

The links among the cost drivers of the South African mobile phone industry and supply chain cost-reduction approaches: a network diagram perspective

MUSENGA FRANCIS MPWANYA¹, CORNELIUS HENDRIK VAN HEERDEN¹

¹ Department of Marketing, Logistics and Sport Management,

Tshwane University of Technology,

Private Bag X680, Pretoria 0001,

South Africa

MpwanayaMF@tut.ac.za; vanheerdenCH@tut.ac.za

Abstract: - The purpose of this paper is to understand the perceptions of mobile-phone players regarding the cost drivers and supply chain cost reduction in the South African mobile phone industry, and to report the links among the cost drivers of the South African mobile-phone industry and supply chain cost-reduction approaches from a network-diagram perspective. Semi-structured interviews were held with eight willing managers of the mobile phone companies in a qualitative case study. Observation and documents were also used for triangulation purposes. The study found network building and network maintenance, handsets, logistics, technology, marketing and sales, as well as training and consulting, to be the cost drivers of the South African mobile-phone industry. The findings of this study suggest that mobile-phone companies should consolidate their strategic relationships and outsource their non-core businesses to specialised service providers. The network diagram designed in the light of the findings showed a set of relationships among the cost drivers of the South African mobile-phone industry and the various supply chain cost-reduction approaches.

Key-words: supply chain, cost drivers, cost reduction, supply chain cost-reduction approaches, mobile phone industry, qualitative case study, network diagram.

1 Introduction

Acquiring accurate and timely information on various activities and processes, as well as the associated costs, is critical in ensuring sound managerial decisions and responsiveness across the supply chain (SC). [40] view a SC as “a network of independent firms that partner to provide goods and services to consumers”. One of the key factors to enhance the efficiency in any SC is the ability to understand, and to manage the cost structure; as it provides the radiography of all costs incurred in the purchasing of supplies, production and the delivery of products and services to the final customers. The cost structure should assist SC managers in

identifying activities with high costs, and to initiate careful cost-reduction measures.

Several studies indicate that cost reduction is not a once-for-all improvement activity, but a continuous improvement measure – because of changing customer demands [18]; [6]. Arguably, [60] states that improving SC processes is the only way to achieve SC cost reduction. [51] conducted their studies on developing a SC cost model in the Indian agricultural sector; and they suggested the use of the system dynamics-grain SC model to reduce the SC costs. In a study conducted by [61] in the

United States automatic test-equipment industry, it was found that architectural costs are complex, inter-related and hierarchically organised. [6] conducted its study on SC cost reduction in the Indian automotive industry. The results suggested that maintaining balanced inventory levels, increased inventory returns and better resource utilisation are all key factors in achieving SC cost reduction.

However, no available study has reported on the various activities performed by mobile-phone companies and the associated links when using a network-diagram perspective on SC cost reduction in the South African mobile-phone industry. The research question posed for this study is: What activities are performed by South African mobile-phone companies, in order to achieve effectiveness and SC cost reduction, and the associated links when using a network-diagram perspective?

The purpose of this paper is to understand the perceptions of mobile phone-players on the issue of SC cost reduction in the South African mobile-phone industry, and to report the links among the cost drivers of the South African mobile-phone industry and SC cost-reduction approaches from the perspective of a network diagram. The structure of the article starts with the literature review, which includes the background on costs in the telecommunication industry, on cost drivers and activity-based costing, and on SC cost-reduction models, leading to the development of the conceptual framework for the study. This is followed by the research methodology used to collect the data and answer the research question, and a discussion on the findings and on the various links and the managerial implications. The article ends with the conclusion of the study.

2 The Literature review

2.1 Costs in the telecommunication industry

One of the main characteristics of the telecommunications industry is the high capital investments [23]; [49]; [57]. [14] state that “based on the expected capacity demand increase, mobile network operators (MNOs) are required to increase capital (Capex) and operational expenses (Opex) accordingly”. [46] define Capex as the fund invested, in order to acquire the physical assets to upgrade the infrastructure. On the other hand, [35] viewed Opex as the cost associated with operating the network infrastructure. Several studies indicate

that MNOs’ Opex exceeds Capex [1]; [47]; and it is an ever-growing cost for the mobile-phone industry [46].

When differentiating an MNO from a service provider (SP), [10] point out that an MNO is a firm that owns a public mobile-telephone network; while a SP is a firm that resells minutes purchased from an MNO. [32] add that SPs also play the role of an intermediary by purchasing all kinds of services from MNOs, and reselling these products to consumers with their brands. In the South African context, the business portfolio of MNOs includes the network connectivity, starter packs and air-times. This makes them dominant and stronger than the other players in the industry [40]. These authors go on to state that “the deregulation of the mobile-telecommunication space and the increasing need for competition and better mobile-service propositions to consumers at reduced costs have led to the emergence of mobile-virtual network operators (MVNOs)”. According to [11], MVNO refers to any company that provides mobile-subscription services under its own brand name, without having a spectrum licence (the firm does not have its own mobile-phone network).

2.2 Cost drivers and activity-based costing

Many studies have highlighted Capex as one of the major cost drivers of the mobile phone industry [22]; [24]; [49]. According to [13], a cost driver is “the factor which generates [the] occurrence of the consumption of resource (capacity) expenses”. [39] argues that identifying and implementing appropriate cost drivers is critical in understanding the nature and the factors that explain the relationships between cost drivers and the total indirect costs of an operation. A wave of studies provides evidence of the link between the cost drivers and activity-based costing (ABC) [13]; [3]; [40]. ABC is a dual-costing methodology that begins with allocating direct costs and overhead costs to various functional activities. These are then finally attributed to cost objects (e.g. products, customers, processes or distribution channels) [9].

[19] states that the use of ABC methodology can lead to precise and valuable cost estimations, especially when overhead costs predominate; because they causally correlate with products and costs and they can reflect a company’s realities within a wide range of products or services. [3] are of the opinion that companies that use multiple-cost

drivers are likely to achieve higher levels of accurate activities through the ABC system. [13] point out two major criteria that should be used when describing different types of cost drivers, namely: optional and specific (of determination). Optional criteria for selecting cost drivers in business organisations include easy identification, use and understanding, direct relationships between overhead costs and cost drivers, and negative or positive impact on company's employees. On the other hand, the specific criteria for selecting cost drivers are degree of complexity, diversity, and variation of the product, degree of accuracy of calculation, and the degree of usefulness of the information.

2.3 Supply chain cost-reduction models

In an effort to reduce costs and to focus on core business, several telecommunication network operators have embarked on a shared-service model in some key functions [41]. [48] view shared services as the practice that promotes the sharing of a set of services by business functions, firms and organisations – in order to avoid duplication of a series of staff functions. Arguably, [29] indicate that the adoption of shared service arrangements is a strategic business approach that requires the collaboration of employees in the integration of systems, processes, and their subsequent transformation. In South Africa, because of the pressure to drive Opex down and provide lower mobile service costs, as required by the Independent Communication Authority of South Africa (ICASA), the MNOs have embraced the shared-service approach, whereby they have pushed back network infrastructure and its maintenance costs to equipment manufacturers (suppliers) [40].

[55], in their study on SC cost reduction, based on process and time analysis, proposed a four-phased theoretical SC cost-reduction model, which comprises: SC costing, improving processes, compressing SC time, and smoothing interfaces. [5] suggests negotiating cost and breakthrough ideas (collaboration), as the two key approaches for reducing SC costs. However, because of the high Capex and Opex in the mobile-phone industry, as highlighted in many studies [1]; [14]; [22]; [49], many MNOs are exploiting new avenues – including the use of network outsourcing and infrastructure sharing – to reduce capital costs [43]. Arguably, [25] assert that for cost-reduction

purposes, MNOs are required to outsource certain operational functions, such as field operations and network services, on the one hand, and to share the infrastructure, on the other hand. [12] indicates that infrastructural sharing also ensures the availability of capital investment to expand the network and to effectively meet customers' needs. [54] argues that MNOs' collaboration on infrastructural building or infrastructure and network sharing can play a critical role in coping with the cost of the roll-out of the Fourth Generation (4G) network. [20] suggest that the sharing of sites would be a better option for MNOs to reduce, significantly, both Capex and Opex.

