

Technological Innovations as a Potential Vehicle for Supply Chain Integration on Basic Metal Industries

Alie Wube Dametew* and Frank Ebinger

Technische Hochschule Nürnberg Georg Simon OHM, Germany

Abstract

This study investigated the roles of technological innovation on basic metal industries and then developed technological innovation framework for enhancing sustainable supply chain integrations to basic metal industries. This sustainable supply chain integration assures mutual benefits and competitive advantage of manufacturing firms. Since the previous research work indicate that technological innovation have critical impact in promoting basic metal industries to improve their performance (in terms of productivity, information shearing, resource utilization, knowledge and technology transfer) and achieve sustainable competitive environments. The filed observation, questioner and expert interview result from basic metal industries indicates that the technological capability of local industries to invention, adoption, modification, improving and use a given innovative technology is very poor. As the result, this poor technological innovation were occurs due to improper innovation and technology transfer framework, non-collaborative operating environment between foreign and local industries, very weak national technology policies, problems research and innovation centers, the common miss points on basic metal industry innovation systems were investigated in this study. However the study indicates that to tackle such problems, adopting flexible innovative and sustainable technological innovation systems to manufacturing industries used as a vehicle for improving the performance and competitiveness of the firms. Also one of the conclusion of the article is that, through using the developed technological innovation framework in this study, basic metal industries improve sustainable supply chain integrations, improve innovation process and support an innovative culture for sector capabilities and achieve sustainable competitive advantage to basic metal industries.

Keywords: Technological innovation; Competitive advantage; Sustainability; Basic metal industry; Conceptual model; Sustainability; Supply chain integration

Introduction and Background

Innovation is an idea, concepts, practice or object that is perceived as new by an individual or other unit of adoption. Innovation is also seen as a process of idea creation, a development of an invention and the beginning of a new product, process, technology, systems or service to the market so as to solve problems to the community. Currently innovation is an essential element for economic progress of a country and competitiveness of manufacturing industry. According to argue that innovation is one of the most important competitive weapons and generally it seen as a firm's core value capability [1]. In addition innovation describes as an effective way to improve firm's productivity due to the resource constraint issue facing a firm. Although a firm's capability to successfully leverage the distinctive competencies of firms in their supply chain is critical to sustaining the competitive advantage of the firm itself. This supported by as innovation within supply chains pertains to how firms leverage suppliers to develop more effective ways to serve either existing or new markets, whether by harnessing existing knowledge or by creating new knowledge [2]. While innovation that leverages distinctive competencies in a firm's supply chain is a potential source of competitive advantage. Though, firms develop their capabilities to use supply chains to knock innovations that sustain their competitive improvement. Even though the innovation practice of developing countries are infant. According to classified Ethiopia among low income countries, as factor driven countries, ranking 127 out of 147 countries. Companies in these factor driven economies are characterized by low competitiveness with low technological readiness and innovativeness [3]. This calls for effort to be driven towards analyzing this low competitiveness of firms in sectors selected as strategic development sectors of Ethiopia. In addition key question is whether the practice of innovation and supply chain can

make an impact on metal industry efficiency and performance. In this paper we intends to filling this gap, by discover the impacts and role of technological innovation for sustainable supply chain integration o metal industries on the development of competitive advantage throughout the supply chain. Though using data collects from literature review on significant value in innovation, supply chin integration and practices is apply. Since this study is intended to study the impacts of technological innovation and then to develop conceptual formwork for enhancing sustainable supply chain integration on basic metal industries performance and global competitiveness.

