# CROWDSOURCING AS A PLATFORM FOR OPERATIONAL PERFORMANCE IN MANUFACTURING FIRMS IN KENYA

**BY**

**NJUKI KIHORO**

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# DECLARATION

I, Elijah Njuki, hereby declare that this project is my own work and effort and that it has not been submitted anywhere for any award.

Signature: ……... Date……

Elijah Njuki Kihoro
D61/73338/2009

This project has been submitted for examination with my approval as university supervisor

Signature: ……... Date: ……

SUPERVISOR
Dr. Kate Litondo
Lecturer, Department of Management Information Systems

# DEDICATION

Dedicated to my loving family for their endless support

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# LIST OF ABBREVIATIONS AND ACRONYMS

| | | |
|---|---|---|
| BPO | - | Business Process Outsourcing |
| IT | - | Information Technology |
| ITO | - | Information Technology Outsourcing |
| KPO | - | Knowledge Process Outsourcing |
| OSS | - | Open Source Software |
| USA | | United States of America |

# ABSTRACT

The use of information technology provides an innovative channel of transforming manufacturing. This is done through the process of outsourcing non-core functions. Firms strive to be providers of high quality goods and services at globally competitive costs. However, for a firm to decide on whether or not to use crowdsourcing as a mechanism of outsourcing the firm has to be assured the strategy will work to improve quality, productivity and timeliness. For manufacturing companies to be globally competitive, crowdsourcing provides a useful solution. This research, therefore, had three objectives: to establish the extent to which manufacturing firms in Nairobi City County have adopted Crowdsourcing; to determine the challenges encountered with crowdsourcing in manufacturing firms in Nairobi City County; and to establish the influence of crowdsourcing on operational performance of manufacturing firms in Nairobi City County. The research was a survey utilizing a sample of 31 manufacturing firms selected using stratified random sampling from a total of 455 registered manufacturing firms. The operations managers of the firms provided the required data by responding to a self-administered questionnaire. The questionnaire required the operations managers to provide both qualitative and quantitative data on crowdsourcing which was the independent variable and operational performance which was the dependent variable. The results show that crowdsourcing is just occasionally used as a method of outsourcing in manufacturing firms. The challenges that face manufacturing firms include maintaining the motivation level of crowd solution providers, managing crowdsourcing participants, loss of control of a firm's processes to participants, control of the Quality of information technology ideas and solutions and inability of firms to articulate and define the key problems. Crowdsourcing has a great influence on productivity. It reduces maintenance costs, cost of inputs, and number of defective products and improves the quality of supervision. Crowdsourcing has also shortened the innovation chain from idea formulation to product. Product rating has also improved. Crowdsourcing affects product quality through improving customers' opinion of products, matching the quality produced and the quality that customers expect, quickening the response to quality issues and ensuring get value for their money. However, crowdsourcing has not done much in improving brand ranking and effectiveness in response to quality issues. Crowdsourcing has not done much to improve timeliness of deliveries despite doing well in improving delivery aspects such as matching delivery services and prices charged, ensuring customers always receive orders in right quantities, increased flexibility of addressing quality issues and strict adherence to agreed delivery schedules. From the regression results, productivity contributes positively to operational performance and the contribution is significant. Timeliness and quality activities do not significantly affect operations performance. The research recommends that manufacturing firms should increase their use of crowdsourcing beyond their current occasional use. Steps should be taken to ensure crowdsourcing software allows for the improvement of the level of motivation of the crowd. Crowdsourcing should be encouraged as a mechanism of cost management, timely delivery and quality improvement.

# CHAPTER ONE: INTRODUCTION

## 1.1. Background of the Study

Information Technology is a generic term covering the acquisition, processing, storage and dissemination of information. It involves application of computers and communication technology in information, information handling and information flow from where it is generated to where it is used (Zorkolcy, 1989). In manufacturing, information technology has innovatively become an inseparable part of the manufacturing process for, through acquisition, processing, storage and dissemination of information, it has led to new products and processes as well as the improvement of existing processes in effect leading to higher productivity, expansion of product portfolios and services (De Weck, Reed, Sarma and Schmidt, 2012).

One way through which information technology has innovatively transformed manufacturing is outsourcing (Quelin and Duhamel, 2003). In an attempt to become more agile and responsive to needs of the supply chain, manufacturers have increasingly begun to outsource core production processes and noncore support processes. Information technology infrastructure and digital platforms are now the critical enablers of outsourcing by improving the flexibility of their manufacturing activity through offering high-speed communication and connectivity (Quelin and Duhamel, 2003).

"Crowdsourcing" is a term first used by Howe (2006). This term was used in the context of the global technology industry. According to Howe (2008) crowdsourcing is simply the act of taking a job usually performed by a designated agent and outsourcing it to an undefined, generally large group of people in the form of an open call. Outsourcing work

on the basis of the fact that current advancements in technology are breaking down the cost barriers that once separated amateurs from professionals.

Crowdsourcing is now a mega trend (Shirky, 2008). It is a strong force driving fueling innovation and collaboration in business. It complements and expand firm's processes with capabilities, equipment, and ideas from a large group of people rather than from their own employees or their seasonal suppliers

It also cuts down cost, trims work force, improves revenues, widens customer base, improves customer loyalty, improves quality, speed and widens opportunities. The rise of global businesses like Facebook, Apple, Amazon and Amazon and OLX indicate the power of the current information technology status and its contribution to business performance. However, the power of crowdsourcing has not been greatly tapped in the Kenyan manufacturing sector despite being realized in political circles. According to Kahl, McConnell and Tsuma (2012) the strength of the digital crowd was realized in the fueling and quelling the post-election violence of 2008 in Kenya. Many manufacturing firms are yet to embrace this new technology. As a result, they are threatened by not reaping benefits like creation of virtual teams and virtual communities (Kodama, 2005).

### 1.1.1. Crowdsourcing

Howe (2006) first defined crowdsourcing as the act of taking a job usually performed by a worker and outsourcing it openly to an undefined large group of people. Crowdsourcing is an example of the ability of the web 2.0 to reach new domains drawing upon people with different economic circumstances. Crowdsourcing is a web-based model used by companies and organizations to outsource projects to a network of individuals. This

approach is widely adopted method of organizing labor for businesses and organizations looking to expand their operations into networked communities.

In manufacturing, crowdsourcing is viewed as the process by which manufacturers complement and expand their manufacturing processes with manufacturing capabilities, tools, equipment, processes and ideas from outside their organizational boundaries tapping into a larger mass of people, typically by means of internet-enabled solutions the phenomenon of crowdsourcing has risen and consumers are becoming more like co-workers who take over specific parts of a production process. Online crowd community give manufacturers a way to think outside the box. Crowdsourcing allows businesses to tap into a broader supply of talent instead of letting innovation be restricted by the ideas, concepts and abilities of in-house employees. Crowd participants give a new perspective and new ideas come with that perspective.

This happens with the process still being under the control of a commercial enterprise (Kleemann and Gunter, 2008). Crowdsourcing challenges includes the following; issue of intellectual property rights and copyright ownership of solutions, crowd trust, quality of ideas and solutions and loss of control.

### 1.1.2. Outsourcing

Quelin and Duhamel (2003) define outsourcing as the operation of shifting, on a long term basis, transactions that were previously governed internally to an external supplier. It involves the transfer of staff to the vendor or the external supplier for the firm. To Grossman and Helpman (2005) outsourcing is about finding a partner that can enable

establishment of a long term bilateral relationship with the partner being able to produce goods or services that fit the firm's particular needs.

According to Quelin and Duhamel (2003) outsourcing is characterized by five elements. These are: a close link between outsourcing processes and the key success factors of a firm; the transfer of ownership of a previously internalized business function usually including the transfer of personnel and physical assets to the service provider; contract that is longer and denser than a mere subcontracting agreement; a long-term commitment and an agreed definition of service levels and obligations of each partner.

Bank (2010) identifies six types of outsourcing. These are: Offshoring, Nearshoring, Onshoring, Business Process Outsourcing (BPO), Knowledge Process Outsourcing (KPO) and Information Technology Outsourcing (ITO). Offshoring is the sourcing of service activities to a lower cost organization in a foreign country. Nearshoring refers to a domestic firm investing outside the country, but into a neighboring region. In onshoring, a company assigns some services to be provided by someone outside a company but within the same country. In Business Process Outsourcing (BPO), a particular process is assigned to another company. Knowledge Process Outsourcing (KPO) occurs when work that needs higher levels of involvement from the worker and necessitates advanced levels of research, analytical and technical abilities is assigned to be provided by another company. In Information Technology Outsourcing (ITO) a computer or Internet related work such as programming, is outsourced to other companies.

### 1.1.3. Operations Performance

According to Slack, Chambers and Johnson (2010) operations are the activities that deliver goods and services to the consumer. They refer to the part of the organization that are devoted to production and/or delivery of goods and services. Operations are divided into manufacturing or service. Manufacturing involves the production of tangible items. Service production involves the production of intangible items that cannot be produced a head of time.

In the systems view, operations can be classified into input, transformation process and output. Inputs are the raw materials and the elements that act on the raw materials. The transformation process is concerned with transforming elements acting on raw materials which give the operations system its goal. The transformation can be achieved physically (as in manufacturing), by location (as in transporting) or by storage (Porter, 2011).

In organizational context, performance involves measurement of the effects of organizational actions. Its essence is the creation of value. Operational performance in the context of this paper refers to the extent to which operations decisions contribute to creation of value in manufacturing firms by reducing cost, workforce and time while increasing revenue, new customers, customer loyalty, innovation, quality, speed and opportunities (Jensen and Meckling, 1976).

### 1.1.4. Kenya's Manufacturing Sector

Manufacturing involves the application of tools and labor in the fabrication of goods for use or for sale. Manufacturing, which can also be referred to as Production, can be simply defined as a value addition process by which raw materials of low utility and value due to

its inadequate material properties, poor or irregular size, shape and finish are converted into high utility and valued products whose dimensions, forms and finish enable them satisfy a given need (Naude and Szirmai, 2012).

The special interest in manufacturing in developing countries stems from the belief that the sector is, among other things, a potential engine of modernization, a creator of skilled jobs, and a generator of positive spillover-effects (Tybout, 2000). This is also the Kenyan case because immediately after independence Kenya saw industrialization as the key to economic development. This was motivated by the benefits attained by advanced economies as a result of their industrialization policies aimed at development of a modern industrial sector (Muchai and Muniu, 2012).

Manufacturing firms in Kenya fall under the umbrella of Kenya Association of Manufacturers. Currently, Kenya Association of Manufacturers has a record of 455 manufacturers as listed in Appendix I. Kenya Association of Manufacturers (2002) posits that measures used by the Kenya Government, such as removal of price controls, foreign exchange controls and introduction of investment incentives have failed to bring about major changes in the overall economy and have not improved the manufacturing performance. The growth in manufacturing sector has mainly been attributed to rise in output of the agro-processing industries. Other key sub-sectors are: manufacture of cigarettes, cement production, batteries, motor vehicle assembly and production of galvanized sheets.

#### 1.1.4.1 Nairobi City County

Nairobi City is the capital city of Kenya and is located within Nairobi County. It is the capital city of the most economically empowered country and the business hub of East Africa. Manufacturing firms in Nairobi City County are the focus of this study because, according to Mulama (2012) most of the manufacturing firms in Kenya are located in Nairobi City. The clustering of the manufacturing firms in Nairobi City with the presence of the city's infrastructure makes it possible for the firms to use information technology for crowdsourcing. Most of the manufacturing firms that have embraced crowdsourcing are likely to be found here. This can also provide a better estimation of the extent to which crowdsourcing is used in Kenya's manufacturing industry.

## 1.2. Research Problem

The crowdsourcing web-based model is increasingly being used by companies and organizations as a mechanism of improving operations performance through outsourcing projects to a network of individuals. Howe (2008) argues that crowdsourcing is breaking down the cost barriers that once separated amateur service providers from professionals. The availability of software and the explosion of social media, smart phones, and applications has provided the opportunity to create online platforms through which workers and tech-savvy consumers communicate. Crowdsourcing enables a company to broadcast an issue to a diverse audience who provide a source of innovation, research on new concepts, design new products, fine tune designs, etc.

