW

Abstract

Innovation processes are vehicles of growth and, therefore, require effective management systems. These circumstances raise the question of how a particular innovation process model influences the features of budgeting implementation at the enterprise. The article aims to figure out the main provisions, which profoundly impact using budgeting for particular innovation process models. Methodologically, this article reviews theoretical approaches and practical basis on innovation process models and peculiarities of using budgeting in this area. Authoritative sources on these issues and the search covering 43 years were observed. This study was also based upon the secondary research data provided by international institutions, such as consulting companies, which help to reveal theoretical foundations and extensive experience in using budgeting practices on innovative companies around the world. Thus, the following statements were identified: an interconnection between the innovation process model and the creation of business units that become budgeting points; specific innovation process models require stage-based budgeting; particular innovation process models demand greater budgeting flexibility. Investigation of these statements led to the discovery: innovation processes models, which require being closed within business units and others that can demand to be more separated; models that are more in need of milestone budgeting; nature of influence flexibility on the efficiency of innovation. The demonstrated findings on features of using budgeting for particular innovation process models can help executives reconsider the existing systems to increase its efficiency.

Keywords innovation, model, budget, development, business unit, flexibility, efficiency

JEL Classification D24, G31, O31, O32

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INTRODUCTION

Nowadays, innovation processes became an integral part of business success. Along with that, to gain a higher return on investment in innovation, executives should effectively exploit the relationships between technology and business model or between process and organization design (Brook & Pagnanelli, 2014). It is highly important because of the fact mentioned by Paraponaris (2003) that now "knowledge is recognized as a competitive issue as well as an organizational issue" (p. 105). Moreover, according to Blomqvist, Hara, Koivuniemi, and Äijö (2004), "in the changing environment companies should focus on their dynamic capabilities beyond specific technologies" (p. 601).

Consequently, when implementing innovative activities, attention should be paid not only to the innovations themselves but also to their implementation's organizational support. Thus, the question of the possibility of efficient use of budgeting for innovation processes is raised.

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For this purpose, it is significant to generalize the main approaches to the conceptualization of innovation process models; to highlight each model's main characteristics; to formulate major statements about the probable ways of using budgeting for some particular innovation process models.

1. LITERATURE REVIEW

Marginson and Ogden (2005) notice that "one important issue concerns how firms are balancing the need to control costs on the one hand with the pursuit of innovation on the other" (p. 29). To solve the problem, the budgeting implementation in managing innovations is used. Despite the widespread use of budgeting, there are some limitations and even disadvantages of applying this tool.

Research by CIMA (2007) found the following: various researchers have identified the drawbacks of traditional budgets that they:

- rarely focus on strategy and are often contradictory;
- are time-consuming and costly to put together;
- constrain responsiveness and flexibility;
- often deter change;
- add little value, especially given the time taken to prepare them;
- focus on cost reduction rather than value creation;
- strengthen vertical command and control (p. 4).

Additionally, Wallander (1999) underlines that strong confidence in budgeting can lead to "a strong tendency to look upon deviations from your budget curves as accidental occurrences. There is thus a risk that the budget will not help to adjust to new circumstances but will rather retard the adjustments" (p. 411). In this case, according to Marginson and Ogden (2005), "decisions about variances should follow automatically from the information received and variances should be corrected. If not, budgetary targets are likely to be missed, leading to ineffective cost control" (p. 30).

Hope and Fraster (2003) also emphasize that "the traditional annual budgeting process encourages dysfunctional and unethical managerial behavior" (p. 197). The researchers are confident that "in turbulent times innovation was stifled by rigid adherence to fixed plans and resource allocations agreed to twelve to eighteen months earlier" (p. 8). Thus, companies increasingly use different forms such as rolling budgets, the activity-based budgeting, and the beyond budgeting approach (Hope & Fraster, 2003; Hansen, Otley, & Van der Stede, 2003). Zamfir (2015) also found that "in operational activities, the budgeting management often has a tendency to break initiatives and innovations" (p. 187).

Along with that, the usefulness of budgeting may be proved by some arguments. In the study by King et al. (2010), it was discovered that "a business's performance is positively associated with the use of written budgets" (p. 54). There is also an opinion of Asogwa and Etim (2017) that:

Traditional budgeting is the panacea for enforcement of control. Budgeting builds extensive planning, coordination and motivational spirit and tends to encourage hard work in an organization. Budgeting is highly recommended in any business environment because it helps organizations define objectives, remain focused and pursue targets (pp. 117-118).

Libby and Lindsay (2010) figured out a few points against some critical statements. Firstly, "time spent on budgeting in the average firm is considerably less than what critics suggest and does not appear excessive" (p. 67). Secondly, "the majority of sample firms do not operate in unpredictable environments to the point where budgets become quickly outdated" (p. 67). Thirdly, "in the majority of firms surveyed, the budget process is explicitly linked to strategy implementation" (p. 67).

