

Usage Of Information Technology In New Product Development Process

Midohoabasi Essienubong

Abstract: "Information technology" (IT) is used in this study to mean any computer, networking, storage, infrastructure, physical devices and software used to create, store, process, exchange and distribute any form of data. As there are advances in the capabilities of IT, companies and businesses involved in the creation of products leverage these capabilities to innovate and create new products. New product development (NPD) is a defined process for developing new products for the market and it is considered the primary step to making a product available to the market. To keep up with the market, firms must continue to innovate and develop new products to meet their customers' dynamic needs. To highlight Information Technology (IT) used in new product development (NPD) process, an empirical research by qualitative analysis, using semi-structured interview methodology was conducted with nine start-up product development leaders. A conceptual model for the use of IT in NPD was created based on scientific theoretical literatures and the NPD framework for defining the stages of the NPD process. The study revealed that dependence on IT in NPD increases along the NPD process and the complexity of the IT tools employed also increases, needing more expertise and knowledge to maximise their use. The study further indicated that the development methodology adopted by firms in their NPD activities informed the choice of IT tools they employed in the NPD process.

Index Terms: New Product Development, Information Technology, Start-ups

1 INTRODUCTION

NPD processes are activities carried out from the conceptual stage of a new product to when it is launched. It is a process that evolves. NPD is a project, and project management strategy may be employed all through the process. The NPD process may differ depending on the industry (Bhuiyan, 2011). In all its peculiarities to the industry of the product, the project still has to be managed effectively in order to achieve the project deliverables. Technology is an integral part of the NPD process, from decision making to conceptualization and prototyping of new products. Technology changes rapidly and this is expected to continue in an exponential style. However, NPD decisions that do not take into careful consideration the dynamics of technological evolution may result in unsustainable investments. Some firms may view new product options in the short-term as being profitable but a careful consideration will reveal the investment may lack long-term potential. Therefore, firms tend to reinvest in subsequent available technologies to remain viable. IT takes the lead in effecting changes in the structure of NPD process; In theory, NPD always begins with first identifying a problem and an idea to mitigate the problem but practically, it is not always a linear stop-by-step process starting from the initial problem to the solution in a clearly defined format (Nambisan, 2010), consequently, the development of IT-based tools to support the NPD process is far from being straightforward. For IT-based systems to enhance the decisions of managers and the work of NPD teams, they should be developed in response to the requirements of NPD teams. New technology selection are germane strategic planning issues, however, the demand for IT evaluation is also on the increase and objective factors such as; profit, revenue, cost and time of completion, alongside subjective factors such as capacity increment, learning and flexibility should be carefully considered in the evaluation of would-be selected technologies. This further shed light on the fact that these challenges take a multiple-criteria decision-making form (He-Yau, Amy, Chao-ChenG and Mei-Sung, 2012). According to Sanayei (2016), evaluating emerging technologies enables businesses to either maintain a technology growth curve or replace the technology that exists in order to be ahead of the competition, retaining a desirable market share. Literatures that deal with technology development have

revealed that in some companies, they develop technology from their own research labs (Daim, Sener and Galluzzo, 2009). Notwithstanding, companies still have access to external sources of technologies such as market research, individual engineers, competitors, universities, etc. which can influence their technological choices for NPD. Beginning from the third industrial revolution, IT was being used to automate production. Its capabilities and possibilities has been and is still expanding. In a typical organizational setting today, IT plays a very important role in the operation of businesses on a daily basis, from communication within cross regional and cross departmental teams, to storing, retrieving of information and vital data. To better appreciate the contribution of IT to NPD, it is imperative to understand the evolution of the NPD field also (Nambisan, 2003). Multiple disciplines have made contributions to NPD research and because of its changing nature, it has brought into focus different disciplines at different times. The roots of NPD research field can be traced to engineering management and R&D literatures of the 1960s to 1970s (Nambisan, 2003). NPD life cycle spans across different knowledge areas and disciplines and IT helps to facilitate all the activities associated with it. Firms and organizations who continuously seek new ways to have a competitive advantage in the industry and in their markets many a times turn to developing new products, thus the process will always involve high performance routine from the first phase to the final phase (Aleixo and Tenera, 2009) and the success is hinged on managing IT and NPD processes appropriately (Daim, et al, 2009)). As the role IT played in NPD increased, there was emphasis on organizational processes and elements (including team building and structure, recognition and award systems, leadership conflict management, team culture, communication and group decision-making) in NPD.

2 THEORETICAL MODEL OF INFORMATION TECHNOLOGY USAGE IN STAGES OF THE NPD PROCESS

NPD begins with the identification of an opportunity in the market to explore and ends with the acceptability of the product by the consumer or end user. This process is continuous in stages going between the idea phase to the value in-use by the consumer and back to the idea phase.