Probst *et al.* (2014) conducted a study to find out how using customer creativity, insight and wit in a crowdsourcing program affected the performance of a firm. The firms under

study involved customers in co-creation, co-designing, user innovation, user manufacturing as a way of stimulating innovations. The study established that companies that used crowdsourcing by way of involving customers generated more sales and revenues. In this context, crowdsourcing through customer involvement brought about value creation strategy enabling brands to acquire a competitive edge.

In another study Evaldsson, Ljungdahl and Suter (2012) conducted a study to establish how crowdsourcing and open source development improved drug development in pharmaceuticals in the USA. The study found that crowdsourcing within a scientific problem context showed crowdsourcing improved drug development.

Manufacturing firms in Kenya produce globally uncompetitive products as evidenced by the poor quality and high prices. Studies done concerning crowdsourcing in Kenya have focused on its non-manufacturing application like fueling and quelling the post-election violence of 2008 in Kenya (Kahl, McConnell and Tsuma, 2012). Tapping in the social media is a mechanism of improving the performance of required functions. To maintain sustainable profitability, Kenyan manufacturers have to come up with operational techniques that aim at improving quality while lowering prices in order to make their products competitive on a global scale. Crowdsourcing provides such an opportunity.

However, there are no known studies that have established whether crowdsourcing is used in the manufacturing sector in Kenya's Nairobi City County and how crowdsourcing affects their performance in terms of cost, trim work force, revenues, customer base, customer loyalty, innovation, quality, speed and opportunities. It is, therefore, not known whether crowdsourcing can be of benefit to the operations in the manufacturing sector in

Kenya's Nairobi City County. To fill this research gap, this research examined the impact of crowdsourcing on operational performance in manufacturing firms in Nairobi City County.

### 1.2.1. Research Objectives

The following were the objectives of this research:

i. To establish the extent to which manufacturing firms in Nairobi City County have adopted Crowdsourcing
ii. To determine the challenges encountered with crowdsourcing in manufacturing firms in Nairobi City County.
iii. To establish the influence of crowdsourcing on operational performance of manufacturing firms in Nairobi city county.

## 1.3. Value of the Study

The findings of this research will be useful to scholars, owners of small businesses and government economic policy makers. To scholars, this research will contribute to the scholarly discussion concerning whether crowdsourcing improves operational performance in firms in the manufacturing sector. Future researchers and other scholars will use the findings of this study in advancement of the discussion.

Owners and managers of manufacturing firms in Nairobi City County and elsewhere will have objective evidence that will shed light on whether crowdsourcing can contribute to operational performance. In case crowdsourcing is found to have a great effect on

operational performance, crowdsourcing can be used as a management approach for manufacturing firms.

Government policy makers will also find the results of this research useful. The established relationship between crowdsourcing and operations performance will provide input for putting in place policies that can improve the profitability of manufacturing firms. Manufacturing firm's access to the technology required for crowdsourcing will enable cost cutting. Such cost cutting benefits product prices.

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Introduction

This chapter reviews the use of IT in the manufacturing sector, the crowdsourcing technology, challenges facing outsourcing, the theories on which this research in based and the conceptual framework.

## 2.2 Use of Information Technology in the Manufacturing Sector

Rana (2013) identifies two main uses of information technology in manufacturing. These two are automation of the manufacturing processes and use in supply chain management SCM). In the manufacturing process IT is used for computer- integrated manufacturing which is the combination of information technology and factory automation. IT is also used for numerical control which is the automation of machine tools that are operated by abstractly programmed command encoded on a storage medium.

In SCM IT is used for transaction execution, collaboration, coordination and decision support. The flow of information is vital to the functioning of a supply chain. Without information relayed timely and to the right place, the whole supply chain would come to a standstill. Hence information technology, which enables information flow within a firm, between firms, and across the supply chain, goes a long way towards ensuring effective and efficient supply chain management. Information technology, in short, forms the backbone of most corporate supply chains.

## 2.3 Crowdsourcing Technology

Oomen and Arroyo (2011) provide four types of crowdsourcing. These categories are: the produce category, the rate category, the Facilitate category and the publicize category. The produce category involves production of a tangible result. The outsourcing process is organized accordingly to the tangible results to be generated. Procter & Gamble is not the only large company seeking the wisdom of crowds for product innovation. Clorox, Siemens, L'Orealand Philips and others regularly rely on networks such as Hypiosand eYeka to crowdsource their product ideas. Much of the crowdsourcing on the Internet revolves around content and information.

According to Brussee, et al. (2008) the process of the produce category of crowdsourcing involves five functions: create, read/retrieve, update and delete. The create function is about creating new information or content, but using the already available material as is done on YouTube. The Retrieve function is about finding and selecting the required information. Add is a function that allows the public to annotate pictures posted by archives and museums with stories, explanations, names etc. The delete function allows the public to delete information or content.

The rate category of crowdsourcing is based on the idea that in many cases the public knows best. This arises from the hands-on experience of the public. The general public is also less likely to have a commercial interest in giving good or bad ratings. An example is when the public is involved in rating services provided by hotels over the internet. The facilitate category involves activities like crowdfunding where an open call is made for funding. This enables volunteers to come up to provide funds for a given course. The

publicize category of crowdsourcing involves drawing attention. Advertising firms use crowdsourcing to create new branded products or scout for new talent (Brussee, et al., 2008).

The direct benefit for a company or organization that uses crowdsourcing is that work is done by the crowdsourcing participants. It is very likely that the work done by crowdsourcing participants could not have been done by the organization itself. This is because either the work would be too expensive, too extensive and time consuming, too boring, or would require knowledge, skills or resources not available by any other method. Crowdsourcing also helps reach a larger group of people who encourage processes like standardization. Further, exposure through crowdsourcing may lead to a culture of openness of the organization resulting in public relations benefits (Malone *et al*., 2010).

However, crowdsourcing has several costs. A key cost of crowdsourcing is the difficulty in quality control and time management especially if the crowd is not under obligation to continue working on a project, or deliver services in a way useful for the organization. Another cost of crowdsourcing is the loss of authority. This tends to frustrate goal achievement since the organization has no control over the virtual crowd. When a task is divided into smaller jobs worked by different people in the virtual crowd, it sometimes becomes difficult to combine the jobs into one unit. Sometimes the collaboration that arises out of crowdsourcing can force an organization to acquire the infrastructure of the other organization to enable collaboration (Oomen and Arroyo, 2011).

Vukovic (2009) provides four stages for a crowdsourcing process. These stages are: registration and specification, initializing crowdsourcing contest, carrying out

crowdsourcing request, and completing crowdsourcing request. In Registration and specification stage, requesters and providers register on the crowdsourcing platform. The requester then presents the task to be crowdsourced in which a clear definition and description of tasks, their start date, end date, the reward of successful completion and other parameters are done.

In the second stage, which is initialization of the crowdsourcing, the platform displays submitted tasks and all prerequisites that are necessary for doing the tasks. In the third stage, which is carrying out crowdsourcing request, the platform provides the environment and tools to enable requesters to submit tasks and also to enables crowd workers to choose the tasks to work on according to their knowledge. The worker is free to choose to work on a task according to his/her interests. In the final stage, the participant completes the request, submits it to the platform, requester validates it against the completion criteria before execution of award payment (Vukovic, 2009).

## 2.4 Challenges of Crowdsourcing

Sonnleitner, Kung and Wenzel (2013) have expressed several concerns regarding crowdsourcing. They argue that the issue of intellectual property rights and copyright ownership of solutions could be a crucial barrier the success of crowdsourcing within enterprises. Pedersen et al. further the position by stating that the success of a crowdsourcing campaign depends on attracting and retaining knowledgeable participants.

Other challenges arise from trust; quality of ideas and solutions and loss of control. There is always mistrust between problem owners, solution providers and the crowds of participants. The quality of ideas can sometimes be low given that there is no means of

evaluating suggestions. The organizations using crowdsourcing risk loss of control as a result of losing information that could possibly hurt the organization (Müller, Thoring and Oostinga, 2010).

Kaufmann, Schulze and Veit (2011) agree that one of the most notable challenges facing crowdsourcing is how to keep solution providers motivated. Contributing to crowdsourcing projects is driven by extrinsic and intrinsic motivation. Extrinsic motivation refers to tangible payoffs, whereas intrinsic refers to a solution provider achieving some form of personal fulfillment. Yu and Nickerson (2011) suggested that offering extrinsic motivation to solution providers may create social barriers in the workplace and discourage cooperation from some.

## 2.5 Studies on Crowdsourcing and Operational Performance

Chatterjee, Khandekar and Kumar (2014) conducted a study to establish how crowdsourcing would cause reinvention of the processes in Indian manufacturing organizations that strive to drive efficiency across their value chain and create sustainable competitive advantage. The study found that the use of crowdsourcing improved the efficiency in the manufacturing firms and recommended introduction of crowdsourcing in manufacturing firms in phases.

Probst *et al.* (2014) conducted another study to find out how using customer creativity, insight and wit in a crowdsourcing program affected the performance of a firm. The firms under study involved customers in co-creation, co-designing, user innovation, user manufacturing as a way of stimulating innovations. The study established that companies that used crowdsourcing by way of involving customers generated more sales and

revenues. In this context, crowdsourcing through customer involvement brought about value creation strategy enabling brands to acquire a competitive edge.

In another study Evaldsson, Ljungdahl and Suter (2012) conducted a study to establish how crowdsourcing and open source development improved drug development in pharmaceuticals in the USA. The study found that crowdsourcing within a scientific problem context showed crowdsourcing improved drug development.

## 2.6 Theoretical Foundations of the Study

This section discusses three theories that form the theoretical basis of this study. These theories are: the social exchange theory, the core competencies theory and the theory of constraints.

### 2.6.1 Social Exchange Theory

The social exchange theory first presented by Blau (1964) has its origins in several disciplines such as anthropology, economics, sociology and social psychology. The model has been used discuss human sexuality (Sprecher, 1998), relationship formation (Huston and Burgess, 1979), employer attitude (Whitener et *al.*, 1998), and the distribution channel working relationship (Anderson and Narus, 1990).

There are three key tenets of social exchange theory. First, social behavior is a series of exchanges. Secondly, individuals attempt to maximize their rewards and minimize their costs in a social exchange. Finally, when individuals receive rewards from others, they feel obligated to reciprocate (Nye, 1979).

Emerson, (1981) identified three types of social exchange relationships. The first type is the negotiated transaction in which there are mutually contingent contributions to the exchange with both contributions evolving together in some social process. In the second type of transaction contributions are performed in a paired but separate manner. However, only one of the contributions is contingent upon the other. This transaction process can be triggered by a "free gift" or altruistic act. The last type is called "incorporation" type or the "productive" exchange relation. In this form of exchange, separately obtained benefit is not possible.

The essence of outsourcing partnership matches the first and the third type of social exchange relations. This means, an outsourcing relationship can either be a negotiated transaction or an incorporation relation. In the same line, this theory indicates that a crowdsourcing relationship can exist in the context of negotiation or incorporation. The company and the provider of the outsourcing have to deliberately enter an agreement before the relationship works for the benefit of both. The role of information technology is to facilitate the negotiations and the realization of benefits for both.

### 2.6.2 Core Competencies Theory

This is a theory of outsourcing discussed by Quinn and Hilmer (1994) and holds that the decision to outsource is determined by whether or not the goods, services or processes outsourced are at the core of a firm's business. This theory suggests that the firm's core activities are not proper to be outsourced. If a firm outsources core activities, then the result is likely to be a reduction in the incentives in firm's innovation, disclosure of the critical technologies and an increase in the number of potential competitors.

Arnold (2000) presented a model for discussing outsourcing. The model identifies four types of activities in a company. The activities are: company core activities, and disposable activities. Company core activities are at the center of a company's activities, followed by core-close activities and core-distinct activities in that order. Disposable activities are the outermost. The Core Competencies Theory suggests that the outsourcing process starts with the disposable activities and gravitates towards the company core activities.