Statement of the problems

Nowadays, supply chain integration, innovation and technology transfer has become the most important source of economic growth and development. However Ethiopian economy, is characterized by lowest level of industrialization and technological capability being core manufacturing sectors, such as steel manufacturing industries, are least developed in many aspects such as, technology employed, technology commercialization, technology adoption, production volume, product quality, labour skills and export capacity [4]. In addition the technological capability of local industries to adopt, modify and improve a given technology is infant and very weak [5]. Due to this Ethiopia

*Corresponding author: Alie Wube Dametew, Technische Hochschule Nürnberg Georg Simon OHM, Nürnberg, Germany, Tel: +4915778568612; E-mail: alie20123@gmail.com

Received June 02, 2017; Accepted June 20, 2017; Published June 27, 2017

Citation: Dametew AW, Ebinger F (2017) Technological Innovations as a Potential Vehicle for Supply Chain Integration on Basic Metal Industries. Int J Swarm Intel Evol Comput 6: 159. doi: [10.4172/2090-4908.1000159](https://doi.org/10.4172/2090-4908.1000159)

Copyright: © 2017 Dametew AW, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

basic metal industry are infant for Growth Transformation Program (GTP) economic contribution and poor competitive advantages. Since to tackle the above problems this research was designed.

General objectives

The main objective of this study is to develop technological innovation framework for improving productivity of manufacturing industries.

Specific objectives

- Assessed the current trends of technological innovation on manufacturing industries.
- Investigate the challenges and opportunities of technological innovation in the context of developing nations.
- Study relation on technological innovation with supply chain integration and sustainability.
- Analysis the gaps and strength of previous researches on technological innovation.
- To develop optimum technological innovation frameworks on sustainability of supply chain integration and improving competitive advantage on basic metal industries.

Research Methodology

The study was conducted through field observation, literature review of research articles, books, magazines, manuals, company report and electronic-sources which are discuss related to basic metal industries innovation and technological innovation (trends, challenges, growth, opportunities) the impacts of technological innovation on supply chain integration were assessed. The literature review focus on basic metal industry innovation competitiveness, the principles and systems of technological innovation, the current trend of technological innovation on developing nation basic metal industries assessed, the gaps of the current research on developing industries are studied, investigate and analysis in detail. Followed by model development based on the literature survey and field study analysis is done. Finally the conclusion and recommendation of the study was done. Since for analysis of the problems, the researcher mainly, for theoretical uses descriptive analyses and are empirically by AHP are used and apply to this study (Figure 1).

Literature Review and Hypothesis Developments

Introduction

Firm performance is a picture of how big the success of an organizations can achieve its their intended goals with the level of efficiency and effectiveness of the manufacturing company and the expectation of customer with time, money, quality, flexibility and cost. Meanwhile, according performance is how companies can improve productivity and reduce inventory and cycle time to increase market share and profits for all members of the supply chain [6]. However, firm performance is achieve by different system and methods. Although the previous study indicates that, for frequent collaboration firms in the supply chain compete with each other using innovative technologies such as web-based orders and integrated communication systems for knowledge and network formation [7]. This provides, the appropriate degree of integration and collaboration and a core catalyst for better performance in the supply systems However, the process of innovation, knowledge is an essential element and in the present