Despite the contradictions, nowadays, there are wide opportunities of using budgeting for innovations. The research "Benchmarking innovation impact 2020" by KPMG (2019) includes the study of budget trends, particularly in the innovative area. Along with all respondents, researchers also "identified a dozen "role model" companies to interview, because they have had innovation, new ventures, or R&D initiatives in place for several

years; have been delivering tangible results; and are widely regarded as industry leaders" (p. 3).

As illustrated in Figure 1, innovative companies are more likely to use annual budgeting for providing innovation processes. According to KPMG (2019):

Being part of the annual budgeting process can make innovation and R&D groups look and feel more like all of the other valuable parts of the company – and force them to justify both the value they are delivering and the importance of investing in the future (p. 29).

Besides, Marginson and Ogden (2005) support the opinion that "the dovetailing of formal procedures with informal processes supports the resolution of tensions between budgeting and innovation" (p. 31).

Despite the widespread use of budgeting to manage innovation processes, the question remains how a particular innovation process model influences the specifics of budgeting implementation at an enterprise.

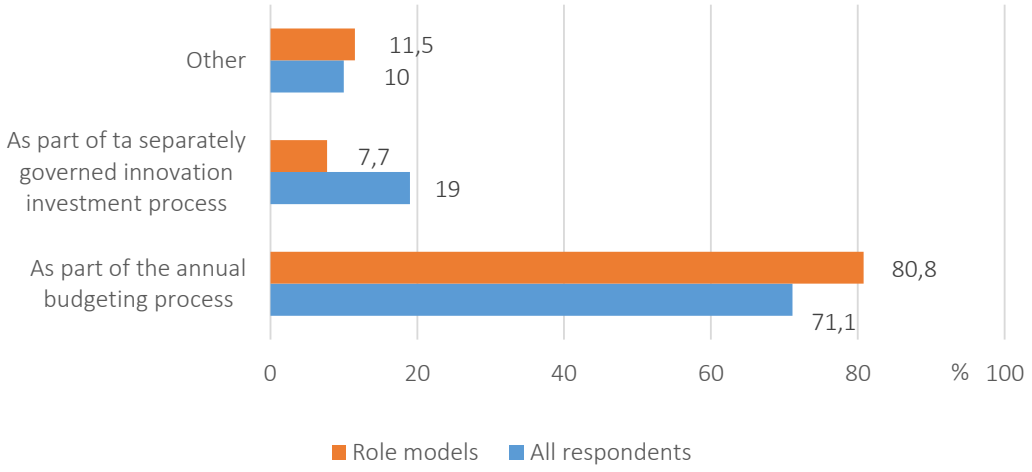
The development of the models of innovation processes was carried out in some stages. This evolution shows how changes in economic conditions affected the transformation of the conceptualization of innovation process models (Table 1).

Each model of the innovation process has its key features, which determine the possibilities of its implementation at an enterprise. Simultaneously, it should be noted that these types are practically not used in their initial form. Along with that, for consideration of some combinations of the models, first of all, it is necessary to allocate the main characteristics of already conceptualized models.

The first generation of innovation process models calls scientific research as the basic impulse of innovation development. This point was caused by the 1950s – mid-1960s, when R&D departments were the centers of innovation production. The linear technology push model consists of the next stages: basic science, design and engineering, manufacturing, marketing, sales.

Rothwell (1994) notes that in mid 1960s – early 1970s, there was a situation when "new products

Source: KPMG (2019).



Note: Other funding comments mentioned:

- "Combo of annual budgeting, then metered funding of efforts (from growth fund)."
- "We have an innovation budget, but we also get money from the business teams and our standard stage-gate product launch process."
- "Hybrid of the two."
- "Ad hoc process."
- "Overall company budget is revised quarterly."
- "None yet."
- "Both. Annual budget for incremental/adjacent innovations, separate [budget] for transformational innovations."
- "Hybrid: Annual budgeting but if we need incremental we go to the executive team for approval at any time."
- "No budget; we depend on other business units."

Figure 1. How innovation efforts are funded

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Table 1. Stages of development of innovation process models

Source: Adapted from Chen et al. (2018), Chesbrough (2003), Galanakis (2002), Manceau and Morand (2014), Nobelius (2003), Preez et al. (2008), Preez et al. (2009), Rothwell (1994), Van der Duin et al. (2007).

Stage	Model type
1950s – mid-1960s	"The linear technology push model"
Mid-1960s – early 1970s	"Market pull" / "Need-pull" / "Demand pull"
Early 1970s – the middle of the 1980s	"Coupling model"
	"Interactive chain-linked model"
Mid-1980s – 1990s	"Integrated model"
	"Stage-gate systems"
	"Scheme of the innovation process by N. Thom"
	"Process model including failures"
	"Process model including requirement specification and functional specification"
	"Networking process"
	"The cyclic innovation model"
2000s	"The creative factory' NPDD model"
	"Open innovation"
2010s	"The holistic innovation paradigm"

were introduced, mainly based on existing technologies" (p. 1) and large and highly efficient companies fought for market share using the market pull model" ("market needs" → "development" →"manufacturing" → "sales").