Arnold (2000) further argues that as a process or activity gets closer to the core of a company, its specificity to the company increases as opposed to processes or activities that are disposable. Further, the strategic importance of a process or activity increases closer to the core while the strategic importance reduces further away from the core. Further away from the core, activities and processes generate competitive disadvantage while closer to the core, activities and processes generate competitive advantage. Therefore, a firm should seek to outsource activities that generate greater competitive advantage while avoiding the outsourcing of core activities.

This theory provides a mechanism of deciding which activities to outsource to other businesses. The process of crowdsourcing is, therefore, a simple method that applies information technology to outsource non-core processes and activity to anyone out there who finds it profitable to provide the services and goods required while the firm focuses on the core competencies.

### 2.6.3 Theory of Constraints

The Theory of Constraints is a management philosophy developed by Goldratt (1990). The theory argues that strength of any chain, process, or system is as good as its weakest

link. Theory of constraints consists of the following separate, but related processes and concepts: performance measures and five focusing steps; logical thinking processes, and logistics.

Goldratt (1990) argues that there are three key performance measurements to evaluate: throughput, inventory and operating expense. Throughput refers to the rate at which the system generates money through sales, not through production. Inventory is the money invested in goods that the firm intends to sell or material that the firm intends to convert into salable items. Operating expense includes all the money the firm spends converting inventory into throughput. The objective of the firm, therefore, is to increase throughput and/or decrease inventory and operating expense in such a way as to increase profit, return on investment, and cash flow.

The five focusing steps were developed by Goldratt (1990) to help systems deal with constraints. The steps ensure improvement efforts remains on track towards system-level improvements. The first step involves the identification of a system's constraint(s). the step is followed by decide how to exploit the system's identified constraint(s) and later by step three which is about subordinating everything else to the decisions made in the second step. In Step Four, the system's constraint(s) are elevated. If a constraint is broken in Step four, go back to Step one without allowing inertia to cause new constraint. Addressing every new link that arises after strengthening one weak link makes the process stronger.

The staged logical thinking process is to be used together with the five steps. The staged logical thinking process helps the five steps by identifying what to change to, and how to

effect the change. The thinking processes are made up of the logics tools used to identify problems, develop solutions and implement the solutions.

This theory is important to this study because it links operational performance to the operations processes in a manufacturing firm. The manufacturing firm aims at increasing throughput and inventory while reducing operating expense. Further, it indicates that manufacturing firms use crowdsourcing as a solution to the weaknesses in their operations. This should, therefore, affect the operational performance.

## 2.7 Summary of Literature Review

Though the theories discussed in the literature review and the empirical findings seem to agree that crowdsourcing enhances productivity, quality and timeliness, the literature is silent with regard to the manufacturing sector as it dwells on digitalized processes only. As a result, the following gaps are identified with regard to the Kenyan context: first, the literature has not indicated how widely spread crowdsourcing is applied in manufacturing firms in Kenya; secondly, it is not clear which challenges face the use of crowdsourcing in manufacturing firms; it is also not clear how crowdsourcing affects productivity, product quality and the timeliness of deliveries of manufacturing firms. This research aims to fill these gaps.

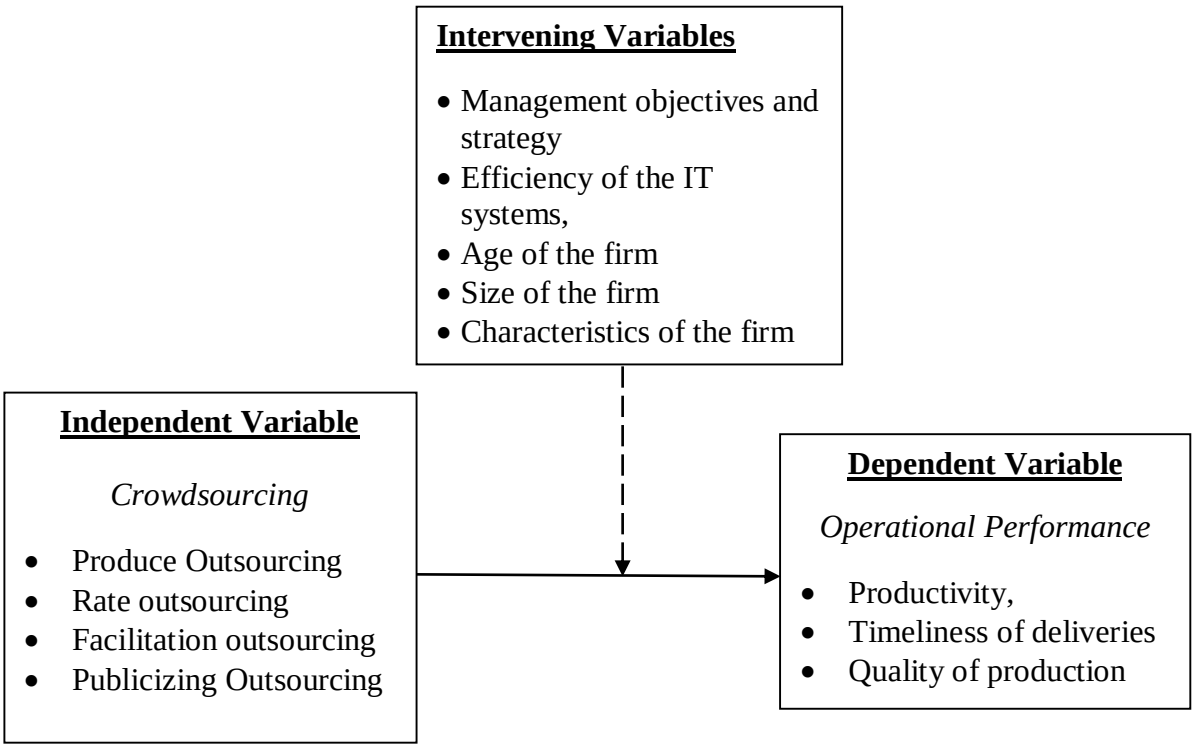
## 2.8 Conceptual Framework

Figure 1 below presents the conceptual framework of this research. The research had one independent variable which is crowdsourcing. The dependent variable was operational performance which was subdivided into Productivity, Timeliness of deliveries and Quality of production. Productivity refers to the output per unit of input. Timeliness of delivery

refers to the accuracy of availing products to the customers the time they are needed. Quality refers to the extent to which products satisfy consumers.

The relationship between crowdsourcing and operational performance is affected by three intervening variables. The intervening variables are management objectives and strategy; efficiency of the IT systems and skills owned by the virtual crowd. The management objectives and strategy give the direction of the manufacturers. If the management finds crowdsourcing as an effective tool of outsourcing, it will work to ensure crowdsourcing becomes an effective contributor to operational performance. The contribution of the crowdsourcing will depend on the efficiency of information technology the manufactures use. Further, the relationship will be determined by the skills owned by those making up the virtual crowd. If they have the required skills, then operational performance will improve as opposed to if the required skills are lacking. Age, size and characteristics of the manufacturing firm also determine the effect of crowdsourcing on operational performance.

**Figure 1: Conceptual Framework**




**Source: Own contribution**

# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter presents the methodology that the researcher used to conduct the research. It presents the research design, the target population, the sample, data collection methods and data analysis methods.

## 3.2 Research Design

This research used the descriptive cross sectional design. According to McClosky (1969) a descriptive study is any procedure involving systematic collection of data from a population or a sample from a population using some form of solicitation like face-to-face interviews, telephone interviews or mail questionnaires. A descriptive research utilizes primary data collected using verbal or written communication based on a representative sample of individuals or respondents from the target population.

In a survey data is collected in a consistently. The existing conditions in a population are carefully documented. A survey has six primary purposes. It aims at calculating diverse statistics; characterizing the diverse statistics and collecting multiple variables. All these are generally focused on describing the population as accurately as possible regarding features of interest (Kish, 1988). The analysis was done across manufacturing firms making it a cross-sectional study.

This research design is applicable for this study since the researcher aimed to use a sample to define the situation as it is in manufacturing in their varied nature. The research collected primary data by use of questionnaires. In effect the study fitted the description of a survey.

## 3.3 Target Population

Target population is depicted as the whole set of the study of all the members of both real or hypothetical be they people, events or subjects to which the investigator desires to generate the result from (Mugenda and Mugenda, 2003). The target population of this study was all the 455 large scale registered manufacturing firms in Nairobi City County (see Appendix I).

## 3.4 Sampling

This research used proportionate stratified random sampling. The strata were the categories of registered firms, namely, Energy Sector, Chemical Sector, Food Sector, Plastics and Rubber, Building sector, Paper Sector, Textile Sector, Timber Sector, Metal and Allied, Pharmaceutical and Medical Equipment Leather Products and Footwear. The stratification was done in order to encompass the variations types of registered manufacturing firms. The 10 percent targeted sample was proportionately divided among the 11 categories of registered manufacturing firms.

According to The Central Limit Theorem any random sample size greater than 30 is approximately normally distributed irrespective of the population size and can be an accurate representative of the population. The theorem, therefore, allows a researcher to select any sample greater than 30. Further, according to Mugenda and Mugenda (2008) a sample should be about 10 percent of the population. A sample of 46 companies satisfies both the Central Limit Theorem and the 10 percent threshold. The respondents were the operations managers from each firm.

**Table 3.1: Sample Size**

| Category | Number of Registered Firms | Sample (10%) |
|---|---|---|
| Energy Sector | 42 | 4 |
| Chemical Sector | 62 | 6 |
| Food Sector | 100 | 10 |
| Plastics and Rubber | 54 | 5 |
| Building sector | 6 | 1 |
| Paper Sector | 48 | 5 |
| Textile Sector | 38 | 4 |
| Motor Assembly and Accessories | 17 | 2 |
| Timber Sector | 22 | 2 |
| Metal and Allied | 38 | 4 |
| Pharmaceutical and Medical Equipment | 20 | 2 |
| Leather Products and Footwear | 8 | 1 |
| **TOTAL** | **455** | **46** |

## 3.5 Data Collection

The researcher used questionnaires in collecting information from the operations managers of the 46 manufacturing firms in Nairobi City County. The required data were collected by means of a self-administered questionnaire. Since all manufacturing firms of interest are located in Nairobi City County, the researcher handed the questionnaire to each of the operations managers in person and collected the completed questionnaires after a week. The data collected were coded in MS Excel software.

## 3.6 Data Analysis

Data analysis was done with each manufacturing firm as the unit of analysis. Descriptive analysis was done by use of summary statistics like the mean and standard deviation. The mean, for instance, was used to find the average response of a respondent concerning a given item regarding the effect of crowdsourcing on productivity, quality and timeliness of

deliveries. The standard deviation was used to measure the variability of responses about a variable determining the effect of crowdsourcing on productivity, quality and timeliness of deliveries. Tables are the main presentations used to display data.

Regression analysis was used to determine the relationship between crowdsourcing and productivity, quality and timeliness of deliveries in the manufacturing firms. The regression model took the form below.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where

$Y$ = Operational Performance

$\beta_0$ = Intercept term

$X_1$ = Crowdsourcing (Production, Rating, Facilitation, Publicizing)

$X_2$ = Characteristics of the firm( Age, Size, Ownership, Efficiency of IT system)

$\beta_i$ = Sensitivity of operational performance variable$i$

$\varepsilon$ = Error term

To test the statistical significance of each of the regression variables $\beta_0$ and the $\beta_i$ the T-tests at 95 % confidence level were used. The F-Test at 95 % was used to test the statistical significance of the whole regression. The F-test was also used to test the significance of the effect of each variable on operational performance. The coefficient of determination $R^2$ and the adjusted $R^2$were be used to determine the strength at which the variation in the independent variables explains the variation in the dependent variable.

# CHAPTER FOUR: DATA ANALYSIS AND PRESENTATION OF FINDINGS

## 4.1 Introduction

This chapter discusses the findings of the research. The objectives of this research were to establish the extent to which manufacturing firms in Nairobi City County have adopted crowdsourcing; to determine the challenges encountered; to establish the influence of crowdsourcing on operational performance. This section presents the finding from analysis of the data obtained from the operations managers of 31 companies that participated in the research. An interpretation of the results is presented in the last subsection of this chapter.