4G is the highly advanced technology that enables more complex mobile applications at a faster pace. In South Africa, the 4G devices operate alongside Third-Generation (3G) and Second-Generation (2G) devices, in order to meet the mobile telecommunication needs of various customers. The 2G cellular technology offers digitalised voice services [7]. According to [2], the 3G cellular technology is designed to meet the need of devices that require high-speed data access and real-time multimedia traffic.

When one considers the SC cost models, as discussed above, it should be noted that all of these models were specifically designed for the manufacturing sector. Because of this, a conceptual framework of relationships is presented in Figure 1. This framework, which is service industry-oriented and forms the basis for data collection and data analysis, is constructed on the basis of the literature review and the use of a qualitative case-study methodology.

2.4 The development of the conceptual framework for the study

The framework is made of three inter-related components: cost drivers, areas for cost reduction and cost-reduction implementation in the South African mobile-phone SC. These components play a critical role in the effectiveness of mobile-phone companies in South Africa's mobile phone SC.

2.4.1 Cost drivers

To achieve their business goals, business organisations –including mobile-phone companies – need to carry out a set of activities and/or processes that generate costs. The failure to gain an insight into these costs could result in high input

costs. Because of this, it is of paramount importance for South Africa's mobile-phone companies to first develop a cost-control mechanism that could identify and manage their cost drivers; since high operating costs have become the norm for the mobile phone industry globally.

2.4.2 Areas for cost reduction

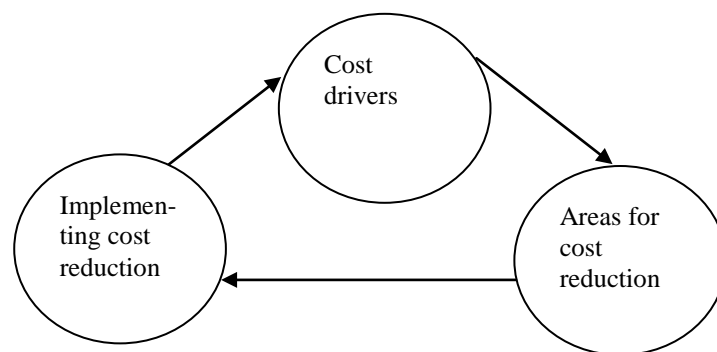
Identifying cost drivers should help South Africa's mobile-phone companies in identifying possibilities and opportunities for cost elimination or reduction; since cost reduction is connected with the issue of cost drivers for each activity carried out by South Africa's mobile-phone companies. The cost structure of mobile phone companies, particularly the operating costs, could help to identify cost-reduction possibilities and opportunities. The identification of cost-reduction possibilities and

opportunities by means of cost-driver analysis should result in the elimination or reduction of non-value-adding activities, the enhancement of value-adding activities and efficient processes, and the relationships among SC partners in the mobile-phone industry.

2.4.3 Implementing cost reduction

The journey of any process of re-engineering should lead to the implementation of cost-reduction efforts; since all high-cost processes identified through cost-driver analysis are thereby either eliminated or reduced. Cost reduction is a means to an end; as it is a cyclical process with ongoing improvement requirements. Implementing a cost-reduction mechanism could enable South Africa's mobile-phone companies to enhance their operational efficiency and to provide lower-priced services to the end-users.

Fig. 1. A conceptual framework for supply chain cost-reduction in the South African mobile-phone industry



3 Research design and methodology

3.1 Nature of the study, selection of components and participants

This study adopted a qualitative research approach by using the single-case design, in order to understand SC cost reduction and report the links among the cost drivers of the South African mobile-phone industry and SC cost-reduction approaches from the perspective of a network diagram. The limited use of the term 'case study' in both academic and practitioner environments seems to be confusing. Echoing the dual use of the term 'case study', [44] states that the term 'case study' can be used to describe a unit of analysis (for example, a case of a particular organisation), or to describe a research method, which is applicable in this study.

The initial selection of components for this study was framed from the literature review in the mobile

phone SC, which comprises device manufacturers, equipment vendors, content providers, content enablers, MNOs, MVNOs, SPs, mobile retailers and users. Because of the disclosure agreements with MNOs and competition, some potential participants (from abovementioned components) chose to decline the request to participate in this study. The final selection of participants for this study was made up of three MNOs, one SP, and one mobile-retailing group. Users were eliminated from the final participant selection; since they could not provide any important, authoritative and insightful contributions to a study that deals with the SC cost-reduction of their suppliers. The selected participants were mainly managers responsible for logistics and SC management departments; and they were necessarily knowledgeable about the South African mobile-phone SC and manifesting the willingness to participate in the study.

Purposeful sampling was used to gain insights into SC cost reduction and the links among the cost drivers of the South African mobile phone industry and SC cost-reduction approaches from the perspective of a network diagram. Prior to the data collection, the interview questions or protocol were

3.2 The data collection

Eight semi-structured interviews were held with six managers from three MNOs (two managers per MNO, but working in separate branches, in order to obtain a variety of opinions), one manager from a SP and one manager from a retailing group, as illustrated in Table 1. These interviews took place from August 2011 to December 2011, and they

Table 1. Participants' sample

Mobile-phone participant	Number of mobile phone companies	Number of managers per mobile-phone company	Total
Network operators	3	2	6
Service providers	1	1	1
Retailing group	1	1	1
Total			8

Saturation was reached with the MNO components at the sixth interview; since no new aspects were obtained from the participants thereafter. On the other hand, saturation could not be reached with the SP component and the mobile-retailing group component; because there was only one willing participant per group (component) who was interviewed.

Three techniques were used to collect the data, namely: semi-structured interviews, observation and documents. Of these techniques, semi-structured interviews were the main data-collection technique. The observation of participants centred on body language, discomfort, and hidden meaning during the interview sessions; and notes were made to indicate such observations [36]. Documents, such as the annual reports of MNOs and other published reports on telecommunication costs were gathered, in order to assist in identifying any potential issues that would need to be addressed in the research question of this study. This form of data collection is well-recognised in qualitative research, particularly in qualitative case studies [8]; [15]; [17].

piloted and refined, in order to ensure clarity to the participants [63]. The selection of the participants in the pilot case study was conducted according to three main criteria: convenience, access, and geographical proximity [63].

were all pre-arranged, audio-recorded and in English. The average duration for these interviews was eighty minutes. These interviews were transcribed after each interview session or a day thereafter; and notes were made during the interview sessions.

3.3 Validity, reliability and triangulation

All eight semi-structured interviews were audio-recorded, transcribed verbatim and validated by the participants. A probing technique was used in this study to address any concerns regarding validity and reliability in qualitative research, as was suggested by [37]. Data triangulation was employed to compare and contrast the opinions of various participants within the mobile phone SC. On the other hand, method triangulation was also achieved; since multiple sources of evidence – interviews, observation and documents – were used and compared.

3.4 The data analysis

The interview data, in the form of transcripts, were analysed with the help of Atlas.ti – the qualitative software that systematically analyses interview data in the form of text, graphic, audio and video – following a three-phased process, as proposed by [45]. This is an adaptation of [38] analytical framework; and it consists of: data reduction, data display, and data interpretation, as well as the drawing of a conclusion. In the data-reduction phase, the interview transcripts per participants were transferred from the voice-recording device to the first author's desktop and labelled confidentially. The interview transcript of each

participant was carefully listened to through Windows Media Player, and reviewed in the light of the notes made for each participant during the interview sessions, in order to get the complete or full picture. Preliminary themes that arose from this process were noted and refined at a later stage. All the transcripts were transported to Atlas.ti (version 6.2) and coded, according to a bottom-up approach. The comparison of one transcript with another, in order to construct patterns and themes resulted in the identification of some similarities and contrasts.