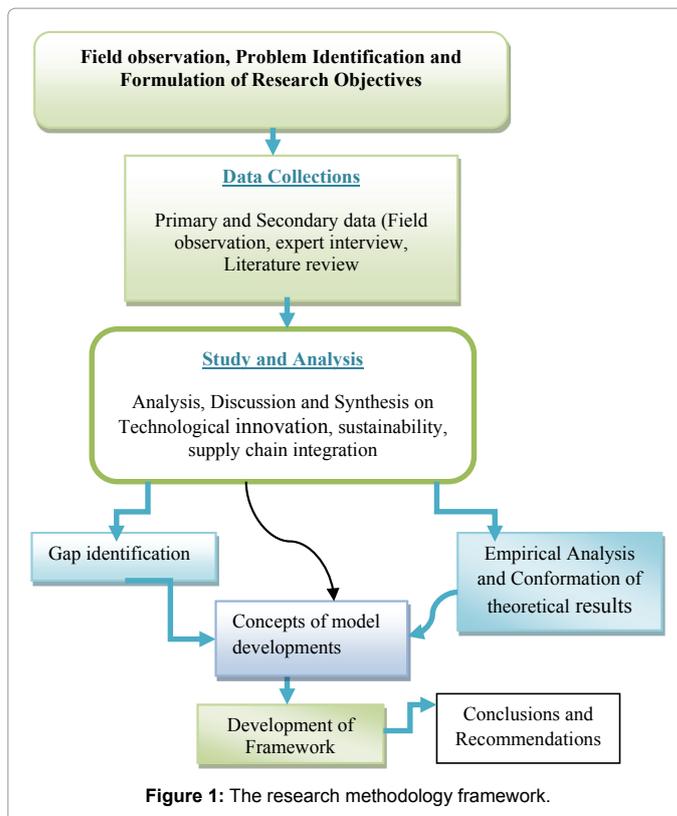


Figure 1: The research methodology framework.

competitive environment innovations help gains an advantage over other organizations. Since innovations are and will surely continue to be a means for organizations to survive in today's turbulent and highly competitive environment [8]. Since, innovation is the fundamental basis for creating firm specific asset that enable a firm to achieve sustainable advantage and improve its corporate performance. However, Innovations are a key source of a competitive advantage that determines the economic success of each organization. Also organizations wish to survive and grow in today's turbulent environment, they have to make every effort to introduce an innovative approach and creativity, therefore top management's support is essential. Thus, innovation is concerned with the process of commercializing or extracting value from ideas. From this perspective, innovation would be expected to be closely linked to firm performance. Indeed there is widespread support for the assertion that firms must be innovative to survive and prosper in a competitive economy. Study identify that technological innovation capability is a dominant source of competitive advantage and thus underpins performance of a firm [9]. There study conducted in such a way that introduced the core ideas of the perspective of dynamic capabilities as the latest approach in the theory of strategic management, and presented the relevance of continuous innovation in today's environment . Then they extended the importance of deploying technological innovation capability as a dynamic capability in a global dynamic environment such as the home appliance industry. Also the study examine the relationships and interactions of the dynamic capabilities, for example, marketing capability, and their influences on performance, technological capability with firm performance. Form we observe that there is a good approach conducting the study within that level but they miss other crucial concepts like, there relation technological innovation, with sustainability, technological innovation with environmental impact and technological innovation with product

capability. As a result emphasis for this missed concepts of the previous work in addition to the included. Thus, based on the argument from previous research, the following hypothesis is proposed here that technological innovation plays important role competitiveness and firm performance.

H1: The performance of technological innovation will have positive impact on sustainable supply chain integration. Since, the pervious study investigates the key technological innovation capabilities for production or design and technological innovation capabilities key potential tools for production management [9]. As recognized, the pervious study technological innovation capability have great impact on production capacity and product improvement. As a result we can proposed the next hypothesis.

H2: Sustainable technological innovation have direct and positive impact on sustainable supply chain integration. Although, firms develop their capabilities to use supply chain systems to knock innovations that sustain their competitive improvement. Likewise, innovation is important to assist address global challenges, such as climate change and sustainable development of nations. Equally, sustainable innovation has been reinforced both by globalization and by rapid advances in new technologies, notably information communication technologies, which have enabled new forms of competition, cooperation and opened new markets for the creation, production and delivery of innovative process, products and services. Similarly in today development, sustainable innovation practice is a crucial determinant of competitiveness and national progress of developed and developing countries manufacturing industries. From this elaboration we can proposed the next hypothesis.

H3: The adaptability of technological innovation have highly impact sustainable supply chain integration. Sustainability of supply chain have positive relation with technological innovation adaptability. Because technological innovation adaptability plays a greet role in performance improvement. Integrating suppliers, customers and competitors and the illumination new product launch success are highly influenced by technological and competitive knowledge developments. Given that the impacts of technological adaptability on sustainable supply chain integration should be tested and investigated.