(Yenicoglu, 2015). Many researchers have put in much work and effort towards developing NPD models that captures stages of the NPD process (Bhuiyan, 2011). One of the frameworks or model for managing the activities of developing new products was developed by Booz, Allen and Hamilton (1982) NPD process was divided into seven sequential stages namely; New Product Strategy Development, Idea Generation, Screening and Evaluation, Business Analysis, Development, Testing and Commercialization. Research suggest that IT tools are viable instruments for connecting a company to its customers, IT tools are seen as a platform to build a relationship between company and users of their products/service (Jespersen and Buck, 2009) and the rise in self-service technologies backs this assertion. A way of building relationship with customers and motivate them to collaborate in the development of new product is by using virtual environments. IT tools shorten the distance between the users of developed products and the company, consequently increasing the user engagement in the development of the new product. Companies can provide a range of online services to the customer that facilitates the involvement of the user in NPD by combining various new technologies (Nambisan, 2002). IT tools can be used to assist managers to monitor and control the NPD activities. It is no secret that many companies operating in the competitive atmosphere of today's markets are in one way or the other compelled to develop new products that can accomplish a variety of products that could simultaneously accomplish several objectives. If these products are introduced at the right time and they offer good value by meeting customers demand, they will enhance the strategic positioning of the company or organization. Internally, many companies rely on IT infrastructure, IT tools and software to aid them realise value added new products at every stage of the NPD process. Some of these tools are custom made; tailored to suit the peculiarities of the company and their products, some others are premium tools with or without redistribution rights, and some are freemium while others are open source tools. IT tools used for NPD process were adapted from traditional or old methods of developing products. For instance, electronic brainstorming which is discussions online used to generate ideas and solve problems was adapted from the conventional face-to-face meetings. As outlined by Lilien and Rangaswamy (1997), some research reveals that the use of electronic brainstorming systems improved efficiency and effectiveness of idea generation compared to face-to-face meeting. The growth of IT tools to facilitate and support NPD processes has been on the increase, however, there is little research reporting the role of these individual or collective tools on each stage of the NPD. Durmuşoğlu et al (2006) carried out a research to measure the frequency of IT tools used in the activities of NPD. IT tools were grouped into; NPD process management tools, communication technologies, collaborative project management tools, financial analysis software, virtual prototyping tools and marketing tools. These IT tools grouping was used to formulate a theoretical model for this study.

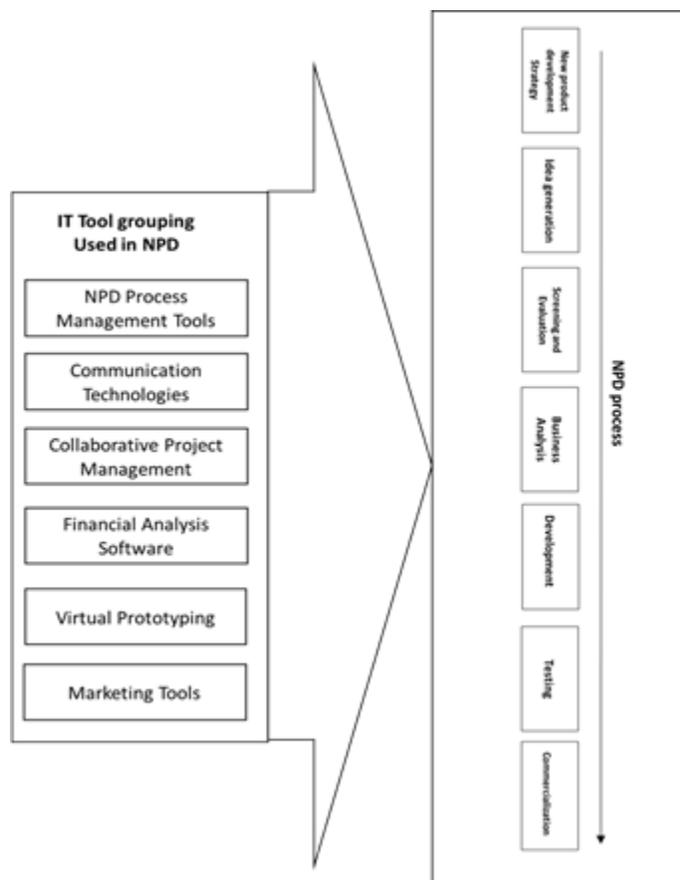


Figure 1. Conceptual model grouping of IT tools used in the NPD Process:

3 METHODOLOGY

Purpose-based on presented conceptual model (see Figure 1), to highlight the main IT used in different NPD stages. For this research, the opinions, experiences and views of nine research respondents will be used to answer the research questions of the use of various IT systems and infrastructure at different stages of the NPD process by utilizing qualitative research methods. Interviews with product leaders from start-ups that were at most five years old was used as the main instrument for carrying out this research. Focusing on start-ups in this study was advantageous in the sense that the NPD process in these organizations are not lengthy and complicated. The approach to the interview for this study was semi-structured interview, this approach was chosen because it is more flexible and gives the interviewer the opportunity to probe and expand the response from the interviewee, thereby achieving depth (Alshenqeeti, 2014). In addition to the note taking during and after the interview, the transcripts were reviewed several times to outline and document patterns and themes. After the completion of this process, themes and ideas that were similar were grouped together and given a conceptual label based on the conceptual modelling for the study. This also served as a source for the prospective code names. After establishing conceptual codes, the coding process began. After this step, the data from all nine interviews were sorted in files using code names and data within each of the files was reviewed to identify and summarise subthemes and their relationships. Unique data or contradictory data was outlined within each summary.

Table 1: Profile of Interview respondents

	Respondent Profile			Company Profile		
	Gender F/M	Portfolio	NPD Experience (in years)	Company Product(s)	Date Established	No of Employees
R1	M	Project Manager	4	Software (Website, Mobile and web App) for start-ups	2014	10
R2	M	Product Manager	2	Mobile Apps	2012	40
R3	M	Lead Software developer	3	Website, Mobile and web Apps, TV shows, documentaries	2012	54
R4	F	CEO/Project Manager	5	Websites, Advertisement, Posters, Web/Social media administration.	2012	11
R5	F	Lead developer/Product designer	3	Website and Web Application	2015	7
R6	M	Product Manager	5	Furniture (Tables, chairs, bed, benches, boards)	2013	30
R7	M	Product Manager	5	Green Plastic Packaging	2012	35
R8	F	Product Manager	4	Customized Clothes, Textile Production	2014	40
R9	M	Product Manager	2	Smart Bin	2015	25

4 FINDINGS AND DISCUSSION

In analysing this result, content analysis technique was applied. Hsieh and Shannon (2005) defined content analysis methodology as "a research method for the subjectivist interpretation of text and data through the systematic classification process of coding and identifying themes or patterns". The reason for this choice is because the interviews conducted were in a semi-structured fashion and they were similarities between each other. According to Silverman as cited by Darasteanu and Moskalenko (2010) which may apply to this study, in content analysis, main issues for the discussion has to be defined, then gathered data can be allocated to some of the defined groups. Thus, contents from all the conducted interviews were divided into groups based on the questions