Hippel (1977) introduces a broader understanding of linear innovation process models and develops an idea of three paradigms for industrial product idea generation: customer-active, manufacturer-active, unfilled "known need":

- customer-active: Product request from customer → "Custom" industrial product → Adoption by others → Universe of standard industrial products;
- manufacturer-active: Needs research by manufacture → Idea generation → Idea testing → Universe of standard industrial products;
- unfilled "known need": "Generally known" user need → Advance in technology → Development of responsive product → Universe of standard industrial products.

The distinctive feature is the emphasis on the possibility of innovation in the production process.

All things considered, subsequent studies (Kline & Rosenberg, 1986) finds some arguments about the importance of "market pull" versus "technology push" as artificial, because "each market needs to enter the innovation cycle, leads to a new design over time, and every successful new design leads to new market conditions" (p. 290).

The coupling model's conceptualization was determined by changes in the macroeconomic situation in the early 1970s – mid-1980s. Rothwell (1994) notices that "companies were forced to adopt strategies of consolidation and rationalization with a growing emphasis on scale and experience benefits" (p. 1). Thus, the coupling model represents the link between the internal process of transforming ideas into products and the current needs of society with the actual state of the science. An important feature is that these references are reversible and present at each stage of the process.

Kline and Rosenberg (1986) note that in the interactive chain-linked model, "there is not one major path of activity, but five" (p. 289): research; potential market; invent and/or produce analytic design; redesign and produce; distribute and market. The model emphasizes different types of relationships between the main elements of the central chain of innovation, research, and knowledge and describes ways how to receive feedback.

The integrated model was a response to the time challenges of the early 1980s and early 1990s. It was necessary to shorten the life cycles of products, which led to time-based strategies (Rothwell, 1994). That caused the necessity to develop innovations based on the next elements: marketing, research and develop-

ment, product development, production engineering, parts manufacturing (suppliers), manufacture. These processes were strengthened by the rapid growth of strategic alliances between companies.

Cooper (1990) defines the stage-gate system as "both a conceptual and an operational model for transition a new product from an idea to launch" (p. 44). This model consists of a certain number of stages (preliminary assessment, detailed investigation (business case) preparation, development, testing and validation, full production, and market launch) and gates between each of them (initial screen, second screen, decision on business case, post-development review, pre-commercialization business analysis, post-implementation review). The gate is a quality control checkpoint, which includes "a set of quality criteria that the product must pass before moving onto the next work station" (p. 46). Usually stage-gate systems include a different number of stages and gates, depending on the company or division. It is important to notice that "each stage is usually more expensive than the preceding one" (p. 46).

It should be noted that each stage is cross-functional. The stage of research and development, marketing, etc. is not singled out by itself. Each stage contains marketing, research and development, and production. None of the business units works within one stage (Cooper, 2008).

Verworn and Herstatt (2002) provide an overview in their working paper, which also includes three innovation process models in the German-speaking area. The first one is the scheme of the innovation process by Thom. This model is partly simplified and represents the main concept without detailed elaboration and presentation of the connections between the particular phases:

1. Idea generation: Definition of the search field → Idea detection → Idea proposal.

2. Idea acceptance: Idea evaluation → Preparation of implementation plans → Decision on one implementation plan.

3. Idea implementation: Realization of the new idea → Sale of the new idea to target customers → Check on acceptance.

The second of reviewed models (Verworn & Herstatt, 2002) is the process model, including failures by F. Pleschak and H. Sabisch, which is more detailed and similar in structure with the stage-gate systems by Cooper. Market and technology development, customer needs, and problems launch the next process:

- Awareness of a problem, Problem analysis/ strategy formulation (company, innovation, technology, market).
- Idea generation, new solutions to the problems. Idea assessment and selection.
- Project and program planning. Cost-effectiveness study.
- Research and development. Technology transfer.
- Rollout in production.
- Launch.

There can be rejected ideas, rejected projects, and failures between these stages. Simultaneously, the model illustrates possibilities of cooperation with research institutes, other companies, and transfer organizations. The model also shows the external influence of different institutions on these relationships' internal innovation process and nature.

Ebert, Pleschak, and Sabisch reveal the process model including requirement specification and functional specification (Verworn & Herstatt, 2002), which also consists of particular phases and displays the influence of major factors (market trends, competitive environment, specific customer needs, potential development inside the company, technological progress, social environment) on the formation of the problem to be solved through the innovation process:

Phase I – Preparation (pre-phase): Problem analysis → Idea generation → Ideas to solve problem → Idea assessment and selection.

Phase II – Elaboration: Research and development project → Requirement specification → Functional specification → Assessment of functional goals (Change of goals).

Phase III – Implementation: Decision (reassurance) → Development process (Assessment of results) → Transfer launch (Concretion/update of functional goals) → New product or process.