H4: Flexibility technological innovation have an impact on sustainable supply chain integration. Flexibility is provides to the company change their product type, quality, quantity and systems based on the customer needs and requirements. the past empirical study shows that flexibility have an impact on the performance and competitive advantage of the firms [10]. Since the impacts of technological innovation flexibility should investigated and tested in this study.

Analysis and Discussion

Sustainable development

Sustainability is ensures the needs of the present without compromising the ability of future generation to achieve their own expectations. Since, sustainability includes programs of environment, economic development, suitable places from local to global and institutions of government, continuous civil society, business and industry to each project their interests, hopes and aspirations onto the banner of sustainable development [11]. On the other hand, sustainable development, concept concern the substitutability of resources and economic growth. This includes capital: Social, natural and man-made. As well as sustainable development elaborates by different researchers and scholars. Since, the ultimate aim of sustainability is

to accomplish the long-term stability of the economic development, resources utilization, environmental friendly, through the integration of knowledge, technology, resource, infrastructures, throughout the organizational manufacturing process.

Supply chain Integration

Integration provides to manufacturing products and services are produced and delivered to the customer the right quantity, required quality without defect and at a competitive price. The pervious study shows that integrated system is to assist in the production, consumption and distribution or the 'supply chain', of goods and services [12]. Supply chain integration (SCI) is, to a great extent, concerned with the development of more integrated approaches that hold out the prospect of eliminating many of the inefficiencies directly attributable to supply chain fragmentation [13]. In addition, Kannan and Tan has been conducted a research on the significance of integrating suppliers, manufacturers, distributors, retailers and customers in a supply chain. Accordingly the previous finding shows that, supply chain integration provides the co-operation between various functions in the supply chain for improving firm performance and effective flow of resources between firm organizations and enhances competitive environment to manufacturing industries. Although sustainable competitive advantage on supply chain firms achieved by through successful coordination and integration of supply chains activities, like all the activities associated with moving goods from the raw materials stage, process and to the end user with supply chains processes. Consequently, an effective and efficient supply chain integration provides, confined flows of products, services and decisions in order to provide maximum value to the customer at low cost and high speed.

Challenges and opportunities of technological innovation

The lurching innovative products, information technologies, rural energy, the progress of new development, capacity building programs are some of the opportunity and benefits of technological innovation systems. The expansions, transformation, growth of these opportunities, have highly impact the growth, the improvement of nations.

This also shows by technological Innovation gives effective chances to create technological innovative product and services, helps in development and capacity building in developing countries [14]. This implies technological Innovation and competitiveness have a dynamic, shared relationship. Innovation flourishes in a focused domain and thus, assumes a key part in the accomplishment of competitive environment. Since to handle this opportunities individuals and industries should work in quality, quickly and consistence conclusively to assemble our future, improvements of nations to the present resource. On the other hand, for the accomplishing needs and comprehensive improvement numerous, numerous challenges were facing on developing. The most common challenges that faced in developing nations manufacturing industry technological innovation systems are related to political, economic, social and environmental factors. But all the challenges have that were faced, the effects are not always negative and out of the challenges there arise opportunities. Even though, developing nations are commonly adducted by negative challenges than the positive possessions. The father of challenges in manufacturing industries are globalization. Subsequently exploration is at the very root of globalization. Since challenges of technological innovation on the developing manufacturing industries are related to, quality, time ,utilization and adoption of technology, on long time taken for innovations to achieve market, Capital escalation of innovation. Since improving the survival and competitiveness of developing nation basic metal industries, needs to furnish proper technological innovation systems [15].