In the data-display phase, the authors subsequently identified links from the data-reduction phase via mind mapping, which enabled them to link this study to prior or preceding ones on SC cost and cost reduction with various industries globally, as mentioned in the introduction section. Themes resulting from the data-reduction phase mirror the research question posed for this study. Outlying statements were noted; and matrices were made using core codes that were created, and which facilitated the making of comparison amongst the different components of South Africa's mobile phone SC. This also helped to identify any patterns therein requiring refinement at the data-interpretation and the concluding phase.

The data interpretation and the concluding phase consisted of investigating the opinions of the participants across and within the matrix, in order to construct a comprehensive picture of SC cost reduction in the mobile-phone industry. Any outlying quotation that could challenge the comprehensively constructed picture was noted. On the other hand, the participants' thick descriptions and pertinent comments were selected as an indication of their understanding of SC cost reduction in South Africa's mobile-phone industry. According to [33], a thick description provides other researchers with a literature base for investigating the possible transfer of these findings to other environments.

This qualitative case study has endeavoured to develop an analytical generalisation; because academic and business communities are given a learning opportunity from the case for themselves, as well as an opportunity to apply the findings to a number of cases [15].

4 The Findings

The themes emerging from the analysis of the interview data are discussed in relation to the available literature. For confidentiality purposes, pseudonyms are used instead of the real names of the participants and the companies for which they work. Various acronyms are employed to link the opinions of the participants to their respective component in South Africa's mobile-phone industry – that is to say to each pseudonym, (where MNO= network operator, SP= service provider, and R= retailer). To answer the research questions: “From the cost structure of the South African mobile-phone industry, would you please mention the major expenses.” and “How can South African mobile-phone companies effectively reduce their costs on a supply-chain basis?” The following interview questions were put to the participants:

- What are the major cost components in the South African mobile-phone industry?
- What approach should be used to reduce supply-chain costs in the South African mobile phone industry?

4.1 Perceptions on major cost components in the South African mobile-phone industry

The six themes that emerged in relation to the major cost components in the South African mobile-phone industry are: network building and network maintenance, handsets, logistics, technology, marketing and sales, as well as training and consultation.

4.1.1 Network building and network maintenance

Network infrastructure and network maintenance are listed among the major cost components in the South African mobile-phone industry, as shown in the following excerpt from one of the participants:

“Headcount, network, deploying and maintenance of the network, sales channels and marketing are the main costs (Keziah: MNO, General Manager Procurement, 42-year-old male)”.

The network infrastructure is one of the key resources that enable MNOs to provide voice and data services to their customers. This study's findings point towards the previous studies that show that network management amounts to 13 per cent of the typical cost structure for an integrated MNO, as contrasted with those of the network

operations that account for approximately 60 to 80 per cent of an MNO's total investment, and between 15 per cent to 20 per cent of an MNO's Opex [4]; [62]; [21].

It can be argued that the network infrastructure drives the mobile phone SC; since the network is the most critical aspect in the telecommunication business, enabling connectivity and the provision of voice and data contents to customers. It requires proper, effective and continuous maintenance and development or upgrading, in order to ensure that mobile-phone services are provided, when needed and at a profit. The building of a telecommunication network infrastructure demands substantial capital investment; and the cost associated with maintaining the network infrastructure is also high in South Africa – due to the importing of most of the network building and maintenance equipment, on the one hand. On the other hand, the constant technological change requires a continuous inflow of investment, to cope with the increasing demand for data along with voice.

4.1.2 Handset acquisition

Handset acquisition is listed among the major cost components in the South African mobile-phone industry, as shown in the following excerpt from one of the participants:

“The major expenses that play a huge role and that influence the price to customers (from sourcing to the final customer) are: distribution costs, security costs, insurance, warehousing costs, which include the labour cost (South Africa has high labour costs); and device costs; but it depends on the kind of devices (Ephraim: MNO, Sourcing Manager, 45 year-old male)”.

Handsets are the means that enable users to access mobile services via the network infrastructure. Handset acquisition and ownership drive the purchasing of subscriber identity-module (SIM) cards and airtime; since these are complementary products. The handset acquisition cost in South Africa is high, because of the sourcing process and the increasing need to meet the demand for mobile-telecommunication services from different categories of users. In order to ensure mobile telecommunication accessibility, South Africa's MNOs, as do their counterparts in the world, need

to subsidise handsets and expect to recover the costs associated with handset subsidies through airtime sales. However, South Africa's mobile telecommunication market, where the share of handsets, SIMs and vouchers (airtimes) accounts for 19.7 per cent of the expenditure composition of MTN SA [59] show how handsets, SIMs and vouchers are some of the key cost drivers of the mobile-phone industry.

4.1.3 Logistics

This study found that logistics is one of the major cost drivers of the South African mobile-phone industry, as shown in the following excerpt from one of the participants:

“The major expenses that play a huge role and that influence the price to customers (from sourcing to the final customer) are: distribution costs, security costs, insurance, warehousing costs, which includes the labour cost (South Africa has high labour costs); and device costs; but it depends on the kind of devices (Ephraim: MNO, Sourcing Manager, 45 year-old male)”.

In the mobile-phone landscape, logistical costs are made up of warehousing costs, and transportation costs. No findings in any of the previous studies support this study's finding, because of its particularity. South Africa's MNOs warehouse various items, in order to provide continuous mobile services to customers. These include devices, SIM cards, mobile-phone accessories, marketing materials, generators, air-conditioners and other building materials used in the building of a network infrastructure. When these are warehoused, or when the devices are distributed to channels, including handset dealers, handset franchises, handset-street vendors (serving under-served communities in the informal sector), and handset retailers for sales, tight security measures are needed.

Since mobile devices are regarded as being high-risk items, and as matters of high concern in the mobile phone market, an insurance mechanism is also needed. The cost associated with the distribution of handsets is enormous; since this comes together with security costs and insurance costs. Security should be provided – not only for handset warehousing and distribution – but also for base stations, stores, and full offices; and these

costs also contribute to the Opex of MNOs. MNOs import most of the equipment needed in the building and maintenance of a network infrastructure. This leads to logistical costs, such as shipping and other transport-related costs and duties. For local services, some MNOs outsource their logistical services from third-party logistical (3PL) companies; while others use alternative business models.

4.1.4. Technology

This study found that technology is one of the cost drivers in the South African mobile phone industry, as shown in the following excerpt from one of the participants:

“One of the main costs is technology; and the rate of change in technology, as well as keeping the network equipment up to date, and also ensuring that the network services are available 24/7/365 (Timothy: MNO, Head of Logistics Department, 50-year-old male)”.

This study’s findings confirm the previous findings by [31] that mention information technology as being among the major components of the overall cost of the telecommunications industry’s Opex. However, [28] notes that the speed of technological change is what differentiates telecommunication from other infrastructural businesses globally. The changes in this technology require constant upgrading in the network infrastructure, which also requires an enormous amount of capital investment.

4.1.5 Marketing and sales

This study found that marketing and sales are two of the cost drivers in the South African mobile-phone industry, as shown in the following excerpt from one of the participants:

“Headcount, network, deploying and the maintenance of the network, sales channels and marketing are the main costs (Keziah: MNO, General Manager Procurement, 42-year-old male)”.