4.1. Results of IT usage in NPD stages

4.1.1. New Product Development Strategy

According to Booz et al (1982), the NPD process begins with putting in place strategies for the new product. Managers and executives define the base and structure for the NPD process by reviewing the missions and goals of the organisation and understanding the role the new product will play. During the interviews with the product managers, different examples of IT tools that is used at this stage if NPD was discussed. One respondents, expanded more on how cloud based open text/word documents has increasingly become a choice at this stage as they can share their thought through comments on Google docs for example. The words of respondents put it into better perspective: "cloud-based word documents like Google drive helps us outline our strategy in way that the whole team is involved, as people can drop ideas and suggestions as they

pop up in their minds for everyone to see" (R9) There are other uses of cloud-based computing and its adoption in businesses as they support an interactive and user-friendly web applications. From the perspective of some of the respondents, cloud computing is virtualized IT resource, software deployment and dynamic development. While some others see it as a technology that helps them stay competitive and brings so much benefits to their business and NPD process. I.e. services like Google analytics can be useful in this regard. We also see that some of the respondents revealed that they had saved templates on some of these IT apparatuses i.e. MS word or other premium software packages for carrying out SWOT and PEST analysis. Venkatraman (1990) best describes how strategies in a business or in NPD development could benefit from IT. According to his study, IT at this stage could bring about transformation to a business or product in terms of what the firm does and how they do it, i.e. redesigning business process (the use of IT to align NPD activities and the organizations activities to achieve breakthroughs in performance), redesigning business network (a new or different approach from the way information and data is used by the organizations and their partners, thereby dumping the traditional use of information in the industry and beginning a revolution on how the industry as whole carry out processes that add value) and redefining business scope (developing new products or extending their market based on available data or completely changing the organization's role in the industry).

4.1.2. Idea Generation

This is a stage were new product opportunities in the market are identified and new ideas are generated to meet the need of the customer (Hauser and Dahan, 2007). Feedback from

those who are close to the consumers and suppliers could be the source of new ideas, one of the respondents interviewed said they get new ideas in this way using Jobs-to-be-done (JTBD) methodology. In the words of the respondents: “we just started using Jobs-to-be-done as one of our idea generating methods, where we do an analysis of our products/service and outline what jobs our products do for our customers and what other complementary jobs our products or new products could do for our customers” (R3) According to some respondent interviewed, IT tools may not play a huge significance at this stage of their product development process, these are the words of one of the respondents: “Our products always come from our customers demand, our customers have the ideas, they bring it to us, while we refine these ideas in agreement with the customer and then implement the ideas, turning them into products. We are always keen on giving the customers exactly what they want so we do not do so much at this stage but wait for the customers to make their demands. We let the customers know the best approach to implement their idea from the standpoint of the industry and based on our experience and strength. We offer them choices, and we implement whatever choice they make irrespective of how good or bad their choice is by our standard and expertise” (R1) It is important to state here that the view of this respondents was based on the business model of the firm and the nature of their products. They do not produce goods in mass quantities for customers, they develop products for other start-ups as these customers make demand for them. Therefore, this stage of the NPD process is being carried out by customers or users of the product and not the firm. For respondents that employ IT tools at this NPD stage, examples of tools used include; Survey analytics tools, MS excel and Balsamiq.

4.1.3. Screening and Evaluation

The ideas gathered in the previous stage is screened and downsized to product concepts that have the best market potentials. In this study, the idea generation stage and the Screening and evaluation stage are two distinct stages of the NPD process but from the answers by some respondents, they treat these stages as the same or one process. When asked what tools they employed to generate ideas, these are some of their response in regard to this question; “What IT tools, infrastructure or software’s do you use in the Idea Generation stage” “We have tools like Balsamiq which helps us in our idea generation process and to also filter the best ideas from the good ones” (R2) and another stated “As we generate our ideas from our customers, we equally use survey tools with our customers to screen these ideas generated on the basis of their importance..... the ideas are generated and measured or screened by the customers simultaneously” (R3) It could be gathered that they do this to minimise the process and save times, as one respondent said, “for us, making the process shorter is important...we have a standard procedure for creating products but our steps and processes are much shorter than what you outlined here (in reference to the conceptual model of this study) ...we consider delivering products timely to the customers as our strength, it also dictates our strategy” (R1) Some of the IT tools mentioned by the research respondents include: Ideawake and online survey tools. Some respondents highlighted they do not have any IT apparatus dedicated to this stage or that they employ minimal use of IT at this stage because they screen their ideas using

Linkert scale. They give generated ideas attributes and allocate a unique number to each of them i.e. using numbers that range from 1 – 10, with 10 being the most important attribute. They further define the outcome of the ideas and rate them according to their profitability and importance. After this step, ideas with the highest scores are selected.

4.1.4. Business Analysis

This is where investigations and all the questions that deals with the business aspect of developing the product concept further is being asked. If a firm is involved in the business analysis of their NPD process, they can hardly do without using one form of IT apparatus or resource to help fast track this stage. From the respondents interviewed, they consider this stage crucial and that the use of IT is highly important here. From what was gathered, data at this stage is what is crucial. To further explain how important this is, a respondent revealed they had to halt a development of a new product because they couldn’t trust the source of the data they had. “we had to stop developing an app about transportation logistics, we did not have enough information for calculating all the algorithmswe needed some IT based tools to get information.... We outsourced this to an agency to gather these data, but at the end, we decide we couldn’t trust the information because it was a technical information about the millimetre of cars” (R4) Therefore, IT tools that can help track, gather and collate data are extremely useful. These tools help them to easily interpret data. This statement was made by a respondent of a firm that creates website and web apps: “...to analyse our business, we track data using google sheets and make use of custom tools using JavaScript to sort data. We use Tableau to search insights and analyse differences” (R1) According to Shahrul-Yazid and Nooh as cited by Barrios and Kenntoft (2008), if scrutiny becomes too much, it may slow down the time-to-market for the product. As time is always a factor at this stage and as such, firms have to set a strict time limit for this process. Most respondents revealed that even after they employ IT to track, gather and collate data, interpreting the data for the future is a totally different challenge. The interpretation of data is what is needed in order to translate or integrate findings in the new product dynamics