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Phase IV – Controlling.

Trott (2005) points out that the network model of innovation "suggests that new product development should be viewed as a knowledge-accumulation process that requires inputs from a wide variety of sources. The model helps to highlight the accumulation of knowledge over time" (p. 403) and try to emphasize the importance of the external linkages in the new product development process":

- External inputs of "Marketing and sales": societal needs, competitors, supplier partnerships, distributors, customers, strategic alliances.
- External inputs of "Finance": competitors, suppliers, distributors, customers.
- External inputs of "Engineering and manufacturing": competitors, suppliers, distributors, customers, university departments.
- External inputs of "Research and development": scientific and technological developments, competitors: suppliers, customers, university departments.

Berkhout, Hartmann, and Trott (2010) develop an idea of the cyclic innovation model. They criticize other models because of their familiar pipeline architecture and isolated state. The proposed model assumes that ideas can arise at any point in the cycle, which, in turn, causes a wave that can spread in both directions around the circle. Simultaneously, nodal points (scientific research, technological change, product development, market transitions) function as a crossroad with a circular motion, and the entrepreneur generates driving forces.

Galanakis (2002) develops an idea of "the creative factory's NPDD model, which is based on the Development Funnel and Stage-Gate models" (p. 49). The author states confidently that "the model can be used to assess the status of each firm according to its innovation activity and simulate different scenarios for each case in order to demonstrate how a firm can improve its innovation outcome" (p. 169).

Chesbrough (2003) conceptualizes two approaches to the knowledge landscape. In the first model, research projects are based only on the enterprise's scientific and technical base. During the development process, some projects are halted, and others are selected for further market introduction. The scientist calls this process closed because projects can go only one way, from the beginning, and there is one way out – into the market.

In the study, some more facts are given, which have rearranged this knowledge landscape. Chesbrough (2003) believes that "if a company does not use its ideas with alacrity, it may lose those ideas to outside organizations" (p. 41).

Along with that, Chesbrough (2003) notices that:

There is a rich variety of possible research inputs available outside the firm. These external results could be brought into the firm and turned into new products and services. What previously was a fundamentally closed, internal environment has transformed into an open environment (p. 40).

In this model, new technologies can go out of the process at any stage, and projects can be implemented on the market in several ways: patenting, side technologies, entering the market with the company's own sales channels.

In recent times, concepts of holistic innovations have appeared in scientific studies. One of these models is conceptualized by Chen et al. (2018) and represents "a complex helix of strategic innovation, collaborative innovation, total innovation, and open innovation, which reflects wisdom of the Chinese context and Eastern culture" (p. 11). The researchers are confident that this model "provides enterprises with a systematic and holistic view of combining strategic management, organizational design, cultural construction, and industrial trends, and realizes the divergent thinking of engineering and social science in the natural sciences" (p. 11). Manceau and Morand (2014) also "argue in favor of a holistic view of innovation combining R&D and creativity and including recent trends such as design thinking, open innovation, digitalization, sustainable development, and resource-limited innovation" (p. 113). Simultaneously, the existing representation of models does not provide a clear understanding of their internal processes.

2. GENERALIZATION OF THE MAIN STATEMENTS

All this variety of models of innovation processes influence the choice of budgeting methods. No single approach fits all scenarios, so it is necessary to identify the main options for different innovation process models. This issue is quite extensive, so the article investigates several basic statements about the probable ways of using budgeting for some particular innovation process models.

Statement 1. There is interconnection between the innovation process model and creation of the business units, which become budgeting points

Innovative companies need to find, according to KPMG (2019), "the right balance between establishing autonomous innovation teams and embedding innovation in the core business" (p. 25). This issue is fundamentally important because, as Simons (2005) mentions, "on the one hand, structure follows strategy. But on the other hand, organization design – through its defining effect on information flows – influences future strategies" (p. 9). The research held by McKinsey (Barsh et al., 2007) discovers that 56% of executives have special product development teams for developing innovation within business units of their companies, meanwhile 25% – centralized innovation initiative teams, 20% – some centralized innovation group or unit, 17% – a traditional R&D center. Researchers have concluded that "companies often seem to isolate innovation projects within business units, even when they see bigger opportunities" (p. 4).

On the other hand, in some cases, this approach cannot bring desired success, because one, according to ICSTI of Ireland (2015), "will come to pass only if researchers have the opportunity to enhance their own track record and reputation by leading their own team, managing a budget, or being the lead investigator named on grant applications" (p. 39). In the situation where individual managers designate budgetary responsibility areas, there was the potential for localized variance analysis and correction as individual managers sought to achieve their compartmentalized budgetary targets (Marginson & Ogden, 2005).

This statement is also supported by earlier research (Lin & Vasarhelyi, 1980). The study shows that "the divisionalized organization in the distributed form will have the advantage of highly motivated divisions which can be innovative and grow" (p. 205).