This study’s findings confirm previously conducted studies, which claim that marketing and sales costs range from 21 per cent to 29.4 per cent of the combined expenditure of mobile-phone companies, particularly an MNO [31]; [4]; [41]. In South Africa, mobile-phone companies, particularly MNOs, spend enormous funds on marketing and sales [56]; and most of the MNOs purchase the

marketing services from SPs. More often than not, marketing and sales efforts involve the advertising of handsets on television, printed and electronic media, and other social platforms, on a daily basis. This is aimed at making end-users purchase handsets and mobile-wireless contents and applications through network usage.

4.1.6 Training and consulting

This study found that training and consulting are two of the major cost drivers in the South African mobile phone industry, as shown in the following excerpt from one of the participants:

“In terms of main costs, we have equipment costs, equipment-maintenance costs, skills costs (local and overseas skills), and software costs (Medad: MNO, Contract managers in the Procurement Department, 45-year old male)”.

Because of the shortage of skills in the telecommunications industry in South Africa [26]; [16], and the speed of technological change requiring upgrading of the network infrastructure, in order to constantly provide data content to the end-users, South Africa’s mobile-phone companies consult leading foreign telecommunication firms on what should be utilised in the building and upgrading of the network infrastructure and imported network-infrastructural equipment. These firms are also used to train local technical personnel to familiarise themselves with the imported network equipment. This results in huge consulting and training costs. This seems to corroborate the study’s findings.

4.2 Perceptions on which approach could be used to reduce supply chain costs in the South African mobile phone industry

The three major themes that emerged from the reporting of findings are: the consolidation of strategic relationships, outsourcing, and direct purchasing transactions from device manufacturers. Each of these factors is discussed below.

4.2.1 Consolidation of strategic relationships

Consolidation of strategic relationships emerged as one of the avenues that mobile-phone companies could use to reduce SC costs in South Africa’s mobile-phone industry. This insight is captured in the following excerpts from two of the participants:

“Firm relationships between SPs or NOs, and retailers and vendors, as well as

strategic relationships with original equipment manufacturers (OEMs), in addition to consolidation, where possible, with all service suppliers need to be maintained (3PLs)” (Keziah, Procurement Group Manager, 38-year-old male).

“... I indicated that consolidation could be the answer; if you could have one supply chain company, one warehouse that distributes all the handsets, so that you could still order them...” (Timothy: MNO, Head of Logistics Department, 50-year-old male).

The consolidation of strategic relationships requires both collaboration and strategic alliances among mobile-phone companies to drive costs down SC-wide. Several studies suggest that for MNOs to lower both Capex and Opex, they have to consider establishing collaborative relationships with other players in the industry. Such relationships could consist of network-sharing, without each network operator being dispossessed of its licence, to provide voice and data contents to the customers [50] or site sharing [20]. In South Africa, there should be a greater level of sharing of network infrastructure between MNOs; and competition should focus on the prices provided to products and services, as opposed to the network infrastructure. Mobile-phone companies should be constantly seeking innovative consolidation mechanisms to strategically sustain their relationships SC-wide, and to be able to provide services at a reduced cost. To achieve this, collaboration and alliance relationships and the outsourcing of some non-core activities are crucial.

4.2.2 Outsourcing

Outsourcing emerged as one of the avenues to drive SC costs down in the South African mobile-phone industry. This insight is captured in the following excerpt from one of the participants:

“... moving away from Peter Drucker’s model, where in order to get a high margin, you have to have everything under your own roof... So now, in order to be more efficient, you have to outsource everything you don’t need, not everything completely, but you can... (Philetus: MNO, Senior Procurement Group Consultant, 45-year-old female).”

Because of the increase in both Capex and Opex caused by technological change and the business

pressure to service end-users at lower mobile prices, mobile-phone companies in South Africa should reconsider their business model by outsourcing some of their non-core activities to logistics service providers. These include logistical activities and call-centre activities. These should be coupled with the change in network-equipment and device-purchasing forecasting approach, to make the operational processes of MNOs more efficient, and thereby to reduce the SC costs substantially.

4.2.3 Direct purchasing transactions from device manufacturers

Direct purchasing transactions from device manufacturers emerged as one of the avenues to drive SC costs down in the South African mobile-phone industry. This insight is captured in the following excerpt from one of the participants:

“... The model suggested is that I, as [a] retailer [need] to buy directly from original equipment manufacturers and sell handsets to customers, who [would] decide whether to connect with any network operator.... They [the network operators] need to support the infrastructure that is directly linked to their core business, which is to provide network (Raphael: R, Supply Chain Manager, 40-year-old male).”

In the current business model, MNOs purchase handsets from device manufacturers and sell them to mobile-retailing companies, which in turn, sell them to the end-users. This model disadvantages mobile retailers at the expense of MNOs; and it contributes to the increase in handset purchasing costs, because of the intermediary role played by MNOs between device manufacturers and mobile retailers. To ensure efficiency, mobile-retailing firms should be allowed to transact directly with the device manufacturers. This would lower costs across the supply chain, and promote better propositions for end-users.

4.3 Network diagram on the drivers of the South African mobile-phone industry and supply chain cost-reduction approaches

A two-phased process was undertaken in the development of the network diagram on the cost drivers of the South African mobile-phone industry and SC cost-reduction approaches. This process includes the first attempt of a network diagram on the cost drivers of the South African mobile-phone industry and SC cost-reduction approaches, and the

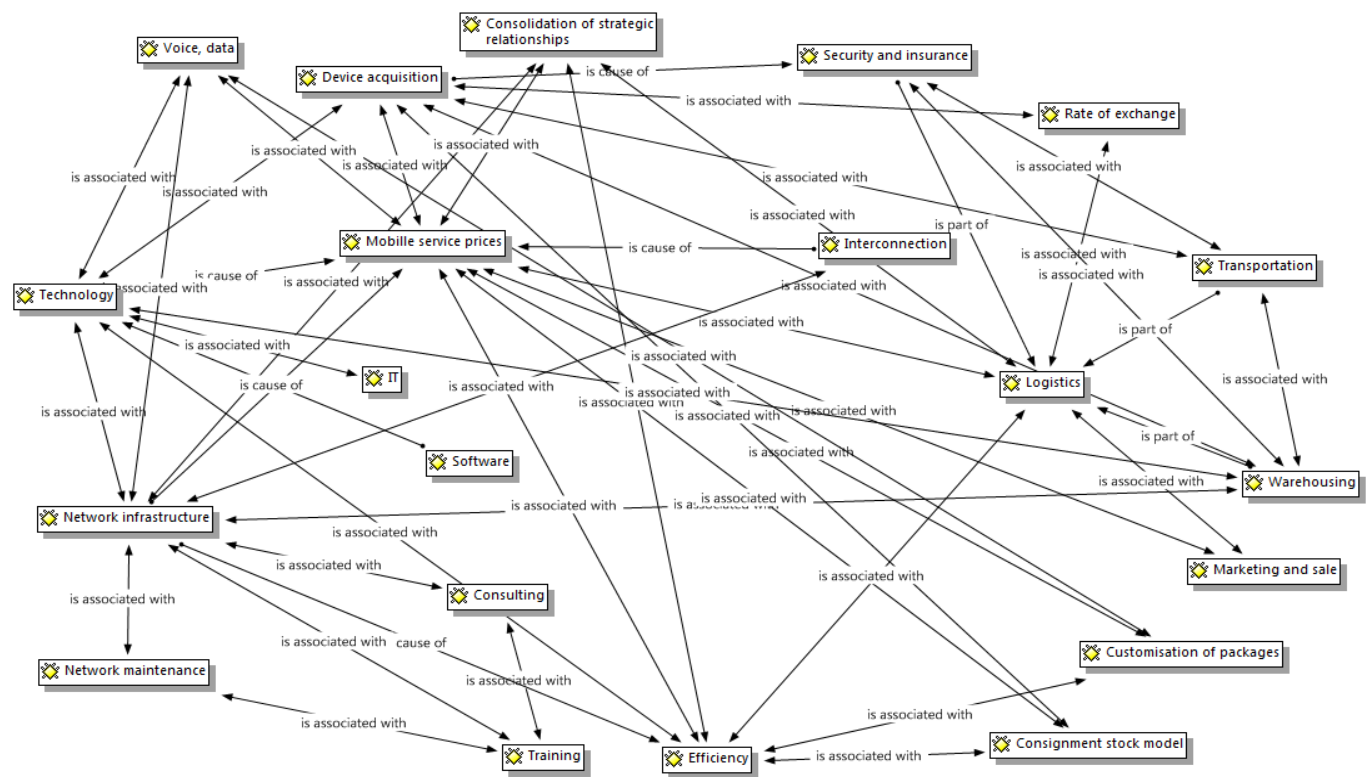
final network diagram on the cost drivers of the South African mobile-phone industry and SC cost-reduction approaches. The process helped understand the different links among core codes, which represent the cost drivers of the South African mobile-phone industry and the various SC cost-reduction approaches. With the help of Atlas.ti, different core codes were linked and discussed as an integral part of the findings of this study.