4.1.5. Development

This is the stage where the idea concept becomes a tangible product. Manufacturing processes are deployed beginning from prototypes to the actual useable product. One aspect of product development that came up from the interviews was the development methodology, which are: Agile development and Waterfall development. A considerable good number of respondents alluded to the fact that they adopted either one of these development methods even though no direct question was asked about the development methodology they employ. When discussing about the use of IT at this NPD stage, their development methodology slipped into answers they gave. This was observed in about five out of the nine respondents interviewed. According to a respondent: “since we adopt agile methodology for the production of most of our software products, we use IT tools such as Tmux. Tmux allows our developers to easily switch between multiple task under one terminal. GitHub also helps our development team store code in the cloud for easy retrieval and for code reviews and discussions” (R3) During discussions with respondents from software firms, it was observed that some firms have

templates for developing software products and they use these templates if the product they are developing aligns with the needs for which these templates was built. They use these templates in combination with a software developing frameworks called CMS (content management systems). For respondents that produced solid products like textile, furniture and Smart bin, the use of IT at this stage of the NPD process was majorly for product design conceptualization through virtual prototyping or rapid prototyping and to track all and monitor the production progress. These are the word of a respondent whose firm produces green plastic packaging, "During production or development of our product, we use ERP software to monitor and track data. The tracking of this data is automatic, directly from work centres and it updates the production inventory and schedules" (R7) The IT tool employed here serves as a real-time production monitoring system. These kinds of IT apparatus are highly prized and sometimes custom made. Also, the respondent indicated that these software's have a steep learning curve, meaning it takes much effort to learn and use. Therefore, those saddled with the responsibilities of using these systems are the NPD leaders or managers.

4.1.6. Testing

This stage seeks to validate the projections with the tangible product through testing in various forms depending on the kind of product. Trials are conducted to determine suitability in market, conformity with industry standards and customer satisfaction (Booz et al 1982). As one respondent highlights, various test are carried out at this stage: "For testing of our web and mobile apps, we do unit testing on each platform and continuous integration test as each development team unit finishes their job. We carryout smoke test to make sure there's no intended side effect and regression test to make sure that other functions developed haven't broken. ...after this, the QA (quality assurance) team test the whole product from the perspective of a developer or producer and from the perspective of the user or consumer" (R5) when asked what IT tools are deployed to test their product at this NPD stage, the respondent said: "we use automated UI testing, Jasmine framework to track the functionality of our end product, another tool we use is protractor. Protractor is an end-to-end test framework for Angular and AngularJS applications. Protractor runs tests against the product in a real browser, interacting with it as a user would" (R1) A respondent that creates software products revealed they move from the idea phase of NPD to developing prototypes for testing. These

prototypes are with lesser functionality, only having the main functions they desire. After this test is complete, they go further into full development of the product.

4.1.7. Commercialization

After testing and launch of the product, this stage of the NPD process are activities geared towards bringing the new product to the consciousness of the market. After testing and launch of the product, this stage of the NPD process are activities geared towards bringing the new product to the consciousness of the market. Cooper (1990) states that this stage of the NPD is known for the involvement of marketing experts who understand the market and how to deliver the right product to the right place and at the right time. During the interview, a respondent echoed this view "...We do not use much IT (except for communication) in the marketing of our products as we are less involved in the marketing or commercial activities of our products. Our marketing is driven by our agents who are close to shop owners and know what the customer wants. They give us feedback about how the product is being received and what the customer needs. It is not that we do not get involved at all, the production department provide inputs towards the marketing execution plan and we educate dealers about our product. That's how far we go in the marketing activities "(R6) It appeared they took this position because they are a start-up and have limited resources to engage in full marketing activities or they believe it is more effective for their agents to be their "marketing experts". But according to them, it was a combination of the fact that they are limited in resources and engrossed with development and perfection of their product, therefore, it was more effective to allow their agents to handle the marketing of the products. When further asked, "Have you not explored online marketing?" "Apart from our website and off course, our social media pages we haven't done anything extra for marketing online" (R6) This is in contrast with some other respondents, especially respondents that dealt with soft or digital products. "For our marketing, we make use of facebook sdk, google analytics, fire base and Apps spy. These tools are used to identify potential customers and their biographic data, to check click rates on our app and how much we have paid for online marketing" (R3) In summary, respondents where unanimous on the fact that taking the whole production process very seriously and ensuring the product meets customers' needs is more important than dedicating lots of IT resources to commercial activities.

Table 2: IT tools used in different NPD stages according to the research respondents

NPD Stage	IT tools/apparatus used
New Product Development Strategy	Open source cloud-based word/text documents (google docs, MS SharePoint), Text, MS packages (word, visio), smart board, communication tools
Idea Generation	Survey analytics tools, MS excel, Balsamiq, Ideadrop
Screening and Evaluation	Balsamiq, Ideawake, Ideadrop and online survey tools
Business Analysis	Google sheets, Custom tools using JavaScript, Tablaeu
Development	Zeplin (to design apps), Laravel framework, react JS, Java, Kotlin, Dreamweaver, Notepad, Solid works (3D CAD design), CMS, Bibucket, Visul Studio, Tmux, GitHub, Plastic ERP software and Lota3D fashion design
Testing	Jasmine framework, Protractor, Hitmap
Commercialization	SEO tools, Social media., Facebook sdk, Google analytics, Fire base and, Salesforce

Some of the tools can function for 2 to 3 stages of the NPD process but they all have one stage they are tailored for. Many of these tools depend on the internet or resources online to functions, while some could be used offline.

