



INVESTIGATION OF CHALLENGES FACED BY SMALL AND MEDIUM ENTERPRISES IN NEW PRODUCT DEVELOPMENT

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ABSTRACT

A case study research was carried out on four manufacturing small and medium enterprises that are involved with new product development. Literature suggests that survival, growth and competitiveness of small and medium manufacturing enterprises are based on their ability to develop and introduce new products into the market. New product development has become a central mechanism through which a company's strategy can be put into practice. Literature suggests that few articles have been written on new product development problems faced by small and medium manufacturing companies. The paper confirmed constraints faced by small and medium enterprises in developing new products such as lack of resources, poor coordination among various departments, lack of project management structures, weak strategic thinking, poor absorptive capacity and non-use of new product development frameworks. Small and medium companies must enable flexibility of staff movement among various departments to enable concurrent development of new products. Problems associated with lack of resources can be averted through formation of industry portals that can aggregate flexibility and agility. The time taken to develop new products can be reduced through sharing of information with their alliances and external networks including universities.

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1 INTRODUCTION

In the present day of globalized markets, rapid technology changes and sophisticated customer preferences, new products and their development are, an important source of competitive advantage [1, 2]. This was supported by Soumala and Jokionen, [3] who reported that the “capability to develop new products is a critical determinant of a firm’s competitiveness”. Human and manufacturing resources available within an organization must be utilized in an integrated fashion in order to create competitive products in short product development cycles [4]. Badiru and Theodoracators, [5] also agreed that timelessness of new product development requires communication, co-operation and co-ordination of design and manufacturing functions. The process of New Product Development, (NPD), is regarded as a complex system since it connects many employees working in different departments and organisational units [6]. NPD is associated with high risks and uncertainty, [1, 2], which at times leads to high failure rate [7, 8]. Successful coordination and management of new product development processes continue to be a challenge in many organisations [9, 10], more-so in small and medium enterprises (SMEs) who are into NPD and manufacturing, hence the motivation for this study. A company’s long-term success is critically influenced by its ability to respond quickly to, “dynamic customer needs, increased complexity of product design and rapidly changing technologies [11].

The demands on product development performance in terms of speed, accuracy and cost have become higher, [2], and can only be achieved if a company meets the industry specific knowledge [12]. However NPD performance in SMEs is affected by various challenges as suggested by De Toni et al, [13], namely; the excessive cost of product development projects, the uncertainty of market acceptance, limited base of managerial competencies, lower availability of financial resources and weaker attraction of skilled manpower. These SMEs also face problems such as poor coordination among various departments, lack of project management structures, poor absorptive capacity and non-use of product development frameworks. [3, 4, 7].

The focus of this study will be on the competency levels of senior personnel who are directly involved in day-to-day activities of managing NPD activities such as, managing trade-offs, dynamics of technology, customer preferences, time pressure, group dynamics and large economic investments, [3, 14]. Cooper and Kleinschmidt, [15], established that, “many managers profess to have a systematic process plan in place for product development; an audit of what actually happens on the shop floor reveals many gaps and deficiencies”. Through the use of Theory of Expert Competence, this paper will investigate competency levels of senior personnel involved with NPD in four SMEs that are into NPD and manufacturing. This work complements the study of De Toni, [13], who identified that there is limited base of managerial competencies in SMEs, and that NPD processes and planning processes are not well researched in SMEs. The words competency and expertise will be used inter-changeably.

The motivation of the study is that senior personnel involved in NPD are involved in reflexive relationships, built on trust and mutual accommodation with other employees [16], which allows effective utilisation of resources in coming up with new products. It is also important to note that this paper focusses on NPD senior personnel competences, since they form core competences of an organisation, which are unique [17], cannot be duplicated by competitors and gives an organisation its characteristic.

2 SUMMARY OF CASE STUDIED COMPANIES

All four companies are SMEs in the manufacturing sector and have exhibited a capacity to design, develop and manufacture new products, through their Research and Development (R & D) departments. Company A is into design and manufacture of products such as agricultural components like pumps and valve bodies, sewer and water reticulation pipes and sprinklers through casting processes. Company B is into manufacturing of farming



components such as ploughs, plough dishes, harrow discs, hoes, picks and shovels including assembly and servicing of tractors. Company C is into manufacturing through casting and extrusion processes. Their products are agricultural plastic parts for drip irrigation and sprinklers. Companies A, B and C supply both domestic and export markets. Company D is into manufacturing of hydraulic equipment used both in the agricultural and mining industries. Their market is mainly domestic.