4.3.1 First attempt to create a network diagram on the drivers of the South African industry and SC cost-reduction approaches

Through the analysis of the transcript and the review of the literature relative to the mobile-

telecommunications industry, some core codes of the network diagram on the cost drivers of the South African mobile-phone industry and SC cost-reduction approaches, as shown in Figure 2, were merged into major core codes to provide illumination on the different links among core codes. The main criteria used to merge core codes were relatedness and inseparability. As an example, core codes, such as IT and software, were merged into core code ‘technology’; the customisation of packages was merged into the core code ‘marketing and sales’, because the aim of such packages is to enhance sales, as well as security and insurance; transportation and warehousing were merged into the core code ‘logistics’; because these are logistics activities, just to name a few.

Fig. 2. First attempt to create a network diagram on the cost drivers of the South African mobile-phone industry and SC cost-reduction approaches

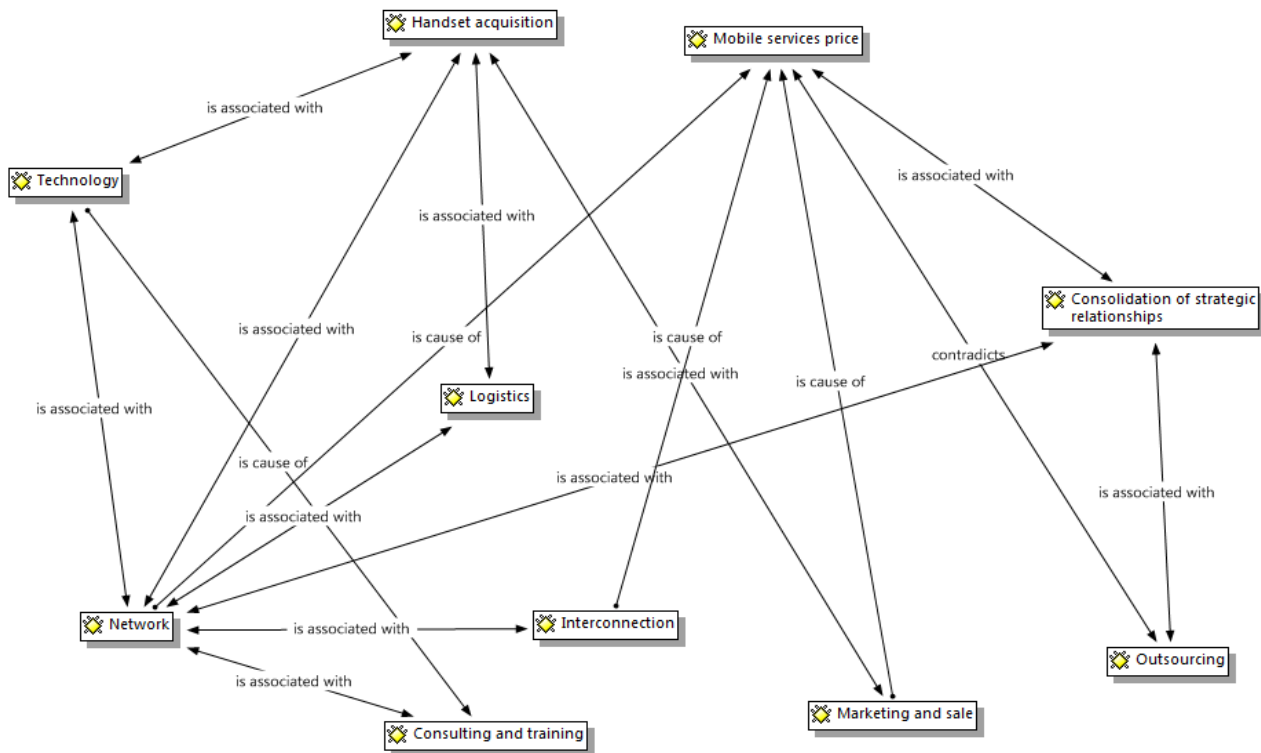


4.3.2 Final network diagram on the South African mobile phone industry and SC cost-reduction approaches

The merging process reduces the number of core codes from twenty-one to ten –in the quest for new insights into the cost drivers of the South African mobile-phone industry and SC cost-reduction approaches. This led to the development of the final

network diagram on the cost drivers of the South African mobile-phone industry and SC cost-reduction approaches. The findings of this study, as discussed in the above sections, show the emergence of multiple relationships between the different codes or loosely categorised themes, as depicted in Figure 3.

Fig. 3. Network diagram on the relationships between the identified core codes impacting on the effectiveness and efficiency of the South African mobile-phone SC



The relationships show the interplay and influence of core codes or loosely categorised themes. The relationships also indicate how complex the core codes are, or the loosely categorised themes associated with SC cost reduction in the South African mobile-phone industry.

4.4 Links from the final network diagram

In this section, the links from the final network diagram on SC cost reduction in the South African mobile-phone industry are provided and discussed. It should be noted that the link between network infrastructure and the consolidation of their strategic relationships and the link between the consolidation of strategic relationships and outsourcing, as well as the link between outsourcing and mobile-service prices have been previously discussed in the above section.

4.4.1 Link between network infrastructure and logistics

Network infrastructure is one of the key assets in the telecommunication business; and it plays an enabling role in ensuring that network operation and the provisioning of mobile wireless services (voice and data) are available to the end-users.

Mobile telecommunication companies invest hugely in the building of their network infrastructure, and the cost of maintaining the network infrastructure is higher in South Africa – due to the importing of most of the network building and maintenance equipment. This leads to logistical costs, such as shipping and other transportation-related costs and duties. Some building materials used in the building of network infrastructure are warehoused by each MNO – until such time as they are needed at construction sites or at telecommunication towers.

4.4.2 Link between handset acquisition and logistics

In South Africa, each MNO warehouses handsets before these are delivered to the distribution channels (retailer and dealers) for sale. The warehousing of handsets, SIM cards, mobile-phone accessories, marketing materials, generators, air-conditioners, and other telecommunication materials and equipment used in the construction of network infrastructure require tight security measures. Security measures and an insurance mechanism are also needed when handsets are distributed to channel members; because handsets

are regarded in the industry as high-risk commodities.

4.4.3 Link between handset acquisition and marketing and sales

One of the commonly used approaches to drive the purchasing of SIM cards and airtime is handset acquisition and ownership; since these are complementary commodities. South African mobile-phone companies, particularly MNOs, allocate substantial amounts of funds to marketing and sales; and the outsourcing of marketing services has emerged as the preferable approach for most MNOs. The medium used to advertise handsets and other mobile phone packages includes television, magazines and other advertising materials. The ultimate goal of this marketing and sales effort is to induce end-users to purchase handsets and mobile-phone services or various propositions through network usage.