## 4.2 Data Presentation

This section focuses on data presentation. With regard to data presentation, the section describes the sample; describes the challenges facing crowdsourcing; and describes the effect of crowdsourcing on productivity, quality and timeliness of deliveries. It also presents the regression analysis of operations performance against quality, timeliness and productivity. The section ends with interpretation of results.

### 4.2.1 Response Rate

This research targeted 46 manufacturing firms in Nairobi County. However, only 31 questionnaires were received back and used for the required analysis. This made a response rate of 75.61 percent. This shows a high response rate that makes the results plausible.

### 4.2.2 Demographic Characteristics of Respondents

Table 4.2 below describes the sample with regard to the age and gender of the operations managers in the manufacturing companies. As show in the table, 64.52 percent of the operations managers were males while 35.48 percent were female. A large number of the operations managers were between 21 and 30 years as shown by their proportion of 74.19 percent. While, generally, more males participated in the research than the females, there were more females participating than male in the 31 to 40 years' age bracket.

**Table 4.2: Composition by Gender**

| Age | Male | Female | Total |
|---|---|---|---|
| **21-30 Years** | 16(51.61%) | 7(22.58%) | 23(74.19%) |
| **31-40 Years** | 3(9.68%) | 4(12.90%) | 7(22.58%) |
| **41-50 Years** | 1(3.23%) | 0(0.00%) | 1(3.23%) |
| **Total** | 20(64.52%) | 11(35.48%) | 31(100.00%) |

As shown in Table 4.3 77.42 percent of the operations managers had served their companies for less than five years while none had served above 10 years. 9.68 percent had served their companies for between 6 and 10 years. 87.10 percent had been in the operations department for a maximum of five years. Only 12.90 percent had been in the operations department for between 6 and 10 years.

**Table 4.3: Composition by Time of Service at the Company and Department**

| | | Years at the Department | | |
|---|---|---|---|---|
| | | *Less than 5 years* | *6-10 years* | ***Total*** |
| **Years in Company** | *11-20 years* | 0(0.00%) | 1(3.23%) | **1(3.23%)** |
| | *6-10 years* | 3(9.68%) | 3(9.68%) | **6(19.35%)** |
| | *Less than 5 years* | 24(77.42) | 0(0.00%) | **24(77.42%)** |
| | ***Total*** | **27(87.10%)** | **4(12.90%)** | **31(100.00%)** |

Table 4.4 presents the description of the companies for which the managers worked for basing on the size of the work force and ownership. As shown, 58.06 percent of the companies have less than 50 workers and were locally owned. Only 3.23 percent of the companies were locally owned and had over 200 workers. The internationally owned companies had between 51 and 150 workers. On aggregate 87.10 percent of the companies were locally owned while 12.90 percent were international. 58.06 percent had a labour force of less than 50 workers.

**Table 4.4: Composition by Work Force and Ownership**

| Work Force | Locally Owned | International | Total |
|---|---|---|---|
| 0-50 | 18(58.06%) | 0(0.00%) | **18(58.06%)** |
| 51-100 | 5(16.13%) | 2(6.45%) | **7(22.58%)** |
| 101-150 | 2(6.45%) | 2(6.45%) | **4(12.90%)** |
| 151-200 | 1(3.23%) | 0(0.00%) | **1(3.23%)** |
| 201-250 | 1(3.23%) | 0(0.00%) | **1(3.23%)** |
| **Total** | **27(87.10%)** | **4(12.90%)** | **31(100.00%)** |

Table 4.5 describes the companies served by the operations managers by age of the company and the methods they use to get internet connectivity. 64.52 percent of the companies use fiber optic connection; 16.13 percent use 3G while 3.23 percent use 4G. 51.61 percent of the companies had been operating for less than 10 years. Companies that had been operational for between 10 and 20 years were the most connected and applying the fiber optic technology followed by those that had been less than 10 years in operation and who also applies fiber optic technology.

**Table 4.5: Composition by Connectivity Method and Age of Company**

| | **Connectivity Method** | | | |
|---|---|---|---|---|
| **Age of Company** | **Fiber Optic** | **3G** | **4G** | **Total** |
| Less Than 10 Years | 9(29.03%) | 4(12.90%) | 3(9.68%) | **16(51.61%)** |
| 10 To 20 Years | 11(35.48%) | 1(3.23%) | 2(6.45%) | **14(45.16%)** |
| Over 20 Years | 0(0.00%) | 0(0.00%) | 1(3.23%) | **1(3.23%)** |
| **Total** | **20(64.52%)** | **5(16.13%)** | **6(19.35%)** | **31(100.00%)** |

### 4.2.3 The Extent of Adoption of Crowdsourcing

This section addresses the first objective of this research regarding the extent to which crowdsourcing is used in manufacturing firms in Nairobi County. The extent is addressed basing on the frequency of use of crowdsourcing and the application of the crowdsourcing. Table 4.6 presents the distribution of the companies regarding the frequency with which they use crowdsourcing. The measures of the frequency of using crowdsourcing were never, occasionally and always. As shown in the table, 83.87 percent of the companies occasionally used crowdsourcing. 12.90 percent had never used crowdsourcing while only 3.23 percent always used crowdsourcing. While 87.10 percent of the companies that used

crowdsourcing were locally owned, the remaining 12.90 percent were internationally owned.

**Table 4.6: Frequency of Outsourcing**

| | Never | Occasionally | Always | Total |
|---|---|---|---|---|
| **Locally Owned** | 2(6.45%) | 23(74.19%) | 1(3.23%) | **27(87.10%)** |
| **International** | 1(3.23%) | 3(9.68%) | 0(0.00%) | **4(12.90%)** |
| **Total** | **4(12.90%)** | **26(83.87%)** | **1(3.23%)** | **31(100.00%)** |

Table 4.7 shows for what purpose the companies use crowdsourcing. Crowdsourcing is used in terms of produce crowdsourcing, rate crowdsourcing, facilitate crowdsourcing and publicize crowdsourcing. 58.06 percent of the companies use crowdsourcing with a majority 54.84 percent comprising local companies. 19.35 percent of companies use crowdsourcing to facilitate processes. Again a majority 16.13 percent are local companies. No international company in Kenya uses crowdsourcing for rating purposes. All the companies that use crowdsourcing for rating of products are locally owned. Crowdsourcing is least used for publicity services as only 6.68 percent showing they use crowdsourcing for this purpose. A majority of the users of crowdsourcing for rating were internationally owned companies.

**Table 4.7: Application of Outsourcing**

| | Local | International | Total |
|---|---|---|---|
| **Produce Crowdsourcing** | 17(54.84%) | 1(3.23%) | 18(58.06%) |
| **Rate Crowdsourcing** | 4(12.90%) | 0(0.00%) | 4(12.90%) |
| **Facilitate Crowdsourcing** | 5(16.13%) | 1(3.23%) | 6(19.35%) |
| **Publicize Crowdsourcing** | 1(3.23%) | 2(6.45%) | 3(6.68%) |
| **Total** | **27(87.10%)** | **4(12.90%)** | **31(100.00%)** |

### 4.2.4 Challenges Facing Crowdsourcing in Manufacturing Firms

This section focuses on the challenges facing the use of crowdsourcing in manufacturing firms. Table 4.8 shows the various items regarding challenges facing the use of crowdsourcing in manufacturing companies that the operations managers responded to. Their responses were on a Likert scale of 1 to 5 with 5 indicating strong agreement and 1 indicating strong disagreement. The mean indicates the average response to each of the item by all the operations managers while the standard deviation measures the spread of the responses about the mean.

The strongest challenges to the use of information technology in the manufacturing companies were: maintaining the motivation level of crowd solution providers ($\mu = 3.84$, $\sigma = 0.95$); difficulty of managing crowdsourcing participants ($\mu = 3.84$, $\sigma = 0.99$); loss of control of a firm's processes to participants ($\mu = 3.58$, $\sigma = 1.21$); the Quality of information technology ideas and solutions ($\mu = 3.55$, $\sigma = 1.29$) and inability of your firm to articulate and define the key problems ($\mu = 3.55$, $\sigma = 1.29$).

However, the challenges that had the least importance on the use of crowdsourcing in manufacturing firms were the intellectual property rights and copyright ownership of solutions ($\mu = 2.97$, $\sigma = 1.45$) and the attraction and retention of knowledgeable crowd participants ($\mu = 2.71$, $\sigma = 1.32$). On aggregate, the operations managers indicated that the use of information technology in manufacturing in Kenya faced challenges. The Cronbach's alpha of 0.8876 indicates the responses of the operations managers are reliable.

**Table 4.8: Challenges Facing Outsourcing**

| Challenges Facing Crowdsourcing | MEAN | SD |
|---|---|---|
| Intellectual property rights and copyright ownership of solutions | 2.97 | 1.45 |
| Attraction and retention of knowledgeable crowd participants | 2.71 | 1.32 |
| Mistrust between your firm and crowd participants | 3.45 | 1.10 |
| The Quality of information technology ideas and solutions | 3.55 | 1.29 |
| Loss of control of a firm processes to participants | 3.58 | 1.21 |
| Maintaining the motivation level of crowd solution providers | 3.84 | 0.95 |
| Discouragement of cooperation from some workers | 3.16 | 1.39 |
| Inability of your firm to articulate and define the key problems | 3.55 | 1.29 |
| Difficulty of managing crowdsourcing participants | 3.84 | 0.99 |
| Unclear policies and strategy in soliciting ideas from participants | 3.39 | 1.31 |
| **GRAND MEAN** | **3.40** | |

*Cronbach's Alpha = 0.8876 (Good)*

Table 4.9 presents a summary of the analysis of the variations in the distribution of responses from the operations managers according to each of the items of categorization in the first column. The analysis was to determine whether each of the categorization significantly affected how the managers responded to items regarding challenges facing the use of IT in manufacturing. The testing was done at 95 percent confidence level at the level of freedom shown as the subscript of each of the critical value of the chi square value. As shown by the remarks column, there was no significant difference in responses according to gender; age of the respondents; the years they had spent in their companies; the number of branches a company had; the size of their labour force; the age of company; the ownership; method of connectivity or according to their application of crowdsourcing.

**Table 4.9: Chi Square Analysis of Challenges Facing Outsourcing**

| Categorization | $\chi^2_{Calculated}$ | $\chi^2_{Critical}$ | Remark |
|---|---|---|---|
| Gender | 3.1360 | $\chi^2_4 = 9.4877$ | Not Significant |
| Age of respondents | 8.3320 | $\chi^2_8 = 15.507$ | Not Significant |
| Years spent in Company | 5.5972 | $\chi^2_8 = 15.507$ | Not Significant |
| Number of Branches | 2.3988 | $\chi^2_4 = 9.4877$ | Not Significant |
| Size of labour force | 3.2405 | $\chi^2_{12} = 21.026$ | Not Significant |
| Age of Company | 1.6361 | $\chi^2_4 = 9.4877$ | Not Significant |
| Ownership | 1.6361 | $\chi^2_4 = 9.4877$ | Not Significant |
| Method of Connectivity | 1.5778 | $\chi^2_8 = 15.507$ | Not Significant |
| Application of Crowdsourcing | 5.4778 | $\chi^2_{12} = 21.026$ | Not Significant |

(Chi square at $\alpha = 0.05$)

### 4.2.5 Effect of Crowdsourcing on the Productivity

Table 4.10 presents the summarized responses of the operations managers regarding the effect of crowdsourcing on productivity. The grand mean of 3.77 indicates the manager agreed that crowdsourcing affects productivity in their firms. They most strongly agreed that crowdsourcing has helped reduce maintenance costs ($\mu = 4.35$, $\sigma = 0.78$); that crowdsourcing has helped reduce the cost of inputs ($\mu = 4.10$, $\sigma = 0.73$); that crowdsourcing has reduced the number of defective products ($\mu = 3.97$, $\sigma = 0.86$; and that it has improved the quality of supervision ($\mu = 3.97$, $\sigma = 1.12$). Further, crowdsourcing has drastically shortened some parts of the innovation chain from idea to product as ideas are gathered and processed much faster ($\mu = 3.87$, $\sigma = 1.18$) and has improved rating of products ($\mu = 3.87$, $\sigma = 1.07$).