Table 1 shows a summary of number of employees, number of years in business, yearly turnover and percentage of turnover that is re-invested into new product development activities.

Table 1: Financing of NPD activities in studied companies
Companies

Aspect	A	B	C	D
Number of employees	105	80	65	75
Years in business	20	15	17	18
Turnover (R-Million)	200	170	150	180
Re-investment for NPD (% of turnover)	10%	15%	12%	16%

2.1 RESEARCH OBJECTIVES

- a) The major aim of this research is to investigate competency levels of senior personnel involved with NPD in SMEs.
- b) To investigate training strategies required to improve competency levels of senior personnel managing new product development.

2.1.1 Research Questions

- (i) To what extent do competency levels of senior personnel affect NPD in SMEs?
- (ii) What type of training is required to improve competency levels of senior personnel managing new product development processes?

3 LITERATURE REVIEW

3.1 New Product Development

Products have a life cycle, as reported by [7], which passes through a series of stages which include development, growth, maturity/saturation and decline. The decline stage of mature products is caused by changes in customer preferences, product technology, competitive activities and other environmental factors. In this phase sales decline, profit margins dwindle and at times this leads to product withdrawal from the market. It is this realization as established by [2, 4] that compels organizations to continuously develop new products to remain competitive.

In business and engineering, new product development (NPD) is the term used to describe the complete process of bringing a new product or service to market [8]. There are two parallel paths involved in NPD, one involves the idea generation, product design and detail engineering; the other involves market research and market analysis, [9]. Owens, noted that, companies see new product development as the first stage in generating and commercializing new products within the overall strategic process of product life cycle

management and is used to maintain or grow their market share. Successful new product development depends on good organization and effective management as reported by Clark and Wheelwright, [18]. The traditional design environment involved segregated cubicles of designers, who were confined to their own worlds of design ideas. This approach worked in the past, as established by [8, 18], because consumers were less sophisticated, and the market was defined more by whatever product was available to the consumers. Current global trend promotes team approach, (cross functional approach) in new product design, [4], which allows people with different perspectives to exchange ideas in order to create a better product than would have resulted from their individual efforts.

New product design starts by defining markets for new or of existing products. Recognition of customers' needs leads is an initial assessment which includes market assessment, appraisal of the competition and preliminary market forecast, as reported by [14]. Engineering and economic analysis then follows which includes preliminary product design, preliminary process design, cost estimation and preliminary financial analysis as reported by [5,8]. Development and testing of the new product then takes place through use of prototypes. Final planning, which includes a marketing plan, a proposal for full-scale production and full analysis of profit potential, is then done. The last phase is the launch phase, which includes management approval, production of the product and an initiation of full-scale operations [19], developed what have become a common NPD process which has eight stages namely; idea generation, idea screening, concept development and testing, business analysis, beta testing and market testing, technical implementation, commercialisation and new product pricing. Figure 1 and 2 shows some of the NPD models/ frameworks that are commonly used.