4.2. Results on Grouping of IT tools used in NPD process

4.2.1. NPD Process Management Tools

In establishing stability in the NPD activities, including managing different NPD stages, these tools are important (Nambisan, 2003). NPD processes need to be designed and supported with the ideal IT apparatus and at the same time controlled. NPD process management supports the whole NPD life cycle. They summarize all the activities including techniques, methods, monitor resources such as human, organizational units and provide information (Bernroider and Bernroider, 2008). During the interview, respondents were asked about the process of product development in their firm and if they used any IT tool to monitor this process. It was gathered that firms that produced solid products such as smart bin, plastic packaging for instance, perceive process management tools as being more important to their development process than firms which developed software products only. These helped them monitor and track data and they could easily see when something goes wrong at a production workstation or unit. From the respondents, it was also gathered that the process management tools were pricier compared to other grouping of IT tools. Some of them are licensed and custom made (flexible or could be easily tweaked to meet their unique needs). When a respondent was asked "what group of IT tools or IT based system do you use throughout the product development process and which group of tools are more important to you". The response: "Our process management tool is one of the most important tools we use in our development process, it was custom made by our parent company...I cannot even tell you what it is called because it is proprietary software, I don't have the right to tell you this on record". (R7) However, from the answers by some other respondents, they do not view these tools as NPD process management tools but collaborative management tools. For those that clearly differentiate process management tools from other tools, the complexity of process management tools also need to be taken into account when deploying them to be used by NPD teams. As Marion et al (2014) perfectly sums it up that NPD leaders and teams need to understand the commitment that is needed for an effective implementation of these tools and they should be ready to commit the effort necessary to sustain knowledge and information within these tools over time.

4.2.2. Communication Technologies

Communication tools are vital to the steady flow and alignment of personnel to the NPD process, activities and goals. Effective communication establishes clear expectations, not just for employees but for customers too. From the interview with respondents, we can deduce that communication tools or technologies are used more often than any other group of tools in the NPD process. As a respondent puts it: "our technical team is in another location, we communicate through various platforms numerous times in a day, we depend on these communication platforms. Slack, Skype, emails are all important for our communication, ... I think communication

tools support our work more than any other group of tools". (R5) To expand more on the various ways IT communication platforms are used, the respondents were asked what IT platforms they use to communicate with their customers and if they differ from what they use internally within the organization. It was observed that apart from emails and phone numbers that customers could use to access these firms, respondents talked about being actively engaged on social media and leveraging it to communicate and form a "bond" with their customers. "...as our products has to do with fashion, we make use of Instagram more than any other social platform, we have lots of followers and we post photos of amazing designs and fashion concepts...our Instagram community is huge and so customers reach out to us directly on Instagram". (R8)

Another respondent said;

"...our social media team jumps on trends or hashtags on twitter and are witty with their social media posts, using memes and posters. In your view, that might be marketing, in our view that's also communication, we have a young team and we want our young customers who are on these platforms to perceive this ...so that they may feel a connection with us" (R7) It can be deduced that communication with customers is beyond treating customers complaints or reaching out to customers only when surveys or tests are to be carried out but communication is actively engaging within the space (e.g. social media) of your customers and making them part of NPD process.

4.2.3. Collaborative Project Management tools

According to study by Nambisan (2003), a wide range of collaborative tools are integrated into IT based systems which supports a distributed environment and that these collaborations have to cater for various NPD team members, as they differ in their IT needs, the nature of their participatory role in the NPD process, their knowledge of the product, their IT capabilities and their organizational culture. The idea behind the use of these group of tools is to actively involve NPD team members in the planning and control process, it is not just solely reserved for NPD leaders or managers but other team members. From the answers by respondents, it was gathered that these tools are always integrated with other communication tools and some respondents that dealt in the development of software products did not seem to view NPD process management tools so differently from collaborative project management tools or they understood both group of tools to do the same job.

4.2.4. Financial Analysis Software

Issues relating to finance is a major part of any product development process. The reason why NPD activities may stall at a certain stage could be as a result of financial constraint and this could greatly increase the chances of a firm exiting the market (Musso and Schiavo, 2008). A lot of firms are increasingly taking a second look at the structuring of their financial reporting, not just from the standpoint of information but with regard to the whole financial reporting process and the value provided to the firm in terms of the planning, management and control (Rasmussen, Goldy and Solli, 2002), this is where financial analysis software becomes very useful to the NPD process. They help to measure profitability of products, develop proven methods to measure profitability,

they improve the consistency of reporting the firm's financial results and improves the reporting process speed. From the interview with respondents, it was gleaned that financial analysis software helped start-ups track incoming and outgoing finances in their NPD process. A respondent said: "we use Brightbook. It is an accounting software we use to track our accounting systems, both inflow and out flow records, to send invoices, monitor and management payments". (R7) Apart from MS excel or any other form of spreadsheets, most respondents couldn't name the financial analysis software used by their accountant but were sure their accountant used one form of financial software or the other to prepare periodical financial statements and reports for the firm.

4.2.5. Virtual Prototyping Tools

Virtual prototyping in a working environment that is distributed, it expands the meaning of having physical product prototypes to a collection of data that when combined represents the prototype. This information can be accessed by different users in different locations (Rix et al, 1995). Virtual prototyping tools enable a visual conception of the product in the NPD process. They bring about a faster time-to-market result for the NPD process as prototype products can be made more quickly. When early product prototypes are made, it allows for a fast verification of the NPD process assumptions. Notwithstanding, the set of requirements which needs to be evaluated and the complexity of the prototype contributes to the NPD process time. A respondent from a start-up that develops Smart Bins said: "...they enable our software developers to begin development long before the hardware design for our product is complete". (R9) It is clear that this tool influences the next development phase, making it more efficient and faster and also act as a stage gate to making decision about moving forward with the development process. These are the words of a respondent: "before we begin full scale development for our new app idea or any new feature for our app, we use prototyping tools to create a small, downscale version of the app. That way we can see what it looks like and know if it is feasible to go into a full-scale development!" (R3) This appears to agree with position of Rix, et al. (1995) which suggests that virtual prototyping technologies is an important tool for NPD decision making, especially when used in the context of rapid prototyping. In rapid prototyping, rapidity is achieved by utilizing virtual prototyping tools with the cooperative effort of the NPD team. A benefit (and challenge) in developing virtual prototypes is that it relies heavily on a good flow of communication with the NPD teams (hard ware and software teams). As a respondent also echoed this view stating that: "virtual prototyping tools help our software and hard ware team know what the other team is trying to achieve" (R9) From the respondent that developed Smart Bins, it was gathered that virtual prototyping was used to simulate their entire hardware platform making using of various simulation models of the different blocks in the system.