However, the operations managers indicated that crowdsourcing has least succeeded in facilitating the best solutions for products ($\mu = 3.42$, $\sigma = 1.31$). It has also not succeeded to a great extent in publicizing products and making them widely known ($\mu = 3.32$, $\sigma = 1.33$). The Cronbach's alpha of 0.7837 indicates the responses are reliable.

**Table 4.10: Effect of Outsourcing on Productivity**

| **Effect of Crowdsourcing on Productivity** | **MEAN** | **SD** |
|---|---|---|
| Crowdsourcing has reduced the number of defective products | 3.97 | 0.86 |
| Crowdsourcing has drastically shortened some parts of the innovation chain from idea to product as ideas are gathered and processed much faster. | 3.87 | 1.18 |
| Crowd sourcing has helped reduce the cost of inputs | 4.10 | 0.73 |
| Crowdsourcing has reduced the cost of detecting defectives | 3.84 | 0.99 |
| Crowdsourcing has facilitated product designs | 3.74 | 0.95 |
| Crowdsourcing has improved the reliability of operations | 3.45 | 1.24 |
| Crowdsourcing has helped reduce production wastage | 3.58 | 1.13 |
| Crowdsourcing has helped improve the quality of supervision | 3.97 | 1.12 |
| Crowdsourcing has helped reduce maintenance costs | 4.35 | 0.78 |
| Crowdsourcing has helped improve rating of your products | 3.87 | 1.07 |
| Crowdsourcing has greatly publicized your products and made them widely known | 3.32 | 1.33 |
| Crowdsourcing has helped facilitate best solutions for products | 3.42 | 1.31 |
| Crowdsourcing has helped improve volume of production | 3.55 | 1.19 |
| **GRAND MEAN** | **3.77** | |

*Cronbach's Alpha=0.7837 (Acceptable)*

Table 4.11 shows the Chi square results of testing whether the items in the categorization column contributed to variation in responses. At 95 percent confidence level, the results show that none of the categorization affected the distribution of responses regarding the effect of crowdsourcing on productivity.

**Table 4.11: Chi Square Analysis Effect of Outsourcing on Productivity**

| Categorization | $\chi^2_{Calculated}$ | $\chi^2_{Critical}$ | Remark |
|---|---|---|---|
| Gender | 0.4998 | $\chi^2_4 = 9.4877$ | Not Significant |
| Age of respondents | 5.5952 | $\chi^2_8 = 15.507$ | Not Significant |
| Years spent in Company | 14.943 | $\chi^2_8 = 15.507$ | Not Significant |
| Number of Branches | 0.5145 | $\chi^2_4 = 9.4877$ | Not Significant |
| Size of labour force | 4.6798 | $\chi^2_{12} = 21.026$ | Not Significant |
| Age of Company | 5.9450 | $\chi^2_4 = 9.4877$ | Not Significant |
| Ownership | 4.3056 | $\chi^2_4 = 9.4877$ | Not Significant |
| Method of Connectivity | 8.0600 | $\chi^2_8 = 15.507$ | Not Significant |
| Application of Crowdsourcing | 10.474 | $\chi^2_{12} = 21.026$ | Not Significant |

(Chi square at $\alpha = 0.05$)

### 4.2.6 Effect of Crowdsourcing on Quality of Production

Table 4.12 shows the extent to which operations managers agreed or disagreed that the crowdsourcing affects the various aspects of product quality on a scale of 1 to 5 with 5 indicating strong agreement. A grand mean of 3.65 shows the project managers generally agreed that crowdsourcing affected product quality. However, the operations managers most strongly indicated that due to crowdsourcing customers have high opinion of their products ($\mu = 4.26$, $\sigma = 0.95$); the quality produced matches the quality that customers expect ($\mu = 3.81$, $\sigma = 1.00$); response to quality issues is quick ($\mu = 3.77$, $\sigma = 1.18$) and customers find the quality of products matching the price ($\mu = 3.65$, $\sigma = 1.18$). The operations managers least agreed that their brands are highly ranked by customers ($\mu = 3.48$, $\sigma = 1.01$) and that response to quality issues is effective ($\mu = 3.23$, $\sigma = 0.97$). The Cronbach's alpha of 0.8679 indicates the responses are reliable.

**Table 4.12: Effect of Crowdsourcing on Quality**

| Effect of Crowdsourcing on Quality | MEAN | SD |
|---|---|---|
| Customers have high opinion of your products | 4.26 | 0.95 |
| The quality produced matches the quality customers expect | 3.81 | 1.00 |
| Customers rank your products better than substitutes | 3.61 | 1.18 |
| Complaints against your products have reduced with time | 3.61 | 1.29 |
| Customers find the quality of your products matches the price | 3.65 | 1.18 |
| Aesthetics of the product are attractive to the customers | 3.52 | 1.21 |
| Your products are easy for the customer to use | 3.52 | 1.29 |
| Your brand is highly ranked by customers | 3.48 | 1.01 |
| Response to quality issues is quick | 3.77 | 1.18 |
| Response to quality issues is effective | 3.23 | 0.97 |
| **GRAND MEAN** | **3.65** | |

*Cronbach's Alpha=0.8679 (Good)*

Table 4.13 presents the Chi square analysis of the variation in the responses according to the categorizations in the first column of the table. The results indicate that there was no significant variation in the distribution of responses according to gender; age of operations managers; years spent in the company; the number of branches the company has; the size of the labour force; the age of the company; ownership; method of connectivity or by a company's application of crowdsourcing. These variables did not affect the distribution of the responses.

**Table 4.13: Chi Square Analysis of Effect of Outsourcing on Quality**

| Categorization | $\chi^2_{Calculated}$ | $\chi^2_{Critical}$ | Remark |
|---|---|---|---|
| Gender | 1.7949 | $\chi^2_4 = 9.4877$ | Not Significant |
| Age of respondents | 2.1032 | $\chi^2_8 = 15.507$ | Not Significant |
| Years spent in Company | 4.3387 | $\chi^2_8 = 15.507$ | Not Significant |
| Number of Branches | 6.1390 | $\chi^2_4 = 9.4877$ | Not Significant |
| Size of labour force | 12.711 | $\chi^2_{12} = 21.026$ | Not Significant |
| Age of Company | 0.3784 | $\chi^2_4 = 9.4877$ | Not Significant |
| Ownership | 3.3359 | $\chi^2_4 = 9.4877$ | Not Significant |
| Method of Connectivity | 1.6626 | $\chi^2_8 = 15.507$ | Not Significant |
| Application of Crowdsourcing | 9.4566 | $\chi^2_{12} = 21.026$ | Not Significant |

(Chi square at $\alpha = 0.05$)

### 4.2.7 Crowdsourcing and Timeliness of Deliveries

This subsection presents the findings regarding the effect of crowdsourcing on the timeliness of delivery of products. Table 4.14 shows the responses of operations managers regarding the effect crowdsourcing on timeliness of delivery of products to customers. The operations managers indicated that customers feel the delivery services match the price charged ($\mu = 4.10$, $\sigma = 0.93$); customers always receive orders in required quantities ($\mu = 3.94$, $\sigma = 0.80$); crowd participants have increased flexibility of addressing quality issues ($\mu = 3.90$, $\sigma = 1.06$) and that crowd participants have helped in strict adherence to agreed delivery schedules ($\mu = 3.77$, $\sigma = 0.91$). The operations managers least agreed that customers experience few problems with deliveries ($\mu = 2.84$, $\sigma = 1.11$) and that crowdsourcing has been useful for keeping the company in touch with the market ($\mu = 2.77$, $\sigma = 1.07$). The responses were, however, of poor reliability as shown by the Cronbach's alpha of 0.5483.

**Table 4.14: Effect of Outsourcing on Timeliness of Deliveries**

| Crowdsourcing and Timeliness of Deliveries | MEAN | SD |
|---|---|---|
| Crowd participants have increased flexibility of addressing quality issues. | 3.90 | 1.06 |
| Crowd participants have helped in strict adherence to agreed delivery schedules | 3.77 | 0.91 |
| Crowd participants have improved cooperation on quality of products. | 3.13 | 1.10 |
| Crowd participants have an excellent mechanism to warn on delivery problems on time. | 3.03 | 1.12 |
| Crowdsourcing has been useful for keeping the company in touch with the market | 2.77 | 1.07 |
| Customers experience few problems with your deliveries | 2.84 | 1.11 |
| The crowd team has led to reduced lead time | 3.10 | 1.09 |
| Customers feel our delivery services match the price charged | 4.10 | 0.93 |
| Customers always receive orders in required quantities | 3.94 | 0.80 |
| **GRAND MEAN** | **3.40** | |

*Cronbach's Alpha=0.5483(Poor)*

Table 4.15 presents the Chi square analysis of the variation in the responses with regard to according to gender; age of operations managers; years spent in the company; the number of branches the company has; the size of the labour force; the age of the company; ownership; method of connectivity or by a company's application of crowdsourcing. The results indicate no significant variation in the distribution of responses according to these variables.

**Table 4.15: Chi Square Analysis of Effect of Crowdsourcing on Timeliness**

| Categorization | $\chi^2_{Calculated}$ | $\chi^2_{Critical}$ | Remark |
|---|---|---|---|
| Gender | 0.5021 | $\chi^2_4 = 9.4877$ | Not Significant |
| Age of respondents | 0.8297 | $\chi^2_8 = 15.507$ | Not Significant |
| Years spent in Company | 1.8788 | $\chi^2_8 = 15.507$ | Not Significant |
| Number of Branches | 0.0067 | $\chi^2_4 = 9.4877$ | Not Significant |
| Size of labour force | 4.8654 | $\chi^2_{12} = 21.026$ | Not Significant |
| Age of Company | 0.9870 | $\chi^2_4 = 9.4877$ | Not Significant |
| Ownership | 0.2205 | $\chi^2_4 = 9.4877$ | Not Significant |
| Method of Connectivity | 1.1508 | $\chi^2_8 = 15.507$ | Not Significant |
| Application of Crowdsourcing | 3.0275 | $\chi^2_{12} = 21.026$ | Not Significant |

(Chi square at $\alpha = 0.05$)

### 4.2.8 Regression Analysis

This section presents the regression analysis of the variables in this research. The dependent variable was operations performance measured by the number of complaints about products in a month. The independent variables: productivity measured by speed of response to quality issues; timeliness of deliveries and quality measured by amounts of money in Kenya shillings spent on product innovation, research on new concepts, designing new products, and or on fine tuning product designs in a month.

To use data on speed of response to quality issues, dummy variables were introduced so that 1 indicated response within a day, 2 indicated responses in two days and 3 indicated responses after 2 days. To use data on timeliness of delivery dummy variables 1 and 2 were used. 1 meant deliveries on schedule while 2 meant deliveries not on schedule. The data used for the regression analysis is presented in Appendix III.

Table 4.16 presents the correlation coefficients between the variables. The highest positive correlation was between operational performance (Y) and productivity ($X_1$) while the lowest positive correlation was between productivity ($X_1$) and quality ($X_3$). The strongest negative correlation was between timeliness ($X_2$) and quality ($X_3$) while the weakest correlation was between operational performance (Y) and quality ($X_3$). The generally low correlation indicated independence of the variables allowing for regression analysis.

**Table 4.16: Correlation Matrix**

| | **Y** | $\boldsymbol{X_1}$ | $\boldsymbol{X_2}$ | $\boldsymbol{X_3}$ |
|---|---|---|---|---|
| **Y** | 1.0000 | 0.4086 | 0.2141 | -0.0686 |
| $\boldsymbol{X_1}$ | | 1.0000 | 0.1784 | 0.0695 |
| $\boldsymbol{X_2}$ | | | 1.0000 | -0.2043 |
| $\boldsymbol{X_3}$ | | | | 1.0000 |

Table 4.17 presents the results of the regression analysis. The intercept term of the model was -4.923($p > 0.05$) which was not statistically significant. The coefficient of productivity ($X_1$) was 10.14 ($p < 0.05$) which was statistically significant. The coefficient of timeliness of delivery ($X_2$) was 5.187 ($p > 0.05$) which was not statistically significant. The coefficient of quality ($X_3$) was -0.0000004293($p > 0.05$) which was not statistically significant. The three independent variables explained only 19.21 percent of the variation in operational performance. The regression had $F_{(3,\ 27)} = 2.139$ ($p > 0.05$) which was not statistically significant.