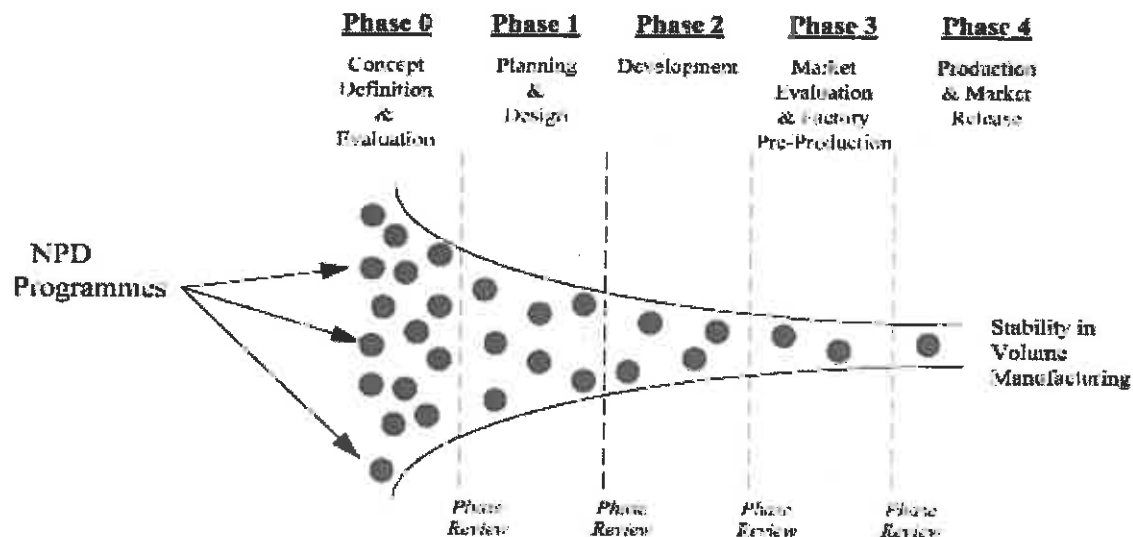


Figure 1: NPD process (after Shepherd [20])

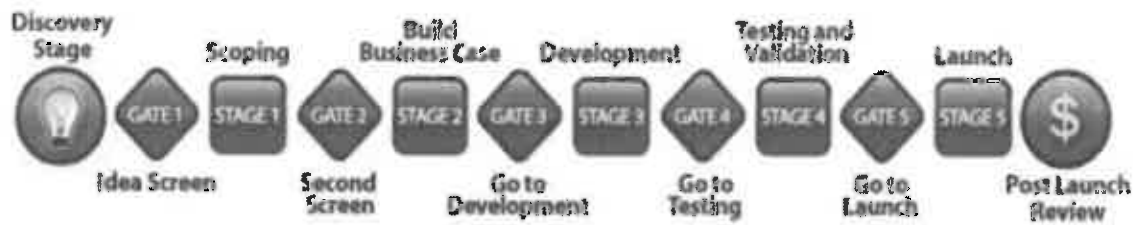


Figure 2: The stage-gate Process, by Cooper and Edgett [21]

Many NPD problems identified in literature appear to be caused by implementation related issues, [8], rather than any fundamental failing of any NPD framework. Implementation involves major management components such as planning, leading, and controlling and these are usually a factor of the competency levels of senior personnel leading NPD activities. Almeida and Miguel, [22], developed from literature dimensions of new product development process, as shown in figure 3. The proposed dimensions are strategic, organizational, technical, planning, control and operational. Their model has two levels structural and operational. These levels indicate two levels of integration in the product development process. The structural level refers to how the product is developed while the operational level refers to the application of the organizational standards in a specific project such as planning and execution of the development project. From strategic, organizational, and management theory, [22], it can be shown that the product development processes are led and executed by senior personnel involved with NPD activities.

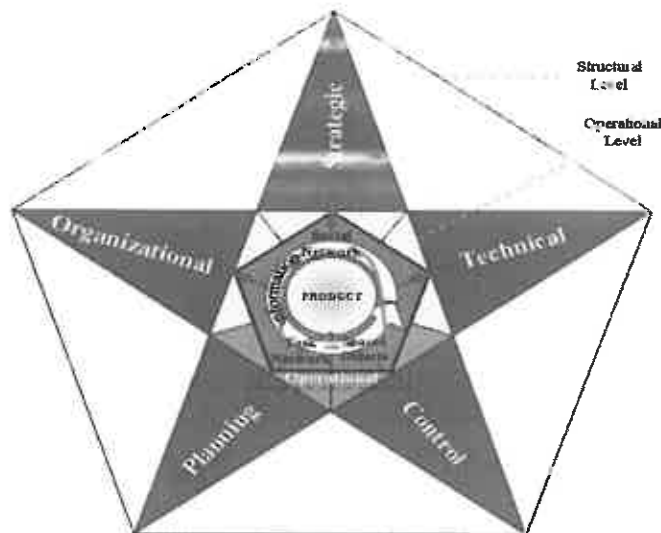


Figure 3: Representation of the conceptual model of the product development process (Adapted from Almeida and Miguel [22])

Research and Development strategy entails that an organisation continues to create value in terms of developing new products that are unique and can-not be imitated by competitors, [18]. The strategy to develop unique products requires organisations to develop unique capabilities. These capabilities are realised through the competencies of senior personnel involved in new product development. An organisation with unique excellent competencies has an ability to develop an adequate return on capital invested in their development, [16, 18].