4.4.4 Link between mobile service prices and interconnection

Many studies have shown the relationship between interconnection rates and mobile-phone prices [27]; [52]; [42]. Since the price-setting of mobile services is informed by the total cost of ownership, rather than a single factor, such as regulated interconnection rates, it is important for mobile-phone companies in South Africa to revisit their costing model, particularly TCO, and to strive to identify ways of decreasing their Opex. However, for South Africa's MNOs to service their final consumers at lower mobile prices, they should, among other factors that inform price determination, reduce their SC costs.

4.4.5 Link between consulting and training and the network

The rate of change in telecommunication space has unquestionably constrained many MNOs to revisit their network operational process, in order to remain in business. This leads to huge investment in consulting and training, particularly in developing economies, such as South Africa's, where most network equipment needed for the construction of the network infrastructure or for its maintenance are imported. In order to identify the appropriate working technology to use in the local market, South African MNOs often seek advice from global specialised consulting firms – due to the lack of local expertise in some telecommunication areas; and in order to operate

imported equipment effectively, local technical staff members are trained: either locally or overseas. The cost associated with these services is high.

4.4.6 Link between technology, and consulting and training

Burmeister Landelahni Amrop, CEO, points out that the shortage of key skills is one of the barriers for South Africa's socio-economic development; as the telecommunication industry could be a vital tool in fostering development [16]. This challenge calls for a joint venture between the government and mobile phone companies, whereby a long-term strategy and massive investment need to be put in place –in order to develop a pool of skills and retain it in the industry. In today's business world, technology is singled out as the biggest driving force of skill shortage on a global scale. This is echoed for the telecommunication and information technology (IT) sectors, regarded as the pillars of economic growth of countries [26]. As alluded to above, to cope with the rapid change in technology and technology convergence, South African MNOs have to upgrade their network infrastructure from 3G to 4G technology, to provide data services effectively; and this leads to the high costs associated with the consulting and training of technical staff members; as most network infrastructure-related equipment and expertise come from overseas.

4.4.7 The link between technology and network infrastructure

The pace in technological change constrains MNOs to upgrade their network infrastructural capacity, in order to provide various mobile services, including voice, mobile-messaging, broadband data and connectivity, and converged ICT services. Echoing the fast technological development in the telecommunication landscape, [58] states that MNOs should consider either to continue building on the 3G network infrastructural capability at low cost, or to introduce the more advanced technology, long-term evolution (LTE), to drive the data at a higher speed.

In South Africa, MNOs have been upgrading the network infrastructure across the country to meet the 4G handset requirements. Considering the speed and cost of technological changes and the need for lower mobile service costs, MNOs should strive to become more efficient and to strengthen

their strategic relationships with other SC players, such as the equipment manufacturers, device manufacturers, mobile-Internet service providers and retailers.

4.4.8 The link between technology and handset acquisition

One of the recent developments in the telecommunication space is the increasing need for data services besides the traditional mobile offering, voice service. Because of this, most end-users endeavour to acquire smart mobile phones, which require 3G and 4G technologies. There has been an upgrade in network infrastructural capacity to cater for various income groups using 2G, 3G and 4G technologies; and this is because the majority of the South African population cannot afford smart mobile phones due to their low incomes. Despite this upgrade, end-users still face network-related challenges with some MNOs in terms of unavailable connectivity when sending messages or calling a number that belongs to another MNO. This challenge, which is usually technology-related, needs particular attention in order to enable end-users to enjoy their mobile-telecommunication experiences.

4.4.9 The link between network infrastructure and handset acquisition

As indicated in the above section, in order to cater for the needs of the end-users of different income groups in the South African mobile-phone market, 2G handsets operate alongside 3G handsets (smart phones) and 4G handsets; and these handsets use 2G technologies, 3G technologies and 4G technologies, respectively. This technologically-combined approach, caused by the upgrade, has engendered network infrastructural costs, on the one hand, and on the other hand, a set of network-related challenges (such as delayed messages, connectivity failure for making calls, and so forth), for which some MNOs are blamed. The introduction of new handset technologies has led to the building and upgrading of the network infrastructural capacity; in order to meet and accommodate newly-created mobile-service needs; and the choice of end-users regarding the acquisition of mobile handsets is intrinsically dependent, among other factors, on handset prices and the available technological package in a country.

4.4.10 The link between network infrastructure and mobile service prices

Mobile phone companies, particularly MNOs, provide a range of products and services to end-users, from mobile-voice services to broadband data and connectivity via mobile messaging, as well as converged ICT services and equipment sales. All these services are powered by network infrastructures. It was found in this study that the network infrastructure (network costs and network maintenance costs) is one of the major contributors to high call tariffs and mobile services in South Africa. Empirical studies are needed to validate this finding; since this study was interpretive in nature.

4.4.11 The link between network infrastructure and interconnection

The responsibility for determining the cost of on-network calls lies with the MNO that originates and ends the call on its own network; but the cost for off-network calls is partially influenced by the interconnection rates of the network that terminates the call, which also partly informs the call cost paid for by the end-user [53]. However, interconnection plays a tremendous role in the telecommunication business, enabling customers to communicate by using the same network or other networks. Although interconnection is a cost for MNOs (when calls have to terminate in another network), it is also a revenue-generating means for MNOs (when calls from rival networks terminate in own network). To ensure competition in the industry, interconnection charges should be cost-based and monitored by competent regulating bodies.

4.4.12 The link between marketing, sales and mobile service prices

MNOs massively spend in the purchasing of technical services (advertising and promotion) to drive sales of handsets and mobile wireless contents, in addition to application, through network usage. Several studies have found that the advertising expense for South Africa's MNOs has increased significantly between 2009 and the second quarter of 2011 [56]. This rise may be attributed to, among other factors, the increasing needs for converged ICT services, particularly communication demand in social networking. Most of these services are outsourced from SPs and the cost associated with these marketing and sale efforts is included and embedded in the acquisition costs, which are a major component of TCO, and a critical factor that informs and impacts on the

prices of services in the mobile-phone industry. However, there is a need for empirical studies that investigate the relationship between marketing and sale costs, in addition to mobile-service prices in the industry from a SC perspective.

4.4.13 The link between mobile service prices and the consolidation of strategic relationships

Although telecommunication is regarded as a successful and highly-grown industry of the modern economy [34]; and while the prices of mobile services have gone down in the developed world and in some developing countries with the same level of economic growth as South Africa; nevertheless, the South African mobile-telecommunication industry is still accompanied by high mobile service prices, despite the regulatory intervention that forcefully reduced the MTRs later in 2010. [30] assert that innovation in mobile contents and applications (services) not only adds to the number of industry players, but also requires more and stronger collaborative relationships among the industry players.

Given that the prices of mobile services are informed by the operating costs, South African mobile-phone companies should combine outsourcing with the consolidation of strategic relationships, in order to service their customers, particularly their end-users, with lower mobile prices.

5 Managerial implications

This study provides some insightful information that could assist the managers of mobile-phone companies in their effort to decrease SC costs and to become more and more efficient, as well as to serve their customers better at lower prices. This study should help the Independent Commission of South Africa (ICASA) and the Department of Communication to understand the cost drivers and the SC cost-reduction approaches, in order to make informed mobile telecommunication policies.