**Table 4.17: Regression Results**

| | Estimate | Std. Error | t-value | Pr(>\|t\|) |
|---|---|---|---|---|
| **(Intercept)** | -4.923 | 10.72 | -0.459 | 0.6497 |
| $\boldsymbol{X_1}$ | 10.14 | 4.596 | 2.206 | 0.0361 |
| $\boldsymbol{X_2}$ | 5.187 | 7.175 | 0.723 | 0.4759 |
| $\boldsymbol{X_3}$ | -0.0000004293 | 0.000001104 | -0.389 | 0.7005 |
| **Multiple R-squared** | 0.1921 | | | |
| **Adjusted R-squared** | 0.1023 | | | |
| $\boldsymbol{F_{(3,\ 27)}}$ | 2.139 | | | 0.1186 |

Regression model: $Y = -4.923 + 10.14X_1 + 5.187X_2 - 0.0000004293X_3$

### 4.2.9 Summary and Interpretation of Findings

This research finds that crowdsourcing is just occasionally used as a method of outsourcing in manufacturing firms. The majority of the manufacturing firms that use crowdsourcing are locally owned manufacturing firms. Majority of the firms utilize the fiber optic technology for connectivity with just a few using the 3G and 4G technology. Majority of the manufacturing firms use crowdsourcing with bias towards produce crowdsourcing. As stated by Brussee, et al. (2008), this indicates that the manufacturing firms use crowdsourcing for creating new information or content, but using the already available material, finding and selecting required information, allowing the crowd to annotate pictures posted by archives and museums with stories, explanations, names etc. and allowing the public to delete information or content.

The challenges that face manufacturing firms include maintaining the motivation level of crowd solution providers, managing crowdsourcing participants, loss of control of a firm's processes to participants, control of the Quality of information technology ideas and

solutions and inability of firms to articulate and define the key problems. These findings are similar to those of Müller, Thoring and Oostinga, (2010) who established that the key challenges facing crowdsourcing were issues of trust; quality of ideas and solutions and loss of control. However, the findings do not agree with those of Sonnleitner, Kung and Wenzel (2013) who indicated that the issue of intellectual property rights and copyright ownership of solutions is a barrier to the success of crowdsourcing within enterprises. The findings do not also agree with Pedersen et al. who indicated that the success of crowdsourcing depends on attracting and retaining knowledgeable participants.

This research finds that crowdsourcing has a great influence on productivity. It has done this by reducing maintenance costs, reducing the cost of inputs, reducing the number of defective products and improving the quality of supervision. Crowdsourcing has also shortened some parts of the innovation chain from idea to product as ideas are gathered and processed much faster. Product rating has also improved. Similar findings were established by Evaldsson, Ljungdahl and Suter (2012) who indicated that crowdsourcing and open source development had improved drug development in pharmaceuticals in the USA. Such findings were also established by Chatterjee, Khandekar and Kumar (2014) in India where crowdsourcing improved efficiency in manufacturing firms. However, the findings differ with those of Probst *et al.* (2014) because while crowdsourcing has not effectively succeeded in facilitating the best solutions for products and publicizing products, Probst *et al.* (2014) indicated that crowdsourcing does just that.

This research establishes that crowdsourcing affects product quality. This is through improving customers' opinion of products, marching the quality produced and the quality that customers expect, quickening the response to quality issues and ensuring get value for

their money. However, crowdsourcing has not done much in improving brand ranking and effectiveness in response to quality issues. Crowdsourcing has, generally, not done much to improve timeliness of deliveries. However, it has improved delivery aspects such as matching delivery services and prices charged, ensuring customers always receive orders in right quantities, increased flexibility of addressing quality issues and strict adherence to agreed delivery schedules. Crowdsourcing has not done much to improve the close touch of manufacturing firms with the market.

The regression results indicate that productivity contributes positively to operational performance and the contribution is significant. Timeliness of delivery contributes positively to operations performance for firms that apply crowdsourcing however, the relationship is not statistically significant. Quality activities negatively affect operations performance, but the effect is not statistically significant. The relationship between operations performance, productivity, timeliness and quality are not significantly statistically related. This indicates that the use of crowdsourcing for productivity purposes has a great contribution to operational performance as opposed to the use of crowdsourcing for timeliness and quality purposes. The findings agree with Chatterjee, Khandekar and Kumar (2014) in who established that crowdsourcing improved efficiency in manufacturing firms. The findings disagree with Probst *et al.* (2014) who indicated that crowdsourcing facilitating the best quality solutions for products.

# CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Summary

The use of information technology provides an innovative channel of transforming manufacturing. This is done through the process of outsourcing. Firms in Kenya or elsewhere strive to be providers of high quality goods and services at globally competitive costs. This can be achieved through revolutionizing the supply chain by outsourcing non-core production processes and non-core support processes. Information technology has become a critical enabler of outsourcing non-core activities to the virtual crowd.

However, for any firm to decide on whether or not to use crowdsourcing, the firm has to be assured the strategy will work to improve quality, productivity and timeliness. With this motivation this research was a survey to establish how companies that use crowdsourcing fared with the application with regard to operations performance.

The results indicate that crowdsourcing is just occasionally used as a method of outsourcing in locally owned manufacturing firms. The fiber optic technology is the mostly used method of connectivity. The use of crowdsourcing is faced with challenges such as maintaining the motivation level of crowd solution providers, managing crowdsourcing participants, loss of control of a firm's processes to participants, control of the Quality of information technology ideas and solutions and inability of firms to articulate and define the key problems. Crowdsourcing also has great influence on productivity and product quality but has not achieved much in improving the timeliness of deliveries.

## 5.2 Conclusions

From the finding of this research, the following conclusions are made. First, crowdsourcing is just occasionally used as a method of outsourcing in manufacturing firms. Majority of manufacturing firms that use crowdsourcing are locally owned firms who use fiber optic connection for produce crowdsourcing. The use of 3G and 4G technology is not widely spread in manufacturing firms in Kenya.

The challenges that face manufacturing firms include maintaining the motivation level of crowd solution providers, managing crowdsourcing participants, loss of control of a firm's processes to participants, control of the Quality of information technology ideas and solutions and inability of firms to articulate and define the key problems.

This research finds that crowdsourcing has a great influence on productivity. It has done this by reducing maintenance costs, reducing the cost of inputs, reducing the number of defective products and improving the quality of supervision. Crowdsourcing has also shortened some parts of the innovation chain from idea to product as ideas are gathered and processed much faster. Product rating has also improved.

This research establishes that crowdsourcing affects product quality. This is through improving customers' opinion of products, marching the quality produced and the quality that customers expect, quickening the response to quality issues and ensuring get value for their money. However, crowdsourcing has not done much in improving brand ranking and effectiveness in response to quality issues.

Crowdsourcing has, generally, not done much to improve timeliness of deliveries despite doing well in improving delivery aspects such as matching delivery services and prices

charged, ensuring customers always receive orders in right quantities, increased flexibility of addressing quality issues and strict adherence to agreed delivery schedules. Crowdsourcing has not done much to improve the close touch of manufacturing firms with the market.

From the regression results, productivity contributes positively to operational performance and the contribution is significant. Timeliness and quality activities do not significantly affect operations performance.

## 5.3 Recommendations

Basing on the conclusion, the following recommendations arise. First, manufacturing firms should increase their use of crowdsourcing beyond their current occasional use. The foreign manufacturing firms in Kenya should widen their use of crowdsourcing. While maintaining the wide use of fiber optic technology, the firms should tap deeper into 3G and 4G technology to benefit from the virtual crowds that use the technology. The firms should widen the use of crowdsourcing beyond produce crowdsourcing.

Steps should be taken to ensure crowdsourcing software allows for the improvement of the level of motivation of the crowd. The software should also enable firms to retain their control over processes under crowdsourcing. This will go a long way in ensuring firms get high quality technology ideas and solutions.

Crowdsourcing should be encouraged as a mechanism of making Kenyan products competitive on the global market. It will enable this competitiveness by reducing maintenance costs, reducing the cost of inputs, reducing the number of defective products

and improving the quality of supervision. By tapping into the virtual crowd, ideas sought will be on global standards as opposed to narrow local standards.

This research establishes that crowdsourcing affects product quality. This is through improving customers' opinion of products, marching the quality produced and the quality that customers expect, quickening the response to quality issues and ensuring get value for their money. However, crowdsourcing has not done much in improving brand ranking and effectiveness in response to quality issues.

As an aspect of quality, the use of crowdsourcing to enhance timely delivery of goods and services should be enhanced. The current use of crowdsourcing is not achieving much in ensuring that goods are delivered on time. The use of crowdsourcing should strive to ensure manufacturing firms maintain close touch with their market.

## 5.4 Limitations of the Study

The study has limited itself to manufacturing firms. This makes the results not applicable to non-manufacturing firms. For stronger results, data is required from all manner of firms that utilize crowdsourcing in their operations.

The study has not shown if the results are applicable universally. It has not, for instance, provided any indication of whether or not the results would be the same in Uganda, Tanzania Rwanda or any other of the member countries in the EAC. The results can only hold for manufacturing firms in Nairobi County. Kenya being a member of the EAC coupled with Kenyan companies investing in the other East African countries requires that crowdsourcing information maintains relevance across East Africa.

One key question a researcher on crowdsourcing would wat to know is whether firms that use crowdsourcing perform operations better than those that do not. This study has not given a clear indication whether the manufacturing firms that use crowdsourcing perform better than those that do not with regard to operations.

## 5.5 Suggestions for Further Research

The findings of this study can be improved if the study is expanded to cover a wider region. A future research can be conducted on the same topic, but using data across all types of firms without limiting the scope to manufacturing firms only. This is with the assumption that the data for a wider spectrum of firms will provide results that are better than those provided by the data used in this study.

Also given that Kenya is a key player in the East African Community the study can be expanded to cover other manufacturing firms within the East African community in order to provide result that will be useful in that context. A study can be done to cover all the manufacturing firms in East Africa. Such a study would be used as a referential manuscript when coming up with plans regarding use of IT manufacturing firms in any of the East African Community member countries.

This research can be repeated in a way to compare firms that use crowdsourcing against those that do not use. This will enable a comparison that will enable firms to conclude whether or not crowdsourcing improves operational performance of manufacturing firms.