3.2 Theory of Expert Competence

Smith and Mireless, [23], reported that experts command competence motivation, which is the drive to demonstrate self-imposed levels of achievement in attaining personal, professional and job related standards of excellence. In this paper senior personnel involved in NPD are treated as experts. These individuals are defined as having the necessary skills and abilities to undertake NPD projects with success. These NPD experts are expected to have the two types of knowledge; “explicit, “know what” and tacit, “know how”, [23]. They are recognised within the NPD profession and are regarded to perform at highest levels. According to the Theory of Expert Competence; the skills and abilities that emerge or do not emerge in these experts depend on five factors: domain knowledge, psychological traits, cognitive skills, decision strategies and task characteristics [24].

Adequate domain knowledge is obtained not only from textbook knowledge but from experience working on real problems such as NPD projects. [24]. This type of knowledge is a prerequisite for being an expert. “Shanteau [24] further argues that experts display a common set of psychological traits, which were described by [23], “as self-presentation... the creation of and maintenance of a public image. These traits contribute to the decision style found in many experts; they include strong self-confidence, excellent communication skills, ability to adapt to new situations and a clear sense of responsibility”. Experts use both formal and informal decision strategies, [24]. In engineering management these traits fall under leadership and communication abilities of senior personnel in NPD and these abilities will be investigated in this study.

Cognitive skills possessed by experts include, “highly developed attention abilities, a sense of what is relevant, the ability to identify exceptions to rules and the capability to work effectively under stress. They include making use of dynamic feedback, relying on decision aids, decomposing complex decision problems and pre-thinking solutions to tough situations, [24]. Task characteristics determine whether experts behave competently or not. Regardless of knowledge obtained by an expert, traits, skills and strategies, competence observed in an expert depends on the task, such as NPD. This paper will make use of the Theory of Competence to investigate factors that affect competency levels of senior personnel involved with NPD.



Figure 4: New Product Development Competency Factors.



4 RESEARCH METHODOLOGY

The research methodology of this study included relevant literature review, and detailed case studies. These case studies were used to explore, describe, explain and compare NPD activities done in the four companies [25]. Descombe [26], stated that, “case studies focuses on one instance’s relationships and processes in a natural setting with the possibility of using multiple sources and methods for both data gathering and analysis”. The triangulation method was used for data gathering as suggested by Scandura [27]. The method included extensive literature review, a cross functional mail survey (with well-prepared questionnaires) and in depth case studies including interviews. Triangulation offers more complex, overlapping descriptions of the case and makes the report more trustworthy, [28]. The questionnaire focused on new product development competence factors shown in figure 4 the questionnaire was distributed to senior personnel involved with new product development. Targeted departments were Research and Development, design office, manufacturing, marketing and finance

5 RESEARCH FINDINGS

The responses received were 9, 12, 13 and 11 for companies A, B, C and D respectively.

5.1 Sources of Knowledge and Skills

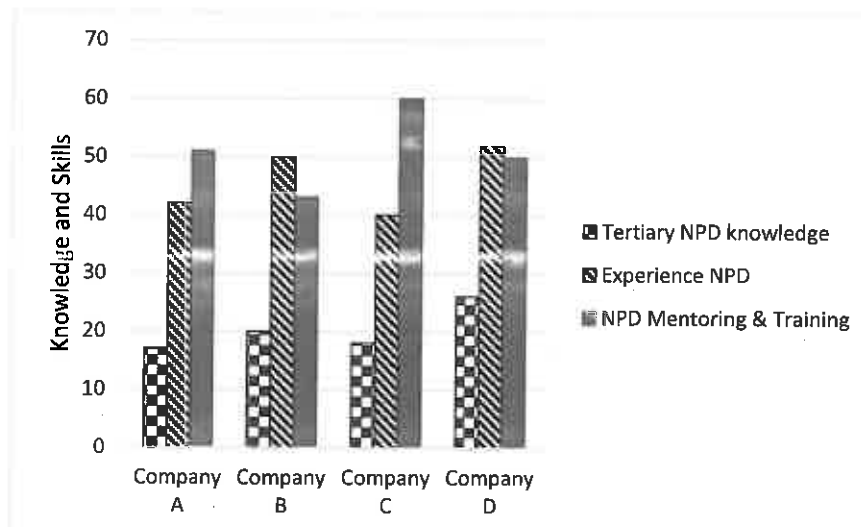


Figure 5: Senior Personnel’s NPD Sources of Knowledge and Skills

All respondents indicated that most employees had no formal training or knowledge to discharge duties involving new product development diligently. Lack of knowledge and training hampers the development of new products. Most of the respondents indicated that they acquired their NPD experience from networking and sharing information in conversations with other colleagues at work and in their social networks.