In current practice, this statement is revealed in the research by KPMG (2019), where the results show that "the disruptive the innovation, the further it tends to be separated from the core business – business unit staff are leveraged for 82% of incremental innovation, compared to 24% for transformational innovation. Incremental efforts are usually best handled by the core business units they impact". It is also important to highlight that "more risk-averse organizations may require greater distance between their innovation teams and the core to ensure that good ideas are incubated" (p. 25).

Statement 2. Particular innovation process models require budgeting on a milestone basis

There is extensive experience, confirmed by PWC research (Shelton & Percival, 2013), that "innovation does not operate on an annual budgeting cycle. Instead, innovation resources need to be deployed on a milestone basis. Innovation budgets should be protected and not able to be used for the operations of the day-to-day business" (p. 36).

This point of view is also supported in the study by Capgemini Consulting (Thompson et al., 2018). The researches quote executives of the innovation companies who share the opinion that:

Part of the budget should be earmarked for exploration and not diverted because of pressures for short-term financial performance. Furthermore, some companies have *a dedicated budget (approximately 5% of the total R&D budget) to research new products and new technologies. Under these circumstances, business leaders have accepted that they can only get access to that budget if they actually bring out long-term topics or innovative ideas* (p. 9).

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It is equally important that some innovative companies "always reserve a part of their budget for disruptive technologies, where they do not necessarily get a solution or a product in mind, but they experiment" (p. 9). In this case, the company will simply "learn about the technology and from there managers decide if it is worth to have a more substantial investment on it" (p. 9).

Subsequently, Lin and Vasarhelyi (1980) emphasize if it is decided that a particular project is needed, the staff, among others things, "must work to establish natural project phases and breakdown project costs by phases; establish detailed phase-by-phase budget; present detailed project budget to management with detailed cost and result forecast" (p. 207).

Statement 3. Particular innovation process models demand more flexibility in budgeting

The research held by KPMG and ACCA shows that only 21% of 900 finance professionals from more than 50 countries agreed that the planning, budgeting, and forecasting process incorporated sufficiently flexible data modeling capabilities (O'Mahony & Lyon, 2015).

Along with the fact that innovation companies widely use budgeting, the need for greater flexibility becomes especially significant.

It is important to put a sharper point on the assertion that in this case situations, where executives may adjust R&D to smooth accounting earnings and to signal firm value are not considered (Bange & Bondt, 1998).

Marginson and Ogden (2005) notice that "in practice, however, decisions on budget variance correction must be taken in a wider context in the light of the pursuit of innovation, which implies a degree of inefficiency, and also of unexpected financial requirements" (p. 30). Along with that, Pennetier et al. (2018) mention that "variation in R&D spending is negatively related to innovation performance in terms of both quantity and quality provided overall investments in R&D are controlled" (p. 25). At the same time, "only unpredictable variability is harmful; predictable variability has no effect or potentially even a positive effect" (p. 26). Therefore, "if the performance of R&D is a priority, then managers should strive to make any strategic repositioning in R&D funding as gradual as possible" (p. 26).

It should be noted that the results of numerous studies emphasize the statement that there is an interconnection between the efficiency of budgeting and the objectives of its use, especially in the area of innovation.

Dunk (2011) reveals the following:

When the emphasis is on using budgets as a planning mechanism… it facilitates product innovation impacting positively on firms' financial performance. In contrast, the results show that when the emphasis is on using budgets primarily as a control mechanism, innovation does not promote performance (p. 109).

In general, Lin and Vasarhelyi (1980) emphasize that:

In R&D the budgeting of costs serves only as a guideline for the determination of expenditures. The R&D area requires budgets tied together with progress estimates on the specific projects and the various phases of the project. For product-oriented R&D projects financial control has to assess benefits in addition to cost control (p. 207).

Moreover, Shelton and Percival (2013) declare that "experience shows it is far more important to manage how the funds are spent, rather than worrying excessively about budgets" (p. 36).

Another important point about the budget's ability to be flexible enough for innovations is discovered in the research by Marginson, Ogden, and Frow (2006). According to them, "a particular issue for managers, as they sought to respond innovatively to unfolding events and new information, is the question as to whether or not to correct a budget variance, given these new circumstances". The study reveals that "furnishing managers with a range of management controls which they may call upon for tension resolution purposes may reduce the pressure on organizations". Because of this, "managers may not perceive the interplay between budgets and innovation to be particularly problematic" (p. 15).

The other side of the issue about flexibility is noticed by KPMG (2019): "the annual budget process can disadvantage long-term investment, particularly

when those decisions involve multi-year investment cycles. By favoring existing programs over new, disruptive ones, the annual budget is often inflexible when funding is needed to respond to unexpected disruption" (p. 48).

A relationship has been identified between the degree of flexibility required and the nature of innovations (Chiesa, Frattini, Lamberti, & Noci, 2009). In particular, "radical innovation projects, especially in the early stages of development, are characterized by a stronger reliance on flexible and social control management systems, while diagnostic control mainly emerges in late development and commercialization" (p. 416).