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# APPENDICES

## Appendix I: Registered Manufacturing Firms in Nairobi City County

| Energy Sector | | |
|---|---|---|
| A.I Records (Kenya) Ltd | Modulec Engineering Systems Ltd | Kenwestfal Works Ltd |
| Amedo Centre Kenya Ltd | Mustek East Africa | Kenya Power & Lighting Co. Ltd |
| AssaAbloy East Africa Ltd | Nationwide Electrical Industries | Kenya Scale Co. Ltd/ Avery Kenya Ltd |
| Aucma Digital Technology Africa Ltd | Nationwide Electrical Industries Ltd | Kenya Shell Ltd |
| Avery (East Africa) Ltd | Optimum Lubricants Ltd | Libya Oil Kenya Limited |
| Baumann Engineering Limited | PCTL Automation Ltd | Power Technics Ltd |
| Centurion Systems Limited | Pentagon Agencies | Reliable Electricals Engineers Ltd |
| Digitech East Africa Limited | Power Engineering International Ltd | Sanyo Armo (Kenya) Ltd |
| Manufacturers & Suppliers (K) Ltd | Eveready East Africa Limited | Socabelec East Africa |
| Marshall Fowler (Engineers) Ltd | Frigorex East Africa Ltd | Sollatek Electronics (Kenya) Limited |
| Mecer East Africa Ltd | Holman Brothers (E.A.) Ltd | Specialised Power Systems Ltd |
| Metlex Industries Ltd | IberaAfrica Power (EA) Ltd | Synergy-Pro |
| Metsec Ltd | International Energy Technik Ltd | Tea Vac Machinery Limited |
| East African Cables Ltd | Kenwest Cables Ltd | Virtual City Ltd |
| **Chemical Sector** | | |
| Anffi Kenya Ltd | Maroo Polymers Ltd | Imaging Solutions (K) Ltd |
| Basco Product (K) Ltd | Match Masters Ltd | Interconsumer Products Ltd |
| Bayer East Africa Ltd | United Chemical Industries Ltd | Odex Chemicals Ltd |
| Continental Products Ltd | Oasis Ltd | Osho Chemicals Industries Ltd |
| Cooper K- Brands Ltd | Rumorth EA Ltd | PolyChem East Africa Ltd |
| Cooper Kenya Limited | Rumorth East Africa Ltd | Procter & Gamble East Africa Ltd |
| Beiersdorf East Africa td | Sadolin Paints (E.A.) Ltd | PZ Cussons Ltd |
| Blue Ring Products Ltd | Sara Lee Kenya Limited | Rayal Trading Co. Ltd |
| BOC Kenya Limited | Saroc Ltd | Reckitt Benckiser (E.A) Ltd |
| Buyline Industries Limited | Super Foam Ltd | Revolution Stores Co. Ltd |

| | | |
|---|---|---|
| Carbacid (CO2) Limited | Crown Berger Kenya Ltd | Soilex Chemical Ltd |
| Chemicals & Solvents E.A. Ltd | Crown Gases Ltd | Strategic Industries Limited |
| Chemicals and Solvents E.A. Ltd | Decase Chemical (Ltd) | SupaBrite Ltd |
| Coates Brothers (E.A.) Limited | Deluxe Inks Ltd | Unilever Kenya Ltd |
| Coil Products (K) Limited | Desbro Kenya Limited | Murphy Chemical E.A Ltd |
| Colgate Palmolive (E.A) Ltd | E. Africa Heavy Chemicals (1999) Ltd | Syngenta East Africa Ltd |
| Johnson Diversity East Africa Limited | Elex Products Ltd | Synresins Ltd |
| Kel Chemicals Limited | European Perfumes & Cosmetics Ltd | Tri-Clover Industries (K) Ltd |
| Kemia International Ltd | Galaxy Paints & Coating Co. Ltd | Twiga Chemical Industries Limited |
| Ken Nat Ink & Chemical Ltd | Grand Paints Ltd | Vitafoam Products Limited |
| Magadi Soda Company Ltd | Henkel Kenya Ltd | |
| **Food Sector** | | |
| Africa Spirits Ltd | Annum Trading Company Limited | Premier Flour Mills Ltd |
| Agriner Agricultural Development Limited | Aquamist Ltd | Premier Food Industries Limited |
| Belfast Millers Ltd | Brookside Dairy Ltd | Proctor & Allan (E.A.) Ltd |
| Bidco Oil Refineries Ltd | Candy Kenya Ltd | Promasidor (Kenya) Ltd |
| Bio Foods Products Limited | Capwelll Industries Ltd | Trufoods Ltd |
| Breakfast Cereal Company(K) Ltd | Carlton Products (EA) Ltd | UDV Kenya Ltd |
| British American Tobacco Kenya Ltd | Chirag Kenya Limited | Unga Group Ltd |
| Broadway Bakery Ltd | E & A Industries Ltd | Usafi Services Ltd |
| C. Czarnikow Sugar (EA) Ltd | Kakuzi Ltd | Uzuri foods Ltd |
| Cadbury Kenya Ltd | Erdemann Co. (K) Ltd | ValuePak Foods Ltd |
| Centrofood Industries Ltd | Excel Chemical Ltd | W.E. Tilley (Muthaiga) Ltd |
| Coca cola East Africa Ltd | Kenya Wine Agency Limited | Kevian Kenya Ltd |
| Confec Industries (E.A) Ltd | Highlands Canner Ltd | Koba Waters Ltd |
| Corn Products Kenya Ltd | Super Bakery Ltd | Kwality Candies & Sweets Ltd |
| Crown Foods Ltd | Sunny Processor Ltd | Lari Dairies Alliance Ltd |
| Cut Tobacco (K) Ltd | Spin Knit Dairy Ltd | London Distillers (K) Ltd |
| Deepa Industries Ltd | Highlands Mineral Water Co. Ltd | Mafuko Industries Ltd |
| Del Monte Kenya Ltd | Homeoil | Manji Food Industries Ltd |
| East African Breweries Ltd | Insta Products (EPZ) Ltd | Melvin Marsh International |
| East African Sea Food Ltd | Jambo Biscuits (K) Ltd | Kenya Tea Development Agency |

| | | |
|---|---|---|
| Eastern Produce Kenya Ltd | Jetlak Foods Ltd | Mini Bakeries (Nbi) Ltd |
| Farmers Choice Ltd | Karirana Estate Ltd | Miritini Kenya Ltd |
| Frigoken Ltd | Kenafric Industries Limited | Mount Kenya Bottlers Ltd |
| Giloil Company Limited | Kenblest Limited | Nairobi Bottlers Ltd |
| Glacier Products Ltd | Kenya Breweries Ltd | Nairobi Flour Mills Ltd |
| Global Allied Industries Ltd | Kenya Nut Company Ltd | NAS Airport Services Ltd |
| Global Beverages Ltd | Kenya Sweets Ltd | Rafiki Millers Ltd |
| Global Fresh Ltd | Nestle Kenya Ltd | Razco Ltd |
| Gonas Best Ltd | Nicola Farms Ltd | Re-Suns Spices Limited |
| Hail & Cotton Distillers Ltd | Palmhouse Dairies Ltd | Smash Industries Ltd |
| Al-Mahra Industries Ltd | Patco Industries Limited | Softa Bottling Co. Ltd |
| Alliance One Tobacco Kenya Ltd | Pearl Industries Ltd | Spice World Ltd |
| Alpha Fine Foods Ltd | Pembe Flour Mills Ltd | Wrigley Company (E.A.) Ltd |
| Alpine Coolers Ltd | | |
| **Plastics and Rubber** | | |
| Betatrad (K) Ltd | Prestige Packaging Ltd | Haco Industries Kenya Ltd |
| Blowplast Ltd | Prosel Ltd | Hi-Plast Ltd |
| Bobmil Industries Ltd | Qplast Industries | Jamlam Industries Ltd |
| Complast Industries Limited | Sumaria Industries Ltd | Kamba Manufacturing (1986) Ltd |
| Kenpoly Manufacturers Ltd | Super Manufacturers Ltd | Keci Rubber Industries |
| Kentainers Ltd | Techpak Industries Ltd | Nairobi Plastics Industries |
| King Plastic Industries Ltd | TreadsettersTyres Ltd | Nav Plastics Limited |
| KingwayTyres&Automart Ltd | Uni-Plastcis Ltd | Ombi Rubber |
| L.G. Harris & Co. Ltd | Wonderpac Industries Ltd | Packaging Masters Limited |
| Laneeb Plastics Industries Ltd | ACME Containers Ltd | Plastic Electricons |
| Metro Plastics Kenya Limited | Afro Plastics (K) Ltd | Raffia Bags (K) Ltd |
| Ombi Rubber Rollers Ltd | Alankar Industries Ltd | Rubber Products Ltd |
| Packaging Industries Ltd | Dune Packaging Ltd | Safepak Limited |
| Plastics & Rubber Industries Ltd | Elgitread (Kenya) Ltd | Sameer Africa Ltd |
| Polyblend Limited | Elgon Kenya Ltd | Sanpac Africa Ltd |
| Polyflex Industries Ltd | Eslon Plastics of Kenya Ltd | Silpack Industries Limited |
| Polythene Industries Ltd | Five Star Industries Ltd | Solvochem East Africa Ltd |
| Premier Industries Ltd | General Plastics Limited | Springbox Kenya Ltd |
| **Building sector** | | |
| Central Glass Industries Ltd | Kenbro Industries Ltd | Manson Hart Kenya Ltd |
| KarsanMurji& Company Limited | Kenya Builders & Concrete Ltd | Mombasa Cement Ltd |
| **Paper Sector** | | |
| Ajit Clothing Factory Ltd | Paper House of Kenya Ltd | General Printers Limited |
| Associated Papers & Stationery Ltd | Paperbags Limited | Graphics & Allied Ltd |
| Autolitho Ltd | Primex Printers Ltd | Guaca Stationers Ltd |

| | | |
|---|---|---|
| Bag and Envelope Converters Ltd | Print Exchange Ltd | Icons Printers Ltd |
| Bags & Balers Manufacturers (K) Ltd | Printpak Multi Packaging Ltd | Interlabels Africa Ltd |
| Brand Printers | Printwell Industries Ltd | Jomo Kenyatta Foundation |
| Business Forms & Systems Ltd | Prudential Printers Ltd | Kartasi Industries Ltd |
| Carton Manufacturers Ltd | Punchlines Ltd | Kenafric Diaries Manufacturers Ltd |
| Cempack Ltd | Conventual Franciscan Friers-Kolbe Press | Kitabu Industries Ltd |
| Chandaria Industries Limited | Creative Print House | Kul Graphics Ltd |
| Colour Labels Ltd | D.L. Patel Press (Kenya) Limited | Label Converters |
| Colour Packaging Ltd | Dodhia Packaging Limited | Modern Lithographic (K) Ltd |
| Colour Print Ltd | East Africa Packaging Industries Ltd | Pan African Paper Mills (EA) Limited |
| Kenya Stationers Ltd | Elite Offset Ltd | Ramco Printing Works Ltd |
| Kim-Fay East Africa Ltd | Ellams Products Ltd | Regal Press Kenya Ltd |
| Paper Converters (Kenya) Ltd | English Press Limited | SIG CombiblocObeikanKenya |
| **Textile Sector** | | |
| Africa Apparels EPZ Ltd | Kenya Trading EPZ Ltd | Spinners & Spinners Ltd |
| FulchandManek& Bros Ltd | Kikoy Co. Ltd | Storm Apparel Manufacturers Co. Ltd |
| Image Apparels Ltd | Le-Stud Limited | Straightline Enterprises Ltd |
| Alltex EPZ Ltd | Metro Impex Ltd | Sunflag Textile & Knitwear Mills Ltd |
| Alpha Knits Limited | Midco Textiles (EA) Ltd | Tarpo Industries Limited |
| Apex Appaels (EPZ) Ltd | Mirage Fashionwear EPZ Ltd | Teita Estate Ltd |
| Baraka Apparels (EPZ) Ltd | MRC Nairobi (EPZ) Ltd | Thika Cloth Mills Ltd |
| Bhupco Textile Mills Limited | Ngecha Industries Ltd | United Aryan (EPZ) Ltd |
| Blue Plus Limited | Premier Knitwear Ltd | UpanWasana (EPZ) Ltd |
| Bogani Industries Ltd | ProtexKenya (EPZ) Ltd | Vaja Manufacturers Limited |
| Brother Shirts Factory Ltd | Riziki Manufacturers Ltd | Yoohan Kenya EPZ Company Ltd |
| Embalishments Ltd | Rolex Garments EPZ Ltd | YU-UN Kenya EPZ Company Ltd |
| J.A.R Kenya (EPZ) Ltd | Silver Star Manufacturers Ltd | |
| **Timber Sector** | | |
| Economic Housing Group Ltd | Transpaper Kenya Ltd | Wood Makers Kenya Ltd |
| Eldema (Kenya) Limited | Twiga Stationers & Printers Ltd | Woodtex Kenya Ltd |
| Fine Wood Works Ltd | Uchumi Quick Suppliers | United Bags Manufacturers |