The results show that all companies rely on mentoring and in-house training for employees to get knowledge and skills in NPD activities. Respondents showed that they now have some experience in NPD that ranged from 3 to 15 years. NPD competence can be improved if NPD is taught at tertiary level. Issues such as market intelligence and patent searching was found missing amongst most of the respondents. The issue of involving customers in formulating product parameters was also not given due attention. Most companies do not carry out patent searching. This is a shortcoming in that resources might be wasted in trying to develop already existing products.

Most respondents indicated that there is no new product development framework followed at their companies. New products are developed in a haphazard manner due to either lack of

resources or lack of manpower. The link between these companies' business strategies and NPD was found to be weak. During interviews senior personnel failed to explain how much the business strategy influenced NPD.

5.2 Cognitive Skills

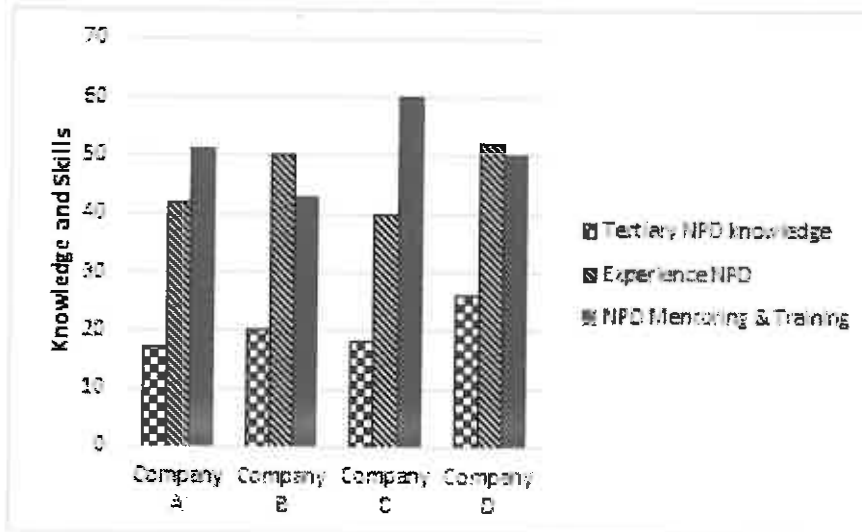


Figure 6: Senior Personnel's Levels of Cognitive skills

Creativity was found to be high in almost all companies. However competences of problem solving and multi-tasking were noticed to be very low. These low competences affect senior personnel in their day to day NPD activities. Multi-tasking was found to have been affected by lack of training in NPD activities. Most senior personnel had difficulties in paying attention to their daily duties and meeting the demands of cross functional meetings.

Competence of creativity was found to be high in companies C and D, in A and B it was well below 50 %.