6 Conclusion

Globally, mobile telecommunication is a network infrastructure-based and rapidly technology-changing industry. Given the high Capex and Opex, and the increasing business pressure for low-priced mobile communication services, mobile-phone companies need to put in place a cost-control mechanism that would identify and manage their cost drivers and rethink their business model, as

well as identify ways to decrease their Opex, particularly their SC costs. This study found network building and network maintenance, handsets, logistics, technology, marketing and sales, as well as training and consulting, as the cost drivers in the South African mobile-phone industry. The study suggests that MNOs need to consolidate strategic relationships through a greater level of sharing of network infrastructure between MNOs; and to outsource non-core activities from service providers, in order to significantly reduce SC costs. The study, using a network diagram, shows the links among the cost drivers of the South African mobile-phone industry and the SC cost-reduction approaches, which are critical in ensuring the effectiveness and efficiency of the South African mobile SC.

References:

- [1] Al-Debei, M. M., Avison, D., *Business model requirements and challenges in the mobile telecommunication sector*, 2009 [Online]. Available from <http://bura.brunel.ac.uk/handle/2438/380/>. Accessed: 27 January 2011.
- [2] Alexoiu, A., Bouras, C., Kokkinos, V., Rekkas, E., An improved mechanism for multiple MBMS sessions assignment in B3G cellular networks, *Wireless Network*, Vol. 169, No. 3, 2010, pp. 671-686.
- [3] Amdee, N., Sonthipermpon, K., Arunchai, T., Warawut, P., *Optimal cost drivers in activity based costing based on an artificial neural network*, 2014 IEEE International Conference on Industrial Engineering and Engineering Management, pp. 719-723, Bandar Sunway, 9-12 December, 2014 [Online]. Available from <http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7058732>. Accessed: 14 April 2016.
- [4] Anderson, J., William, B., Unbundling the mobile value chain, *Business Strategy Review*, Autumn, 2004, pp. 51-57.
- [5] Anklesaria, J., *Shared value chain cost reduction through innovative supplier relationships*, Institute of Supply Management's 93rd Annual International Supply Management Conference, pp. 1-6, St Louis, MO, USA, 2008 [Online]. Available from <http://www.ism.ws/files/Pubs/Proceedings/BGAnklesaria.pdf>. Accessed: 23 May 2010.

- [6] Aqua Management Consulting Group., *Supply chain cost reduction in India. Supply chain cost reduction opportunities for Indian companies. Special report*, 2008 [Online]. Available from <http://www.aquamcg.com/DesktopModules/ListingOfEvents/UploadFile/633773271593028750SupplyChainCostReductioninIndia.pdf>. Accessed: 15 February 2012.
- [7] Barkan, E., Biham, E., Keller, N., Instant cipher text-only cryptanalysis of GSM-encrypted communication, *Journal of Cryptology*, Vol. 21, No.3, 2008, pp. 392-429.
- [8] Baxter, P., Jack, S., Qualitative case-study methodology: study design and implementation for novice researchers, *The Qualitative Report*, Vol. 13, No. 4, 2008, pp. 544-559.
- [9] Beekman, G.J. , Activity-based costing of IT, IEEE International Conference on Exploring Quantifiable IT yields, Amsterdam, Netherlands, 19-21 March, 2007 [Online]. Available from <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5206409&tag=1>. Accessed: 01 October 2010.
- [10] Brito, D., Pereira, P., *Mobile virtual network operators: beyond the hyperbolae*, 2006 [Online]. Available from http://www.concorrenca.pt/download/WP/5_MVNO_Hype_Oct06.pdf. Accessed: 11 October 2010.
- [11] Burger-Helmchen, T., Plural-entrepreneurial activity for a single start-up: a case study, *The Journal of High Technology Management Research*, Vol. 19, No. 2, 2008, pp. 94–102.
- [12] Cellular Operators Association of India, *Infrastructure sharing in telecom sector*, 2007 [Online]. Available from http://www.coai.com/INFRASTRUCTURE_SHARING-Sept.18.2007-FINAL.pdf. Accessed: 19 September 2012.
- [13] Cokins, G., Căpușeanu, S., 2010. Cost drivers. Evolution and benefits, *Theoretical and Applied Economics*, Vol. 8, No. 549, 2010, pp. 7-16.
- [14] Costa-Pérez, X., Swetina, J., Guo, T., Mahindra, R., Rangarajan, S., Radio access network virtualization for future mobile carrier networks, *IEEE Communications Magazine*, Vol. 51, Is. 7, 2013, pp. 27-35.
- [15] Creswell, J.W., *Qualitative inquiry and research design. Choosing among five approaches*, 2nd edition, Thousand Oaks: SAGE Publications, 2007.
- [16] Dlamini, P., *Telecoms skills shortage critical*, 2012. Available from <http://www.sowetanlive.co.za/incoming/2012/03/27/telecoms-skills-shortage-critical>. Accessed: 23 October 2012.
- [17] Eisenhardt, K., Building theories from case-study research, *Academy of Management Review*, Vol. 14, No. 4, 1989, pp. 532-550.
- [18] Fawcett, S.E., Ellram, L.M., Ogden, J.A., *Supply chain management. From vision to implementation*, Pearson international edition, Upper Saddle River, NJ: Pearson Prentice Hall, 2007.
- [19] Fiorentino, A., Cost drivers-based method for machining and assembly cost estimations in mould manufacturing, *International Journal of Advanced Manufacturing Technology*, Vol. 70: 2014, pp. 1437–1444.
- [20] Frisanco, T., Tafertshofer, P., Lurin, P., Ang, R., *Infrastructure sharing and shared operations for mobile-network operators*, Network Operations and Management Symposium, pp. 129-136, Salvador, Bahia, Brazil, 7-11 April, 2008 [Online]. Available from <http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=04533455> Accessed: 02 September 2010.
- [21] Frisanco, T., *Benchmark-based assessment of outtasking, outsourcing, and managed services for mobile network operators*, In: Network Operations and Management Symposium, pp. 763-776, Osaka, Japan, 19-23 April, 2010 [Online]. Available from <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5488372>. Accessed: 23 July 2012.
- [22] Geoffron, P., Infrastructure-based competition versus service-based competition in the European mobile market, In: L. Benzoni & P. Geoffron (eds.), *A collection of essays on competition and regulation with asymmetries in mobile markets*, pp. 37–42, Paris: Quantifica Publishing, 2007.
- [23] Gunasekara, S., Analysis and mathematical modeling of consumer behavior in mobile telecommunications industry, *International Journal of Scientific & Technology Research*, Vol. 4, No. 6, 2015, pp. 333-343.
- [24] Harmantzis, F.C., Tanguturi, V.P., Investment decisions in the wireless industry applying real options, *Telecommunications Policy*, Vol. 31, 2007, pp. 107-123.
- [25] Hasbani, G., Weichsel, P., Trimmel, D., Cockburn, S., *After the downturn: the four trends that are shaping telecom's future*, Booz & Co, 2009 [Online]. Available from

http://www.booz.com/media/uploads/after_the_downturn.pdf. Accessed: 11 September 2012.

[26] H.R. Future., *Skills needed to underpin telecom's growth*, 2009 [Online]. Available from <http://www.hrfuture.net/education-and-training/skills-needed-to-underpin-telecoms-growth.php?Itemid=265>. Accessed: 18 September 2012.

[27] Independent Communications Authority of South Africa., *Annual report: consumer Affairs 2010-2011*, 2011 [Online]. Available from <https://www.icasa.org.za/Portals/0/Regulations/Annual Reports/ICASA Annual Report2011.pdf>. Accessed: 16 February 2012.

[28] International Telecommunications Union., *Measuring the information society*, 2012 [Online]. Available from http://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2012/MIS2012_without_Annex_4.pdf. Accessed: 10 April 2013.

[29] Janssen, M., Joha, A., Zuurmond, A., *Simulation and Animation for Adopting Shared Services: evaluating and Comparing Alternative Arrangements*, *Government Information Quarterly*, Vol. 26, No. 1, 2009, 15-24.