Sustainability of technology and supply chain-integration

Supply chain integration compressively defiled by the previous researcher in a such a way that the coordinated collaboration between the organization and its partners of suppliers and customers depending on an effective management of incoming material, services, information and money [16]. This provide to add extra value to product by delivering cost-effective quality product to final consumers timely. On the other sustainability provides to promotes economic prosperity, increased social welfare and environmental protection, provide the best ways to improve the lives of people everywhere and conservation within the right of future generations to those resources and environmental conservation. To think futurity in a supply chain systems within a firm, sustainability is used as a vehicle to achieved that. Although, it is possible to integrate and think over the widespread of the issues on environmental awareness, resource conservation, resource sustainability, into supply chain integration process and activities. Thus developed and developing world basic metal industries imperative the efficiency, they should integrate their systems in line to cooperate in solving the environmental, social, economic problems, achieve sustainable growth, enhancing mutual benefits from the common world. However the relationship between technological sustainability and supply chain integration have positive relationships, this confirms H2.

Thus sustainability of technology and supply chain integrations have direct relation one to the other.

The performances of technological innovation impacts sustainable supply chain

The development strategists of manufacturing industries have to think for the creation of knowledge, Innovation and invention, R&D also attend to the details of its acquisition, adaptation, dissemination and use in diversified local settings. Given that innovations should be considered broadly as improved systems and products, processes and business or organizational models. since, it is useful to review what is involved the systems and strategies of innovation that will help structure the analysis of the most appropriate policies, institutions and capabilities necessary to increase innovation in manufacturing industries. But innovation is contextual, because innovation in the context of developing countries is not so much a matter of pushing back the frontier of global knowledge, but more the challenge of facilitating the first use of new technology in the domestic context. On the other hand for countries behind the technological frontier, acquisition of existing knowledge may be expected to yield higher increases in productivity than would flow from a similar scale investment in R&D or other efforts to push back the technological frontier. According to the previous work, direct foreign investment, licensing, technical assistance, importation of technology as embodied in capital goods, components or products, copying and reverse engineering and foreign study are the key channels are the means of technology transfer for private goods [17]. Since innovation is accomplished when a new product or process is made available on the market that affordable and useful to the customers. Innovation process considers the diffusion (or dissemination) is the process that sees a successful innovation gradually coming to be widely available for use in relevant applications through adoption by firms or individuals. Also inventions may result from different economic and social environments, innovations are mainly a result of the firm's activity. Since technology is part of the innovation system as it enables and constrains the activities of actors in the innovation system. The performance improvement to be capable, it moves in such

a way that, utilize an invention and turn it into innovation, the firm should efficiently combine information, human, knowledge, financial, technological and material resources and existence of a functional distribution system is needed. Although technological innovation is not only the technical change and a linear process that simply goes from invention to innovation to diffusion. In reality, it is more a cyclical process, the feedback between market experience, accessibility, affordability by the customer, the capacity to simplify the lifestyle of the community and incorporating further technical development are especially important. Therefore technological innovations comprise new or significantly modified technological products and processes, wherever technological novelty emerges, unlike improvements, from their performance characteristics [18]. Also, technological innovation capabilities make it possible for firms to response to changes rapidly and to acquire technological innovation strategies and innovative outputs [19]. On the other hand he performance of technology and standards could prove an effective tool to spread effective and environmentally friendly technologies. Although technological performance could confirm important in promoting efficient end-use technologies at the end-user level, their application is much more controversial from the industry perspective. These concern happen from clear, technological innovation systems, proper knowledge and technology transfers, apparent economic principles, standards are usually considered more costly than market-based solutions. Since from the above we understand that innovation directly linked to invention and technology ,while technological innovation also likely connected to the level of innovation process and the utilization of resource and the effectiveness of potentials. Also technological innovation highly influence for the cooperation, collaboration, information shearing and improvement of firm performance. but cooperation, collaboration and proper information sharing furnished by proper supply chain integration [12,20]. As result technological innovation have a direct impact on supply chain integration. The analysis indicated that sustainable supply chain integration is positively associated with the performance of technological innovations. Hence this supporting H1. Since, basic metal and engineering industry sector is central the birth and development of technological innovation to enhancing socio-economic development and transformation in an nations [21]. However, in Eastern Africa, basic metal and engineering sector unfortunately plays a rather limited role in promoting technological innovation, knowledge transfer and contribution of GDP growth compared with other regions. Since it is necessary to follow proper technological innovation systems and process so as to implement proper supply chain integrations in the regions.