5.3 Psychological traits

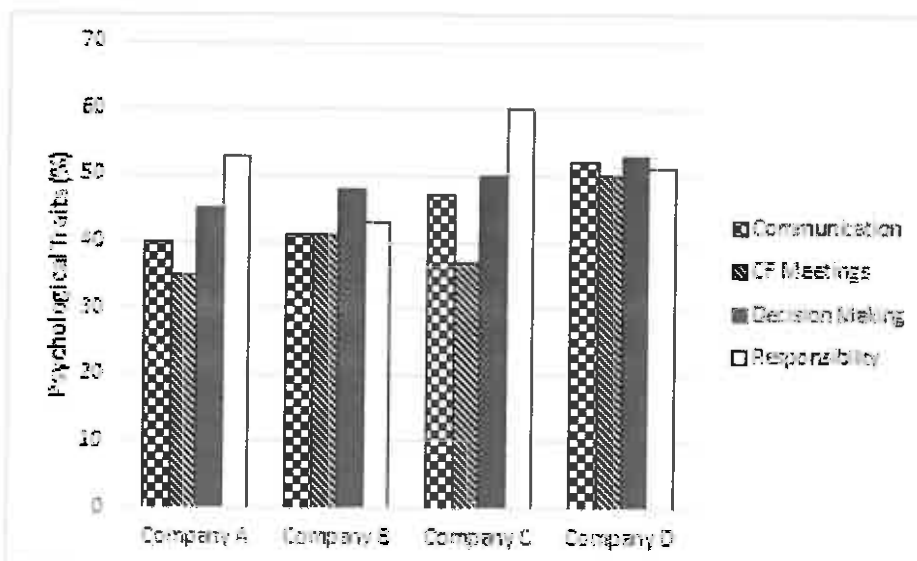


Figure 7: Senior Personnel's Psychological traits

Psychological traits are one of the most important competence factors that help NPD processes. Communication reduces product development time as it keeps the development



team focused. Communication plays an important role in charting the direction and objectives of the company. However the research established that there is poor coordination among various departments. Formal and informal meetings are lacking as indicated by low responses on cross functional meetings. This is in disagreement with [40] who indicated that formal team briefings are essential for the dissemination of information and discussion of current status.

5.4 Discussion

Lack of NPD knowledge and training that was established in Figure 5 agrees with the US National Research Council, [30] which established that, “most engineering curricula do not focus on the entire product realization process”, in its finding on why American firms were lagging behind their competitors like Japan and the U.K. Lack of formal training robs senior personnel of tacit knowledge, [23]. NPD knowledge can also be improved through patent searching. Patent searching was found missing in all companies and this contradicted the findings done by Ulrich [14], who reported that, “Patent searching is an important link in information gathering and it makes available technical information and concepts that are protected”,

There is need for these SMEs to focus on their strategies. Current global trends dictates that successful product development requires a strategy as well as a process (model) as indicated by [14] A design model speeds up designing, thereby reducing development time and costs. “Cravens and Piercy [36] established that NPD process continues to evolve and become more sophisticated, hence the need to have an established NPD process that can be updated regularly”.

Figure 6 indicated that creativity as quite high in all companies. Scandura and Williams, [27] reported that creativity is the mental process that leads to conceptualisations, artistic forms, solutions, ideas, theories or products that are unique and novel”. NPD demands that employees work in a supportive environment that will enable their creativity to flourish, [28], since creativity is the most valuable resource needed in new product development. “Yin [25] established in their research that high levels of worker motivation results in high levels of creativity, which results in better new product development practices”.

Coordination among various departments was found to be weak. This has a negative effect on the timelines for NPD as well as teambuilding. It is the responsibility for management to nurture a corporate culture that influences team building for the benefit of NPD activities. Smith and Mireless, [23] suggested that teams are built and defined by shared values, strong organizational culture and socialization”. It is the work and duty of NPD senior personnel to see that their organizations’, policies, procedures and values are enablers of team building, since this has the effect of breaking down barriers among various departments. Results of shared thinking are faster and stronger due to synergies of cohesive problem-solving groups, [17].

NPD senior personnel must create boundary-less organizations, which are flexible, responsive to change and facilitate the free exchange of ideas and information, [14]. During interviews, most workers alluded to the fact that most senior personnel do not make decisions in time, they consult with top management first. This affects product development timelines with some negative effects of delays and demotivating staff as well. However most experts are willing and take responsibility for the jobs they do. Accepting responsibility is an important competence factor as it puts senior personnel in charge and it somehow motivates them to achieve more.

According to work performed by Cooper et al [15], potential problems in NPD may arise with the implementation of a new product development process. More bureaucracy, tighter controls that might thwart creativity and slower decision making are all potential problems that might plague the introduction of any formal process. Indeed, many of the problems



identified appear to be caused by implementation related issues rather than any fundamental failing of the NPD framework.

6 RECOMMENDATIONS

The research confirmed general problems associated with new product development found in innovation management literature. Factors that were found to affect senior personnel in making competent decisions on new product development include weak business strategy, limited support for innovation and weak management practices.