Besides, a significant challenge is the possibility of flexible budgeting during a crisis. It is extremely important because, from time to time, the crisis can become a part of each company's functioning. Hud and Rammer (2015) find that:

Maintaining a higher level of innovation expenditures despite a deteriorating macroeconomic environment could give firms a head start over its competitors in the following upswing period if the competitors refrained from following this strategy. This allows them to offer new products to the market earlier in the post-crisis period, better quality or better targeted to user needs (p. 16).

3. DISCUSSION

The study shows that innovation processes models which, due to the initial cause of innovations, require being closed even more within business units where they were invented. This is particularly noticeable in the manufacturer-active model (Hippel, 1977), the process model, including requirement specification and functional specification by Ebert, Pleschak, and Sabisch (Verworn & Herstatt, 2002). According to KPMG research (2019), the same approach is required for those processes that are triggered by consumer demand and are incremental innovations; and for promoting new ideas being accepted and adopted quickly into the business. In particular, it could be the integrated model (Rothwell, 1994), the process model including failures by Pleschak and Sabisch (Verworn & Herstatt, 2002), the network model of innovation (Trott, 2005).

Conversely, some innovation processes models may require more isolation. Particularly, it refers to transformational innovations, which may be represented, to some extent, in the following models: the stage-gate systems (Cooper, 1990); the creative factory model (Galanakis, 2002).

Another point is that there are innovation processes models which are more in need of milestone budgeting. For instance, due to their depiction, they may be the coupling model (Rothwell, 1994); the interactive chain-linked model (Kline & Rosenberg, 1986); the stage-gate systems (Cooper, 1990); the creative factory model. At the same time, the process model, including failures by Pleschak and Sabisch, clearly illustrates the process that requires the budget on the basis that there is funding not necessarily to find a solution but to do an experiment.

To clarify the need for flexibility in budgeting, the point that budgeting should be more a planning tool than a control one is emphasized. Under these conditions, the ability to be modified becomes notably important, especially in a crisis. For innovation to be effective, changes in the budget should lead to a downward movement rather than for managers to reduce innovation funding because of their daily activities. This statement is mentioned by Tănase (2013) who underlines that participatory budgeting may motivate employees, increase their performance, and their satisfaction may help the entity to obtain more realistic budgets.

Due to the complex design and the existence of complex interconnections, the following models require more flexibility: the process model including failures by Pleschak and Sabisch; the process model including requirement specification and functional specification by Ebert, Pleschak, and Sabisch; the cyclic innovation model (Berkhout et al., 2010); the creative factory model; the model of the open innovation (Chesbrough, 2003).

4. STUDY LIMITATIONS

There is a complete understanding that models of innovation processes observed in this article do not constitute a complete set of all conceptualized models. Nevertheless, the presented models represent the main trends in this field within particular

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periods. The next limitation is a partial disclosure of budgeting features for some particular innovation process models. This issue demands separate studies for each type of model or their combinations and can be a possible outlined area for further research.

CONCLUSION

A significant effect from providing innovations, according to Andersen et al. (2019), may result in "a focus solely on implementing digital technology. At the same time, companies need to remain aware that successful innovation not only requires the right technology, it also needs the right people and the right organization structures" (p. 23). Based on this, the study showed that particular innovation process models require different approaches for using budgeting because of their design.

The research helps to identify innovation processes models that require being closed within business units where they were invented and others, that contrariwise, can demand to be more separated. Additionally, the study has identified innovation processes models that are more in need of milestone budgeting. Furthermore, the research found that the contradictory nature of flexibility has a significant influence on innovation's efficiency. There were also discovered evidence that it is better when innovation teams have sufficient tools to manage budgeting; budgets are used more as a planning tool than a control one. All of the following statements are especially important during a crisis.

The novelty of the results is that the existing scientific studies do not represent a comprehensive approach to characterizing interrelation between particular innovation process models and features of using budgeting in this field. Otherwise, the current study has initiated the development of that approach.

The possibility of practical use of the obtained results is that, depending on the innovation process model that is used at the enterprise, executives have a clearer guiding line for improving the budgeting system, at least as for such items as the degree of separation, milestone basis, and flexibility. The demonstrated findings of these relationships' nature will help to reconsider the existing systems to increase efficiency. This paper also provides an initial basis for future research on some particular innovation process models' budgeting features.