| | | |
|---|---|---|
| | Ltd | Ltd |
| Furniture International Limited | Rosewood Office Systems Ltd | Statpack IndustriesLtd |
| Hwan Sung Industries (K) Ltd | Shah Timber Mart Ltd | Taws Limited |
| Kenya Wood Ltd | Shamco Industries Ltd | Tetra Pak Ltd |
| Newline Ltd | Slumberland Kenya Limited | |
| PG Bison Ltd | Timsales Ltd | |
| Motor Vehicle Assembly and Accessories | | |
| Auto Ancillaries Ltd | General Motor East Africa Limited | Megh Cushion industries Ltd |
| VarsaniBrakelining Ltd | Impala Glass Industries Ltd | Mutsimoto Motor Company Ltd |
| Bhachu Industries Ltd | Kenya Grange Vehicle Industries Ltd | Pipe Manufacturers Ltd |
| Chui Auto Spring Industries Ltd | Kenya Vehicle Manufacturers Limited | Sohansons Ltd |
| Toyota East Africa Ltd | Labh Singh Harnam Singh Ltd | Theevan Enterprises Ltd |
| Unifilters Kenya Ltd | Mann Manufacturing Co. Ltd | |
| **Metal and Allied** | | |
| Allied Metal Services Ltd | Morris & Co. Limited | KhetshiDharamshi& Co. Ltd |
| Alloy Street Castings Ltd | Nails & Steel Products Ltd | Nampak Kenya Ltd |
| Apex Street Ltd Rolling Mill Division | Orbit Engineering Ltd | Napro Industries Limited |
| ASL Ltd | Rolmil Kenya Ltd | Specialized Engineer Co. (EA) Ltd |
| ASP Company Ltd | Sandvik Kenya Ltd | Steel Structures Limited |
| East Africa Foundry Works (K) Ltd | Sheffield Steel Systems Ltd | Steelmakers Ltd |
| Elite Tools Ltd | Booth Extrusions Limited | Steelwool (Africa) Ltd |
| Friendship Container Manufacturers | City Engineering Works Ltd | Tononoka Steel Ltd |
| General Aluminum Fabricators Ltd | Crystal Industries Ltd | Welding Alloys Ltd |
| Gopitech (Kenya) Ltd | Davis &Shirtliff Ltd | Wire Products Limited |
| Heavy Engineering Ltd | Devki Steel Mills Ltd | Viking Industries Ltd |
| Insteel Limited | East Africa Spectre Limited | Warren Enterprises Ltd |
| Metal Crown Limited | Kens Metal Industries Ltd | |
| **Pharmaceutical and Medical Equipment** | | |
| Alpha Medical Manufacturers Ltd | Madivet Products Ltd | KAM Industries Ltd |

| | | |
|---|---|---|
| Beta Healthcare International Limited | Novelty Manufacturing Ltd | KAM Pharmacy Limited |
| Biodeal Laboratories Ltd | Oss. Chemie (K) | Pharmaceutical Manufacturing Co. |
| Bulks Medical Ltd | Dawa Limited | Regals Pharmaceuticals |
| Cosmos Limited | Elys Chemical Industries | Universal Corporation Limited |
| Laboratory & Allied Limited | Gesto Pharmaceutical Ltd | Pharm Access Africa Ltd |
| Manhar Brothers (K) Ltd | GlaxoSmithkline Kenya Ltd | |
| **Leather Products and Footwear** | | |
| Alpharama Ltd | C & P Shoe Industries Ltd | East Africa Tanners (K) Ltd |
| Bata Shoe Co. (K) Ltd | CP Shoes | Leather Industries of Kenya Limited |
| New Market Leather Factory Ltd | Dogbones Ltd | |

(Source: Kenya Association of Manufacturers, 2014)

## Appendix II: Questionnaire

You are requested to complete this questionnaire as honestly as possible. The data obtained from this questionnaire will be used solely for academic purpose and will be handled with utmost confidentiality.

### SECTION A : GENERAL INFORMATION

**Please indicate your choice by ticking (√) on the spaces**

1. Please indicate your gender: Female ( ) Male ( )
2. Please indicate your age
   Below 21 years ( ) 21-30 years ( ) 31-40 years ( ) 41-50 years ( )
   Above 50 years ( )
3. For how many years have you served in this company
   Below 5 years ( ) Between 6 -10 years ( ) Between 11 -20 years ( )
   Over 20 years ( )
4. For how long have you been working in the Department?
   Below 5 years ( ) Between 6 -10 years ( ) Between 11 -20 years ( )
   Over 20 years ( )
5. How many employees does your firm have? _____
6. How many branches does your firm have? _____
7. What is the ownership of the firm? Local ( ) International ( )
8. For how many years has your firm been operational? _____
9. In what ways has your company tapped on growing use of social technologies?
   _____
   _____
10. In terms of IT infrastructure connection, how are you connected to the outside world?
    Fiber Connection ( ) 3G Wireless connection ( ) 4G Wireless connection ( )
    None ( )
11. How frequently Does your department employ outsourcing as a strategy?
    Never ( ) occasionally ( ) Always ( )

12. How frequently do you let many participants outside the firm perform some functions for the firm?

    Never ( )  occasionally ( )  Always ( )

13. What type of crowdsourcing does your firm apply?

    ( ) Produce crowdsourcing -focus in this category is on producing a tangible result and the process is organized accordingly e.g. research on new concepts, design new products, and to fine tune designs

    ( ) Rate crowdsourcing -This category is based on the idea that in many cases the public knows best, because they are involved and have hands on experience. The general public is also less likely to have a commercial interest in giving good (or bad) ratings

    ( ) Facilitate crowdsourcing –This category we find crowdfunding where an open call is made for funding, crowdsource volunteers help run an event or help in funding e.g. charities

    ( ) Publicize Crowdsourcing-Firms advertisement use crowdfunding to create new branded products where the brand attention it creates is usually more important than the product itself

## SECTION B: CHALLENGES FACING CROWDSOURCING

To what extent do you agree that the following are challenges to information technology?

**(1- Strongly Disagree, 2- Disagree, 3- Neutral, 4 – Agree, 5 – Strongly Agree)**

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1. | Intellectual property rights and copyright ownership of solutions | | | | | |
| 2. | Attraction and retention of knowledgeable crowd participants | | | | | |
| 3. | Mistrust between your firm and crowd participants | | | | | |
| 4. | The Quality of information technology ideas and solutions | | | | | |
| 5. | Loss of control of a firm processes to participants | | | | | |
| 6. | Maintaining the motivation level of crowd solution providers | | | | | |
| 7. | Discouragement of cooperation from some workers | | | | | |
| 8. | Inability of your firm to articulate and define the key problems | | | | | |
| 9. | Difficulty of managing crowdsourcing participants | | | | | |
| 10. | Un clear policies and strategy in soliciting ideas from participants | | | | | |
| | Indicate other challenges facing the user of information technology with regard to crowdsourcing in your firm. | | | | | |

## SECTION C: EFFECT OF CROWDSOURCING ON PRODUCTIVITY

Indicate the extent to which you agree with the following statements.

**(1- Strongly disagree 2- Disagree, 3- Neutral 4 – Agree 5 – Strongly agree)**

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1. | Crowdsourcing has reduced the number of defective products | | | | | |
| 2. | Crowdsourcing has drastically shortened some parts of the innovation chain from idea to product as ideas are gathered and processed much faster. | | | | | |
| 3. | Crowd sourcing has helped reduce the cost of inputs | | | | | |
| 4. | Crowdsourcing has reduced the cost of detecting defectives | | | | | |
| 5. | Crowdsourcing has facilitated product designs | | | | | |
| 6. | Crowdsourcing has improved the reliability of operations | | | | | |
| 7. | Crowdsourcing has helped reduce production wastage | | | | | |
| 8. | Crowdsourcing has helped improve the quality of supervision | | | | | |
| 9. | Crowdsourcing has helped reduce maintenance costs | | | | | |
| 10. | Crowdsourcing has helped improve rating of your products | | | | | |
| 11. | Crowdsourcing has greatly publicized your products and made them widely known | | | | | |
| 12. | Crowdsourcing has helped facilitate best solutions for products | | | | | |
| 13. | Crowdsourcing has helped improve volume of production | | | | | |
| | Indicate other ways in which crowdsourcing affects productivity of products in your firm | | | | | |

## SECTION D: EFFECT OF CROWDSOURCING ON QUALITY

To what extent do you agree that crowdsourcing has contributed to the following with regard to the quality of your products?

**(1- Strongly disagree 2- Disagree, 3- Neutral 4 – Agree 5 – Strongly agree)**

| | | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|
| 1. | Customers have high opinion of your products | | | | | |
| 2. | The quality produced matches the quality customers expect | | | | | |
| 3. | Customers rank your products better than substitutes | | | | | |
| 4. | Complaints against your products have reduced with time | | | | | |
| 5. | Customers find the quality of your products matches the price | | | | | |
| 6. | Aesthetics of the product are attractive to the customers | | | | | |
| 7. | Your products are easy for the customer to use | | | | | |
| 8. | Your brand is highly ranked by customers | | | | | |
| 9. | Response to quality issues is quick | | | | | |
| 10. | Response to quality issues is effective | | | | | |
| | Indicate other ways in which crowdsourcing affects quality of products in your firm. | | | | | |

## SECTION E: CROWDSOURCING AND TIMELINESS OF DELIVERIES

To what extent do you agree that crowdsourcing has contributed to the following with regard to timeliness of deliveries?

**(1- Strongly disagree 2- Disagree, 3- Neutral 4 – Agree 5 – Strongly agree)**

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1. | Crowd participants have increased flexibility of addressing quality issues. | | | | | |
| 2. | Crowd participants have helped in strict adherence to agreed delivery schedules | | | | | |
| 3. | Crowd participants have improved cooperation on quality of products. | | | | | |
| 4. | Crowd participants have an excellent mechanism to warn on delivery problems on time. | | | | | |
| 5. | Crowdsourcing has been useful for keeping the company in touch with the market | | | | | |
| 6. | Customers experience few problems with your deliveries | | | | | |
| 7. | The crowd team has led to reduced lead time | | | | | |
| 8. | Customers feel our delivery services match the price charged | | | | | |
| 9. | Customers always receive orders in required quantities | | | | | |
| | Give other ways in which crowdsourcing affects the timeliness of deliveries in your firm | | | | | |

## SECTION F: OPERATIONAL PERFORMANCE

1. On Average how many complains about your product do you get per month?

   _____

2. How quickly do you respond to quality issues of your products?

   In a day (  ) Two days (  ) More than two days (  )

3. Are your products always delivered on schedule?

   Yes (  )  No (  )

4. How much money in Kenya shillings do you spend on product innovation, research on new concepts, designing new products, and or on fine tuning product designs in a month?

## Appendix III: Regression Data

| Serial No. | Y | $X_1$ | $X_2$ | $X_3$ |
|---|---|---|---|---|
| 1. | 15 | 2 | 1 | 200000 |
| 2. | 20 | 2 | 2 | 100000 |
| 3. | 10 | 3 | 2 | 100000 |
| 4. | 5 | 1 | 1 | 100000 |
| 5. | 4 | 1 | 1 | 300000 |
| 6. | 5 | 1 | 1 | 200000 |
| 7. | 4 | 2 | 1 | 1000000 |
| 8. | 30 | 2 | 1 | 1000000 |
| 9. | 20 | 1 | 1 | 300000 |
| 10. | 60 | 3 | 1 | 0 |
| 11. | 4 | 1 | 2 | 0 |
| 12. | 25 | 2 | 1 | 0 |
| 13. | 15 | 2 | 1 | 10000000 |
| 14. | 30 | 1 | 1 | 5000000 |
| 15. | 50 | 2 | 1 | 350000 |
| 16. | 30 | 2 | 1 | 400000 |
| 17. | 20 | 1 | 1 | 0 |
| 18. | 60 | 2 | 2 | 250000 |
| 19. | 30 | 1 | 2 | 0 |
| 20. | 4 | 2 | 1 | 1000000 |
| 21. | 8 | 2 | 1 | 50000 |
| 22. | 10 | 1 | 1 | 50000 |
| 23. | 7 | 1 | 1 | 1000000 |
| 24. | 10 | 2 | 1 | 250000 |
| 25. | 5 | 2 | 1 | 100000 |
| 26. | 4 | 1 | 1 | 500000 |
| 27. | 3 | 1 | 1 | 3000000 |
| 28. | 3 | 1 | 1 | 0 |
| 29. | 10 | 2 | 1 | 10000000 |
| 30. | 10 | 1 | 1 | 20000 |
| 31. | 20 | 2 | 2 | 50000 |