The research established that competences are an individual's traits or personality aspects that are important for professionally discharging duties at hand. Individual competences are concerned with the fundamental characteristics that are inherent in a person's actions in relation to all kinds of tasks and situations. It is the duty of management to recognize skill and expertise of employees and to nurture and motivate employees. It is recommended that core competencies be created through interactions of staff and connections between the organisation's objectives, strategy, structure and culture. Most employees in similar jobs hold similar qualifications and experience, but they are differentiated by, "their individual's effort, enthusiasm, motivation and underlying self-image that distinguish the successful employee from the unsuccessful one [31].

The traditional over the wall approach, where product development activities are uncoordinated amongst various departments involved in new product development, is still prevalent in most companies. This reflects a deficiency in formal training and strategy with regards to new product development methodologies. Undergraduate and Postgraduate courses in institutions of higher learning must have curricula that address new product development aspects.

Non-use of NPD framework has compromised the involvement of customers. Successful new product development requires that customers and suppliers should be involved in the development process at the earliest moment as indicated by [32]. New product development models such as Quality Function Deployment QFD, Evolutionary process, Stage Gate process emphasizes the involvement of the customer at the design stage. This reduces both development costs and time and ensures that the designed new product has a market. Customer satisfaction as established by [14, 32] is one of the facets that can be used by a company to assess the success or failure of new product development, involving the customer in the early stages of product development is therefore a very important aspect.

The research proposes that companies use four perspectives on organisational learning that were developed by [31], in improving the competence of senior personnel leading NPD activities.

The first perspective is the individual behaviour perspective focusses on the informal, unconscious behaviour of a single organisational member and the interpersonal interactions among a number of members of an organisation [33]. Improving the behaviour of senior personnel enhances their team participation, a requirement for NPD [5].

The second perspective is the decision support perspective which focusses on individual learning process in an organisation. The learning process includes use of information technology and decision models that support decision making [30, 32]. Decision making is a very important competence in NPD.

The third perspective is the management and organisational structure perspective which concentrates on collective learning process guided by formal organisational structure and management systems through formal planning, control processes, operating procedures and reward systems [14, 30]. Senior personnel will understand their responsibility and authority as well as how to coordinate staff from different departments. This in turn will improve NPD timelines.



The fourth perspective is the corporate culture perspective that focusses on social, informal relations, collective habits, behavioural patterns and attitudes existing in an organisation. Corporate culture emerges from collective learning processes and it guides and shapes collective and individual behaviour [33]. The corporate culture will improve senior personnel's competence in values and norms.

NPD companies must improve their monitoring of innovation and management of technology. Product technology is a critical factor in product design as it can dramatically change the competitiveness of products. Companies are encouraged to monitor publications done by university research arms, the armed forces, private foundations and the government. It is also important for these companies to make use of NPD metrics such as customer feedback and new ideas that have a potential for breakthroughs and adoption. Employees must be taught how to work with marketing, research and engineering groups in organising and classifying new ideas.

6.1 LIMITATIONS

Few SMEs were studied making the results ungeneralisable. Costs associated with new product development as reported by Jensen et al [34] such as, "poor designs, product malfunctioning, product liability claims, expensive product recalls and potential higher production costs," were not looked into. The dynamics of core competencies due to product-market strategy of the firm changing was not part of the research. The commercial performance of new products [35], that can be studied through business analysis stages that include sales forecasts, cost estimation, profit projections, risk assessments and cannibalization of sales were not looked into, and can form basis of future research. The research did not reach out to these companies' customers. Absorptive capacity influenced by Research and Development was also not covered.

6.2 FUTURE WORK

Future research may look at internal and external efficiency with regards to a company's potential in new product development. The efficiencies can be measured against new product development metrics such as development time, acceptance by customers, reworks, and development costs. There are various subsets of product development strategy, and these include product development diversification strategy, product modification strategy and revolutionary product development. However this paper did not cover any of the subsets of product development strategy, and this can be considered as part of future work.

7 CONCLUSION

The paper presents an investigation of the competence levels of senior personnel involved with new product development. The competency factors looked into were sources of NPD knowledge, cognitive skills and psychological traits. The study established that formal training in new product development is lacking, and this was found to impact negatively on NPD timelines. On cognitive skills creativity was found to be high but problem solving and multitasking skills were found to be weak. Psychological traits competence was found to be affected by poor communication standards that led to poor coordination among various departments. The paper proposed that senior personnel's competency levels can be improved through organisational learning.

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