The impacts of Innovative technological adaptability on sustainable supply chain

Technologies involve the techno-economic workings of such artifacts, including costs, safety and reliability. These features are crucial for understanding the feedback mechanisms between technological change and institutional change [22]. Technology consists technological trajectory and accumulation of knowledge. Since Technological trajectory refers to a single branch in the evolution of a technological design of a product/service. As such, a technological trajectory is a set of technologies that consistently develop over time in certain direction [13]. However, innovation refers to a tradable application of an invention, as a result of invention integration into economic and social practice. Innovation is regarded, therefore, being a result of a process that starts with an idea genesis and continues with its materialization [18]. Thus the idea of the innovation process stresses that the flow of technology

and information among people, organizations, regions, enterprises and institutions is key to an innovative process. These process consists the interaction between actors who are needed in order to turn an idea into a successful process, product or service in the marketplace. However, study shows that, many innovation systems are characterized by some flaws that greatly hamper the development and diffusion of innovations [22]. Since these flaws are often labeled as system failures or system problems. But Intelligent and evidence based innovation policy therefore evaluates how innovation systems are functioning, tries to create insight in the system problems and develops policies accordingly. Although an actors, institutions, networks and technology are the common and the basic building blocks or components of proper innovation systems [13]. even if the Eastern Africa basic metal industries are infant stage of innovation, but they should use and adopt the building blocks of proper innovation system and procedures. Because technological adaptability results for adapt the process or systems continuously its technological systems according to different changing conditions. Since elegant results are increasingly integrated in manufacturing and production process, involving a leading-edge-technology with an aim to preserve, yet enhance the environmental quality. In this circumstance technological adaptability plays a major role to improve the production sustainable attributes. Since technological adaptability could be impact supply chain sustainability with, accessibility, affordability, healthy production and performance of manufacturing industries. Therefore, the analysis of this study extremely supported hypothesis H3. Thus, East Africa basic metal and engineering industries takes a general approach to adopt and use, trying to identify the proper systems and the developments of adaptable technological innovation that could be apply to in the regional basic metal industry as a whole. Also individual companies should investigate these trends with a focus on their specific product range and organizational aims.

Flexibility of technological innovation on Sustainable supply chain

Flexibility provides to give the organization more room and ability to respond quickly to unpredicted changes. Technology flexibility refers to the ease of modifying a new technology system for some special application environments. The previous study indicates that, novel technology flexibility could impact the standardization and encourage the information sharing, which is a most important factor influencing innovation systems [23]. We hypothesize that the higher flexibility of technological innovation level have impact on sustainable supply chain and the firm performance. Flexible technology on capability dimensions for product modification, versatility of manufacturing process, production volume, mix, physical distribution, demand management and strategy development is positively related to sustainable supply chain integration [24]. Inanition industrial innovation includes the technical design, manufacturing, management and commercial activities involved in the marketing of a new (or improved) product or first commercial use of a new (or improved) process or equipment. Since Innovation is the specific tool of entrepreneurs, the means by which they exploit change and opportunity for a different business or service. It is capable of being presented as a discipline, capable of being learned, capable of being practiced. Although flexibility, technology and innovation are some of the strategies that enhance supply chain integration in manufacturing industries [25,26]. Since currently, changes in the environment (socio-political, changing demand, etc.) are the cause for increasing uncertainty in the market place. In order to deal with this, flexibility, innovation in the supply chain becomes more and more important. As a result of this flexible technological innovation system is positively influence the sustainability of supply chain

integrations. However in the current globe due to the domination of information technology manufacturing equipment and machines have become so complicated that each are made up of different technologies. This complexity results improved technological innovation apply and used in the developed. Since to be globally competitive, developing nation (including Eastern Africa) basic metal industries integrates their systems in technology and flexible technological innovation.