AUTHOR CONTRIBUTIONS

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REFERENCES

1. Andersen, N., Boersch, Dr. A., & Blohmke, Dr. J. (2019). *A Deloitte survey on European companies and how digital technologies can strategically enhance innovation*. Retrieved from https://www2.deloitte.com/content/dam/insights/us/articles/DE_897_Innovation-in-Europe/DI_Innovation-In-Europe.pdf
2. Asogwa, I. E., & Etim, O. E. (2017). Traditional Budgeting in Today's Business Environment. *Journal of Applied Finance & Banking, 7*(3), 111-120. Retrieved from http://www.scienpress.com/Upload/JAFB/Vol%207_3_7.pdf
3. Bange M. M., & Bondt, W. F. M. (1998). R&D budgets and corporate earnings targets. *Journal of Corporate Finance, 4,* 153-184. https://doi.org/10.1016/S0929-1199(98)00006-6
4. Barsh, J., Capozzi, M., & Mendonca, L. (2007). *How companies approach innovation: A McKinsey Global Survey*. Retrieved from https://www.elkarbide.com/sites/default/files/MCKINSEY%20INNOVACI%C3%93N.pdf
5. Berkhout, G., Hartmann, D., & Trott, P. (2010). Connecting technological capabilities with market needs using a cyclic innovation model. *R&D Management, 40*(5), 474-490. https://doi.org/10.1111/j.1467-9310.2010.00618.x
6. Blomqvist, K., Hara, V., Koivuniemi, J., & Äijö, T. (2004). Towards networked R&D management: the R&D approach of Sonera Corporation as an example. *R&D Management, 35*(5), 591-603. https://doi.org/10.1111/j.1467-9310.2004.00365.x
7. Brook, J. W., & Pagnanelli, F. (2014). Integrating sustainability into innovation project portfolio management – A strategic perspective. *Journal of Engineering and Technology Management, 34,* 46-62. https://doi.org/10.1016/j.jengtecman.2013.11.004
8. Chen, J., Yin, X., & Mei, L. (2018). Holistic Innovation: An Emerging Innovation Paradigm. *International Journal of Innovation Studies, 2*(1), 1-13. https://doi.org/10.1016/j.ijis.2018.02.001
9. Chesbrough, H. W. (2003). *Open innovation: the new imperative for creating and profiting from technology*. Harvard Business School Publishing Corporation.
10. Chiesa, V., Frattini, F., Lamberti, L., & Noci, G. (2009). Exploring management control in radical innovation projects. *European Journal of Innovation Management, 12*(4), 416-443. https://doi.org/10.1108/14601060910996909
11. CIMA. (2007). *Beyond Budgeting.* Retrieved from https://www.cimaglobal.com/Documents/ImportedDocuments/cid_tg_beyond_budgeting_oct07.pdf
12. Cooper, R. G. (1990). Stage-gate systems: A new tool for managing new products. *Business Horizons, 33*(3), 44-54. https://doi.org/10.1016/0007-6813(90)90040-I
13. Cooper, R. G. (2008). The Stage-Gate Idea-to-Launch Process–Update, What's New, and NexGen Systems. *The Journal of Product Innovation Management, 25*(3), 213-232. https://doi.org/10.1111/j.1540-5885.2008.00296.x
14. Dunk, A. S. (2011). Product innovation, budgetary control, and the financial performance of firms. *The British Accounting Review, 43*(2), 102-111. https://doi.org/10.1016/j.bar.2011.02.004
15. Galanakis, K. (2002). *The 'Creative Factory' An Innovation Systems Model Using a Systems Thinking Approach*. Retrieved from http://go.warwick.ac.uk/wrap/1269
16. Hansen, St. C., Otley, D. T., & Van der Stede, W. A. (2003). *Practice developments in budgeting: An overview and research perspective*. http://dx.doi.org/10.2139/ssrn.410544
17. Hippel, E. (1977). *A customer-active paradigm for industrial product idea generation*. Retrieved from https://www.semanticscholar.org/paper/A-Customer-active-Paradigm-for-Idustrial-Product-a-Hippel/bc24989489d2bda2c-713cf30798ff9fd05582b81
18. Hope, J., & Fraster, R. (2003). *Beyond budgeting: How managers can break free from the annual performance trap*. Harvard Business School.
19. Hud, M., & Rammer, Ch. (2015). *Innovation Budgeting Over the Business Cycle and Innovation Performance*. http://dx.doi.org/10.2139/ssrn.2608122
20. Interdepartmental Committee on Science, Technology and Innovation of Ireland. (2015). *Excellence talent impact. Ireland's strategy for research and development, science and technology*. Retrieved from https://dbei.gov.ie/en/Publications/Publication-files/Innovation-2020.pdf
21. King, R., Clarkson, P. M., & Wallace, S. (2010). Budgeting practices and performance in small healthcare businesses. *Management Accounting Research, 21,* 40-55. https://doi.org/10.1016/j.mar.2009.11.002
22. Kline, St. J., & Rosenberg, N. (1986). *An overview of innovation*. Retrieved from http://dec.ec.unipg.it/~fabrizio.pompei/KlineRosenberg(1986).pdf
23. KPMG. (2019). *Benchmarking innovation impact 2020*. Retrieved from https://info.kpmg.us/content/dam/info/en/innovation-enterprise-solutions/pdf/2019/benchmarking-innovation-impact-2020.pdf
24. Libby, Th., & Lindsay, R. M. (2010). Beyond budgeting or budgeting reconsidered? A survey of North-American budgeting practice. *Management Accounting Research, 21,* 56-75. https://doi.org/10.1016/j.mar.2009.10.003
25. Lin, W. Th., & Vasarhelyi, M. A. (1980). Accounting and financial control for R&D expenditures. *Studies in the Management Sciences, 15,* 199-213. Retrieved from https://www.researchgate.net/publication/280578370_Accounting_and_Financial_Control_for_RD_Expenditures