4.2.6. Marketing Tools

These IT based tools or systems are created to help firms promote their products to their target customers, they further strengthen the position of the firm in the market by aiding their marketing strategy. These could also be online customer relationship management (CRM) products, used to personalise, customise and distribute marketing materials and

to also measure the success of marketing campaigns. From the interview with respondents, it was gathered that there are two major categories of IT based systems for marketing of new products. They include: *Digital media*: The use of software technology i.e. CRM software to reach potential customers with measurable communication that is well targeted. They also include search engine optimization (SEO), search engine marketing (SEM), mobile marketing, online advertisement that is interactive, online partnerships (affiliate marketing), opt-in email and the use of web analytics tools that can provide information about internet users activities online including, location, search key words and IP address, i.e. google analytics. *Social media*: A lot of business today are shifting their marketing focus to social media marketing. The goal of using social media as a tool for marketing is to develop an online relationship or bond with customers in an interactive fashion rather than to just get customer data. There are various platforms on social media for marketing and a lot of businesses have social account on major social media platforms.

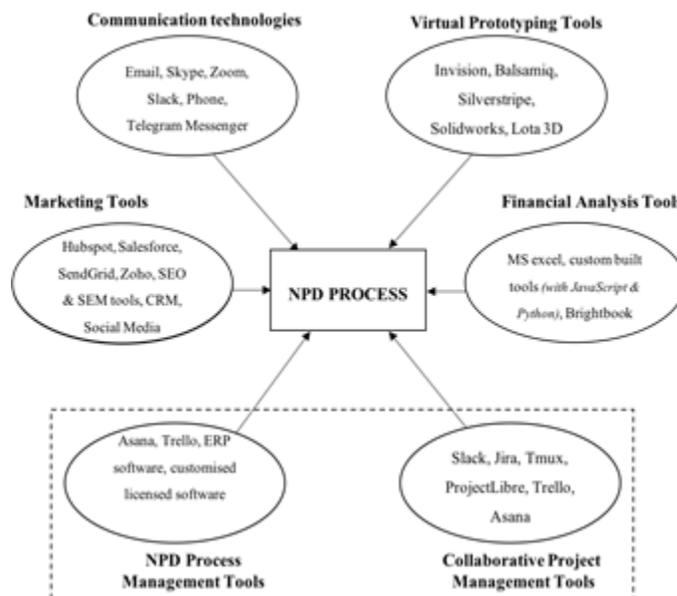


Figure 2. Group of IT tools used in the NPD process from research respondents

Figure 2 is a grouping of IT tools in the NPD process as revealed by the research respondents. It was observed that research respondents that developed software products viewed NPD process management tools and Collaborative tools as doing the same job. This is partly because some of these new IT based technologies are beginning to integrate all functions needed for NPD activities into one system. Some IT based tools now integrate process management, collaboration project management tools and communication tools into a single system. This observation seems to agree with the study of Nambisan (2003), where the infusion of IT tools in NPD was examined along four dimensions. Collaboration tools integrated with communication technologies was one of the four examined dimensions.

4.2.7. IT based tools used in NPD Process

The following are some specific IT based tools that respondents employed for various tasks in their NPD Process.

Most of the respondents were conversant with these tools. They include: Slack, Trello, Asana, Salesforce and Balsamiq.

Slack: This is a cloud-based collaboration and communication tool which provides an open channel for teams to organize conversations on a topic, project or team. This tool provides a transparent view of private channels for sensitive conversations, information, as well as for teamwork. Features that are included in this tool includes; file sharing, direct messaging, comments, stars to reference conversations and also harmonization with other cloud-based internet services such as Dropbox and Google Drive. Other software tools can also be integrated into this tool. Files are archived and they could be synchronized on different devices (Slack, 2017). **Trello:** This is a visual process management tool that has features for collaboration. This includes: comments, calendar, notification and file attachment. Either for team use or individual use, a user can create a checklist, label them, input dates and invite people to join the task. Other services and applications such as Google Drive, OneDrive and Dropbox could be integrated into this tool. This tool works in real time and could also be synchronized across various devices. Other features include voting, Snooze tasks later and filers (Trello, 2017).

Asana: This tool supports process management and team collaboration with features such as projects, tasks, dashboards and conversations. With this tool, a user can have a quick progress view of projects at a glance without the need to schedule meetings and team updates. The features in this tool include task and project creation, setting up due date and time, task and project conversation, archives of files that is searchable, calendars, a dashboard for checking the progress on projects, team management features and inbox for notification and updates. This tool can also be integrated into other applications such as Slack, Google Drive and Dropbox (Asana, 2017).

Salesforce: This is a cloud-based customer relations management system. With this tool, a user can automate sales processes. It has an interface for managing task and for automatically routing and events that are important. Also included in its features are social networking plugins that enable the user to join in on conversation about their products. Integrated into this tool are analytic tools and services such as email alert and Google services (Salesforce, 2017).