[30] Jing, Z., Xiong-Jian, L., *Business ecosystem strategies of mobile network operators in the 3rd era: the case of China Mobile*, *Telecommunications Policy*, Vol. 35, 2011, pp. 156-171.

[31] Katz, R.L., Hamilton, B.A., *Remedies for telecom recovery project. Managerial strategies recommendations*. Final report. Columbia Business School, 2003 [Online]. Available from http://www.citi.columbia.edu/CITI_Manual_advisorycomm.pdf. Accessed: 20 June 2013.

[32] Kuo, Y.F., Yu, C.W., *3G telecommunication operators' challenges and roles: a perspective of mobile commerce value chain*, *Technovation* Vol. 26, No.12, 2006, pp. 1347-1356.

[33] Lincoln, Y.S., Guba, E., *Naturalistic inquiry*, Beverly Hill, CA: SAGE, 1985.

[34] Littlechild, S.C., *Mobile termination charges: calling party pays versus receiving party pays*, *Telecommunications policy*, 30, 2006, pp. 242-277.

[35] Machuca, C.M., *Expenditure study for network operators*, International Conference on Transparent Optical Networks, Vol. 1, pp. 18-22, Nottingham, Nottinghamshire, UK, 18-22 June, 2006 [Online]. Available from <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4013626>. Accessed: 16 August 2010.

[36] Marshall, C., Rossman, G.B., *Designing qualitative research*, 5th edition, Thousand Oaks: SAGE Publications, 2011.

[37] McKinnon, J., *Reliability and validity in field research: some strategies and tactics*, *Accounting, Auditing and Accountability Journal*, Vol.1, No. 1, 1988, pp. 34-54.

[38] Miles, M.B., Huberman, M.A., *An expanded sourcebook. Qualitative data analysis*, 2nd edition, Thousand Oaks, CA: SAGE, 1994.

[39] Miller, J.A., *Designing and implementing a new cost management system*, *Journal of Cost Management*, Vol. 6, 1992, pp. 44-45.

[40] Mpwanya, M.F., Van Heerden, C.H., *Perceptions of managers regarding supply chain cost reduction in the South African mobile phone industry*, *Journal of Transport and Supply Chain Management*, Vol.9, No.1, 2015, pp. 11 pages.

[41] MTN., *MTN Annual Report*, 2008 [Online]. Available from http://www.mtn-investor.com/mtn_ar08/book1/pdf/MTN_book1.pdf. Accessed: 22 June 2010.

[42] Muller, R., *Lower interconnect rates mean higher retail prices: Cell-C CEO*, 2012 [Online]. Available from <http://businesstech.co.za/news/mobile/8603/lower-interconnect-rates-mean-higher-retail-prices-cell-c-ceo>. Accessed: 20 November 2012.

[43] Nelson, E., Van Den Dam, R., *Telco 2015. Five telling years, four future scenarios*. IBM Institute for Business Value. IBM Global Business Services, Executive report, Telecommunications, 2015 [Online]. Available from <http://www-05.ibm.com/cz/gbs/study/pdf/GBE03304USEN.PDF>. Accessed: 24 March 2016.

[44] Nieuwenhuis, J., *Analysing qualitative data*, In: Maree, K. (ed.), *First steps in research*. Hatfield, Pretoria: Van Schaik Publishers, 2007, pp. 99-121.

[45] O'Dwyer, B., *Qualitative data analysis: illuminating a process for transforming a 'messy' but 'attractive' nuisance*, In: Humphrey, C. & Lee, B.H.K. (eds.), *The real life guide to accounting research: a behind the scenes view of using qualitative research methods*, Oxford, UK: Elsevier Limited, 2004, pp. 391-407.

[46] Pattanavichai, S., Jongsawat, N., Premchaiswadi, W., *Real options analysis for valuing strategic investments and decisions of the mobile virtual network operator's investment in E-UMUTS*, 9th International Conference on ICT and Knowledge Engineering, pp. 138-144, Bangkok, Thailand, 12-13 January, 2011 [Online]. Available

from

www.ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6152394. Accessed: 06 September 2012.

[47] Peppard, J., Rylander, A., From value chain to value network: insights from mobile operators, *European Management Journal*, Vol. 24, No. 2–3, 2006, pp. 128–141.

[48] Quinn, B., Cooke, R., Kris, A., *Shared services: mining for corporate gold*, London: Pearson Education Limited (Financial Times – Prentice Hall), 2000.

[49] Sabat, H.K., The mobile wireless supply chain, *Productivity*, Vol. 42, No. 4, 2002, pp. 550–563.

[50] Sabat, H.K., Spectrum-acquisition strategies adopted by wireless carriers in the USA, *Information Systems Frontiers*, Vol. 10, 2008, pp. 77–102.

[51] Sachan, A., Sahay, B.S., Sharma, D., Developing Indian grain supply chain cost model: a system dynamics approach, *International Journal of Productivity and Performance Management*, Vol. 54, No. 3, 2005, pp. 187–205.

[52] Sikiti, W.M., The impact of lowering mobile termination rates in South Africa, MBA mini-dissertation, North-West University, 2011.

[53] South African Foundation, *Reforming telecommunications in South Africa. Twelve proposals for lowering costs and improving access*, Occasional paper no.2, 2005 [Online]. Available from

<http://www.safoundation.org.za/documents/ReformingTele.pdf>. Accessed: 07 June 2013.

[54] Stuhmeier, T., Roaming and investments in the mobile internet market, *Telecommunications Policy*, Vol. 36, 2012, pp. 595–607.

[55] Su, T.Y., Lei, X.H., Research on supply chain cost reduction based on process and time analysis, Proceedings of the 2008 IEEE International Conference on Industrial Engineering and Engineering Management, pp. 1625–1629, Singapore, 8–11 December 8–11, 2008 [Online]. Available

from <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4738147>. Accessed: 13 June 2013.

[56] Techcentral., How much SA's telcos spend on advertising, 2013 [Online]. Available from <http://www.techcentral.co.za/how-much-sas-telcos-spend-on-advertising/27882/>. Accessed: 12 March 2012.

[57] Telkom., Telkom Integrated Report, 2015 [Online]. Available from

http://www.telkom.co.za/ir/apps_static/ir/pdf/financ

[ial/pdf/Telkom%20IR%202015%20Final.PDF](#).

Accessed: 15 March 2016.

[58] Temraz, M., Viable strategies for innovation in telecom industry in tough times, In: *13th IFAC Workshop on Supplemental Ways for Improving International Stability*, pp. 89–94, Prishtina, Kosovo, 27–29 October, 2010 [Online]. Available from

<http://www.engineering.tuwien.ac.at/fileadmin/t/wbz/engineering/images/ifac-swiss-2010002-01oct-0089temr.pdf>. Accessed: 07 September 2012.

[59] Van Eeden, J., *The economics of mobile interconnection rates in South Africa*, Econex Research Note 15, 4, 2009 [Online]. Available from http://www.econex.co.za/index.php?option=com_docman&task. Accessed: 14 May 2013.

[60] Vincenti-Brown, C., Cost and the supply chain, In: Ayers, J.B. (ed.), *Handbook of supply chain management*, 2nd edition, Florida: Auerbach Publications/ Taylor & Francis Group, 2006, pp. 305–317.

[61] Wu, C., *Total supply chain cost model*, M.B.A. and MSc thesis, Massachusetts Institute of Technology, 2005.

[62] Wyman, O., Network outsourcing and sharing are changing the face of the mobile phone industry. Press release, 2007 [Online]. Available from http://www.oliverwyman.com/media/PR_analysis_network-models_dig.pdf. Accessed 13: April 2013.

[63] Yin, R.Y., *Case-study research: design and methods*, 4th edition, Thousand Oaks, CA: SAGE Publications, 2009.