http://dx.doi.org/10.21511/ppm.18(3).2020.28

26. Manceau, D., & Morand, P. (2014). A few arguments in favor of a holistic approach to innovation in economics and management. *Journal of Innovation Economics & Management, 15,* 101-115. https://doi.org/10.3917/jie.015.0101

27. Marginson, D., & Ogden, S. (2005). Budgeting and innovation: Do budgets stifle creativity? *Financial Management,* 29-31. Retrieved from http://www.cimaglobal.com/documents/importeddocuments/technicalapr05.pdf

28. Marginson, D., Ogden, S., & Frow, N. (2006). *Research report. Budgeting and innovation. Complements or contradictions?* Retrieved from https://www.cimaglobal.com/Documents/ImportedDocuments/tech_resrep_budgeting_and_innovation_2006.pdf

29. Nobelius, D. (2003). Towards the sixth generation of R&D management. *International Journal of Project Management, 22*(5), 369-375. https://doi.org/10.1016/j.ijproman.2003.10.002

30. O'Mahony, J., & Lyon, J. (2015). *Planning, Budgeting and Forecasting. An eye on the future*. Retrieved from https://home.kpmg/content/dam/kpmg/pdf/2015/08/an-eye-on-the-future-kpmg-acca-report.pdf

31. Paraponaris, C. (2003). Third generation R&D and strategies for knowledge management. *Journal of Knowledge Management, 7*(5), 96-106. https://doi.org/10.1108/13673270310505412

32. Pennetier, Ch., Girotra, K., & Mihm, J. (2018). R&D Spending: Dynamic or Persistent? http://dx.doi.org/10.2139/ssrn.2671828

33. Preez, N., & Louw, L. (Eds.). (2008). A framework for managing the innovation process. *PICMET '08 - 2008 Portland International Conference on Management of Engineering & Technology,* 546-558.. https://doi.org/10.1109/PICMET.2008.4599663

34. Preez, N., Louw, L., & Essmann, H. (2009). An Innovation Process Model for Improving Innovation Capability. *Journal of High Technology Management Research, 17,* 1-24. Retrieved from https://www.semanticscholar.org/paper/An-Innovation-Process-Model-for-Improving-Preez-Louw/d85a97a149efad7d65ea1c7bdc4d7a6e2b8fdc19

35. Rothwell, R. (1994). Towards the fifth-generation innovation process. *International Marketing Review, 11*(1), 7-31. https://doi.org/10.1108/02651339410057491

36. Shelton, R., & Percival, D. (2013). *Breakthrough innovation and growth*. Retrieved from https://www.pwc.es/es/publicaciones/gestion-empresarial/assets/breakthrough-innovation-growth.pdf

37. Simons, R. (2005). *Levers of organization design: how managers use accountability systems for greater performance and commitment*. Harvard Business School Publishing.

38. Tănase, G. L. (2013). An Overall Analysis of Participatory Budgeting Advantages and Essential Factors for an Effective Implementation in Economic Entities. *Journal of Eastern Europe Research in Business and Economics,* 1-12. https://doi.org/10.5171/2013.201920

39. Thompson, N., Bonnet, D., & Ye, I. Y. (2018). The Foundations of Corporate Innovation in the Digital Age. Retrieved from http://ide.mit.edu/sites/default/files/The%20foundations%20of%20corporate%20innovation%20in%20the%20digital%20age.pdf

40. Trott, P. (2005). *Innovation management and new product development* (3rd ed.). Pearson Education Limited.

41. Van der Duin, P., Ortt, R., & Kok, M. (2007). The Cyclic Innovation Model: A New Challenge for a Regional Approach to Innovation Systems? *European Planning Studies, 15*(2), 195-215. https://doi.org/10.1080/09654310601078689

42. Verworn, B., & Herstatt, C. (2002). *The innovation process: an introduction to process models*. https://doi.org/10.15480/882.93

43. Wallander, J. (1999). Budgeting – an unnecessary evil. *Scandinavian Journal of Management, 15,* 405-421. https://doi.org/10.1016/S0956-5221(98)00032-3

44. Zamfir, M. (2015). The pros and cons of budgeting system within economic entities. *Bulletin of the Transilvania University of Brasov, 8*(57), 183-192. Retrieved from https://www.semanticscholar.org/paper/The-pros-and-cons-of-budgeting-system-within-Zamfir/13091d01e4cc23598e-ab7cccb3e81539a23b084c