Balsamiq: This is a software development wire framing tool that helps to lay out ideas quickly and create prototypes. This tool includes many drag-and-drop elements in forms of buttons and lists. They are styled as a hand-drawing making it intentionally rough and giving it a "natural" look. It also has the ability to collaborate with other team members for final thoughts and feedback (Balsamiq, 2017).

4.3. Further Observations and Findings

This study expands on the use of IT in the NPD process from the perspective of NPD leaders and highlights IT apparatus or group of tools they consider vital to the NPD process. The findings support the conceptual model formulated and the results also show a positive dependence of NPD teams on the IT tools and infrastructure available to them.

4.3.1. The Complexity of IT used increased along the NPD process

From this research, it was clear that dependence on IT in NPD increases as the NPD process moves forward. We can deduce

this from the new product development strategy phase where less complex IT tools such as MS word are used, to the development stages where more complex IT tools such as CAD software or programming frameworks are used. This also raises the issues of the expertise or knowledge base of the NPD teams to use these IT tools, making a case for a good knowledge management system within the firm. A knowledge management system is a system for managing knowledge within a firm, it supports the creation, storage and dissemination of expertise and/or knowledge (McKenney, Nieveen and Strijker, 2008). Knowledge can be transferred along cross-functional teams and new findings or experiences along the NPD process can be well documented for future reference or use. For instance, in the context of the research carried out with these start-ups, the development phase of their NPD process is usually more technical and involves a lot of expertise. The IT used at this stage has become overspecialized, and in many cases, there are technical team blocks or units in this phase. Apart from the complexity of the IT tools used at the development phase, it was gathered this phase also relied more on IT. The reliance on IT to implement this stage of the NPD process isn't in the number or quantity of tools deployed but rather, these IT tools themselves are used to develop the new products. In other words, IT tools don't just support this stage, they "create" this stage. Apart from the expertise of the human resource involved, the tools significantly affect the outcome of these products. As all start-ups in this research are technologically driven, we see the use of a programming frameworks or CMS such as Laravel framework to write programming languages in the development of a software product.

4.3.2. Product Development methodology informs the choice of IT tools used by firms

From the findings gathered, the development methodology for a product development process firms choose to adopt informs their choice of the IT tools they employ. NPD processes are not uniform across different products and firms. Some of the reasons for this is the degree of product innovation (Ozer, 2003) and the adopted development methodology. While conducting the interviews, all start-ups that developed software referenced or made mention of their development methodology. They mostly used agile methodology in the development of their product. It also important to note that the development methodology could have a direct relationship with managing the complexity of the NPD. The choice of agile development methodology by firms that developed software influenced their choice to use an IT tool (i.e. Agile Software for Scrum) for their NPD management process.

4.3.3. IT helps to build a relationship between NPD teams and customers

IT helps to build a relationship between NPD teams and customers. Apart from using IT tools like online survey systems to involve the customers in screening ideas, the next visible participation of the customer in the NPD process is at the post development phases. Depending on the NPD process methodology, customers can actually be involved at every NPD phase and IT could support this. For instance, it was noticed that the IT tool or framework for the agile methodology supports the integration of the customers into the NPD process. Therefore, it can be said that IT could be used to support customer participation in the NPD process. This is

reflected in the study by Jespersen et al, (2009), they concluded that IT tools are effective instruments for linking a firm or NPD team to their customers and that they can be used to build a relationship between product developers and product users. Building a relationship with the customer doesn't only have to begin during the commercialization or marketing of the new product but can actually begin at the idea phase and be sustained throughout the NPD process if the right development methodology and appropriate IT tool is used to support the process.

4.3.4. The role of the internet

A good number of the IT based systems used in the NPD process by firms are more effective when linked with the resources on the internet. For instance, as observed in the idea generation phase of the NPD process, firms can use IT systems with the internet to reach target or potential customers to take part in their online surveys and help to generate and/or screen ideas. The internet is what makes the use of collaborative and communication tools possible along a distributed NPD network of teams. Over the internet and other linked resources, teams can collaborate and communicate effectively. The internet also improves organizational learning capabilities (Ozer, 2003), as there are repositories of resources on the web for use and consumption (McKenney et al, 2008). At the business analysis phase of the NPD process, information about competitors, the market, product substitute and other relevant data could be accessed over the internet with a click. Considering the convenience, speed, interactivity and coverage of the internet, firms can gather, categorize and store useful information and data for the NPD process. As a respondent describes it: "we use amazon web services for the storage of media files" (R3). These kinds of internet resource are gaining traction among firms as it is cost effective to store files on the internet with cloud-based services than the fast fading tradition of purchasing hardware storage machines. For virtual NPD teams, they are dependent on the internet to function and collaborate, this further translates into the speed and efficiency of the NPD process. The internet is a major resource for the commercialization, marketing and advertisement of new products. However, NPD teams should not lose sight of internet security breaches and issues. Conscious efforts should be made to secure IT based systems used for NPD that are linked to the internet from spywares and malwares so as not to compromise the integrity of the NPD process or product

5 CONCLUSIONS

In view of the theoretical context of this study, a framework for defining the stages of the NPD process developed by Booz, et al (1982) was the bedrock for which this study was developed. Based on this conceptualized model, an empirical study was done with product development leaders of start-ups. This is with the goal to expand on the use of IT at every stage of the NPD process from the perspective of the interviewed product development leaders. It revealed what IT infrastructure or apparatus or group of tools product development consider vital to the NPD process, how they practically employed IT in their NPD process and how IT informs their NPD decision. Although by their very nature, some NPD stages are more critical. Notwithstanding, every stage in a product development activity impacts the outcome. Therefore, each NPD stage should be treated with an equal sense of importance. It is also

important to understand which stage is more critical for your product and in your industry. Depending on other variables such as the nature of products, the target customer, etc. some NPD stages may not apply to some firms or industries. IT makes it easier for firms to involve their target customers in their NPD activities. So many IT driven digital and social media offer platforms firms can leverage in this regard. Therefore, firms should adopt NPD development methodologies that will afford them the opportunity to fully utilize IT capabilities for involving customers in their NPD process.

ACKNOWLEDGMENT

I want to acknowledge Prof. dr. Vilmantė Kumpikaitė-Valiūnienė, School of Economics and Business at Kaunas University of Technology, Lithuania for the support and guidance on this research work.

REFERENCES

- [1] Aleixo, G. G. and Tenara, A. B. (2009). New Product Development Process High-Tech Innovation Life Cycle. World Academy of Science, Engineering and Technology International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering Vol: 3, No:10
- [2] Alshenqeeti Hamza (2014). Interviewing as a Data Collection Method: A Critical Review. English Linguistics Research; Sciedu Press. E-ISSN 1927-6036 pp. 39 -45
- [3] Asana (2017). [Computer software] Available at <https://asana.com/>
- [4] Balsamiq (2017). [Computer software] Available at <https://balsamiq.com/>
- [5] Barrios Luis and Kenntoft Jonas. (2008). The Business Analysis Process of New Product: a study of small and medium size enterprises. Pg. 3
- [6] Bernroider W. N. Edward and Bernroider Mahshid. (2008). A Comparative Study of Business Process Management Tools based on Open Source Software and a Commercial Reference. 5th International Conference on Cybernetics and Information Technologies, Systems and Applications (CITSA), pp 1-6
- [7] Bhuiyan, N (2011). A Framework for Successful New Product Development. Journal of Industrial Management, JIEM pp. 746-770
- [8] Booz, Allen and Hamilton (1982). New Products Management for the 1980s New York: Booz, Allen and Hamilton
- [9] Cooper G. Robert (1990). Stage-gate systems: A new tool for managing new products. Business Horizons 33, no. 3, 44-54
- [10] Daim, T., Sener, N. and Galluzzo, C. (2009). "Linking Technology and New Product Development." Proceedings of the 42nd Hawaii International Conference on System Sciences pp. 1-9

- [11] Darasteanu Cristian and Moskalenko Maria (2010). New Product Development Process Goes Global: A qualitative study of rethinking traditional concepts. Umeå School of Business pp. 69-102
- [12] Durmuşoğlu, S., Calatone, R. J. and Sambamurthy.V (2006). Is more information technology better for new product development? - Journal of Product & Brand Management. Vol. 15 Iss 7 pp. 435 – 441
- [13] Hauser, J. R. and Dahan, E. (2007). New product development
- [14] He-Yau Kang, Amy H. I. Lee, Chao-Cheng Chang, and Mei-Sung Kang, (2012) "A Model for Selecting Technologies in New Product Development," Mathematical Problems in Engineering, vol. 2012, Article ID 358129, 17 pages, 2012. doi:10.1155/2012/358129
- [15] Hsieh Hsiu-Fang, Shannon E. Sarah. (2005). Three approaches to qualitative content analysis, Qualitative Health Research- Sage Publications, Vol. 15, No. 2, pp. 1277-1285.
- [16] Jespersen KR, Buck N (2009). Usage of ICT tools in new product development: creating user- involvement. In Al-Hakim L and Jin C (Eds.), Handbook of Research on Innovation Systems for Business: Technologies and Applications. IGI Global pp.1-3
- [17] Lilien L. Gary and Rangaswamy Arvind. (1997). Software Tools for New Product Development. Journal of Marketing Research Vol. 34, No. 1, Special Issue on Innovation and New Products. pp. 177-184
- [18] Marion J. Tucker, Barczak Gloria and Hultink Jan Erik (2014). Do Social Media Tools Impact Development Phase? An Exploratory Study. J Prod Innov Manag, 31(S1): pp. 18-29
- [19] McKenney, S., Nieveen, N. M., & Strijker, A. (2008). Information technology tools for curriculum development. In J. Voogt, & G. Knezek (Eds.), International handbook of Information technology in education (pp. 195-210). London: Springer. DOI: 10.1007/978-0-387-73315-9_12
- [20] Musso Patrick and Schiavo Stefano. (2008). The impact of financial constraints on firm survival and growth. Journal of Evolutionary Economics. ISSN 1432-1386 Volume 18, Issue 2, pp. 135–149
- [21] Nambisan, S. (2002). Designing virtual customer environments for new product development: Toward a theory. The Academy Management Review Vo1. 27. No 3, pp. 392-413
- [22] Nambisan, S. (2010). The role of Information Technology in Product Development: An introduction. In Information technology and product development, ed. S. Nambisan, New York: Springer pp. 1–220.
- [23] Ozer Muammer (2003). Process implications of the use of the Internet in new product development: a conceptual analysis. Industrial Marketing Management,32, n. 6, pp. 517-530.
- [24] Rasmussen Nils, Goldy S. Paul and Solli O. Per (2002). Financial business intelligence; trends, technology, software selection, and implementation. John Wiley and Sons, Inc., New York pp. 19-23
- [25] Rix Joachim, Haas Stefan and Teixeira Jose. (1995). Virtual Prototyping: Virtual environments and the product design process. Springer International Publishing, Cham. 1st Edition ISBN 978-0-387-34904-6.
- [26] Salesforce (2017). Available at <https://www.salesforce.com/>
- [27] Sanayei, Amir, (2016) "Technology Decisions in New Product Development". Wayne State University Dissertations. 1482 pp. 1-106.
- [28] Slack (2017). [Computer software] Available at <https://slack.com/>
- [29] Trello (2017). [Computer software] Available at <https://trello.com/>
- [30] Venkatraman N (1990). IT induced business re-configuration, in M.S. Scott Morton, ed., The Endnotes 61 Corporation of the 1990s: Information Technology and Organizational Transformation, Oxford University Press, New York, 1991, pp. 122–158
- [31] Yenicioğlu, B (2015). Participatory New Product Development – A framework for Deliberately Collaborative and Continuous Innovation Design - Procedia - Social and Behavioural Sciences Volume 195 pp.1443 - 1452.