Innovation and supply chain integration

Regardless of the significance of innovation, many developing country metal manufacturing industries have seen little attention for innovation and sustainable supply chain improvement in technological and productivity performance in recent years despite the new opportunities offered by globalization and new technologies, process, and system. However it is request to development of advances in technology, in conjunction with entrepreneurship and innovative approaches to the creation and delivery of goods and services, which translates manufacturing industries into scientific and technological advances, more productive economic activity as well. Since, supply chain integration provided evidence for their potential joint positive impact on competitiveness, efficiency and performance improvement on manufacturing industries [20]. Likewise innovation so as to leverages distinctive competencies in a manufacturing industry supply chain systems as a potential source of competitive advantage [2]. Also technological system for the industry provides to the technology itself, process and workflow, information exchange, job coordination and relationships, task configuration and relationships, rules and job feedback. This concept are the functions of proper supply chain managements. Directly or indirectly supply chain systems change and work with technological and technological changes in of the firms. However indicates that supply chain integration highly influenced by technological innovation and new technology commercialization.

From this theoretical study we found that, researchers widely studied the impact of supply chain integration with firm performance [16,20,24]. But limited study is conducted on the relation between supply chain integration with technological innovations [7]. Since the investigations on this study shows as a positive relationship between technological innovation with sustainable supply chain integrations have their own contributions to fill the previous research gaps. Accordingly to improve the firm performance and sustainability of manufacturing industries, in a complex systems of supply chains, it should be technologically integrated. Since these technological integration is vital means in order to achieve sustainable supply chain systems and enhancing firm performance.

Analytical Hierarchy Process (AHP)-Analysis

Under this section, the impacts of variables could be analyzed and tested in the relations with sustainable supply chain integrations. Since, the impacts of technological innovation performance, sustainability of technological innovation, adaptability of technological innovation and flexibility of technological innovation on sustainable supply chain integration was investigated (Table 1).

S.N	Name of Variables	Percentage Values	Result
1	Performance of technological innovation	35.19%	Sustainable supply chain integration
2	Flexibility of technological innovation	26.77%	
3	Sustainability of technological innovation	22.35%	
4	Adaptability of technological innovation	15.69%	

Table 1: Alternatives variables (independent variable) ranking.

The Table 1 indicates that there were statistically significant differences the impacts of variables on sustainable supply chain integrations. However, AHP analysis result was used to determine differences between specific variables on sustainability of supply chain integrations. As a result the higher value of the variables indicated in the above tables have highly positive impact on sustainable supply chain integrations. This indicates that sustainability of supply chain integrations is more strongly related to the performance of technological innovation the other. This means that, if the performance of technological innovation is weak, the sustainability of supply chain integration also reduce. The reverse of this concept is true. Followed, by flexibility, sustainability and adaptability of technological innovation have positive impact on supply chain integration from the higher to the lower influences levels respectively. Since, in addition to theoretical results, this empirical as well confirms the research hypothesis, H1, H2, H3 and H4.

AHP result (ranking) on the impacts of technological innovation on sustainable supply chain integration (Table 2).

This empirical result shown in the table above, the performance of sustainable supply chain integration (such as information, shearing, resource utilization, sustainability of firm, technology and knowledge transfer, production capacity, product improvement capability) highly affected by the performance of technological innovations. Since good technological innovation systems have a positive impact on sustainable supply chain integration on basic metal industries (Table 3).

The above table shows that, the major variables of sustainable supply chain integrations such as were affect the final performance of supply chain integration in terms of information shearing, resource utilization, technology (adaptability, utilization, level) and knowledge transfer and supply chain sustainability. Thus H1, H2, H3 and H4 in the same way sustainable supply chain integration is positively and significantly related to the four technological performance capabilities. Therefore the research hypothesis (H1, H2, H3 and H4) were supported.

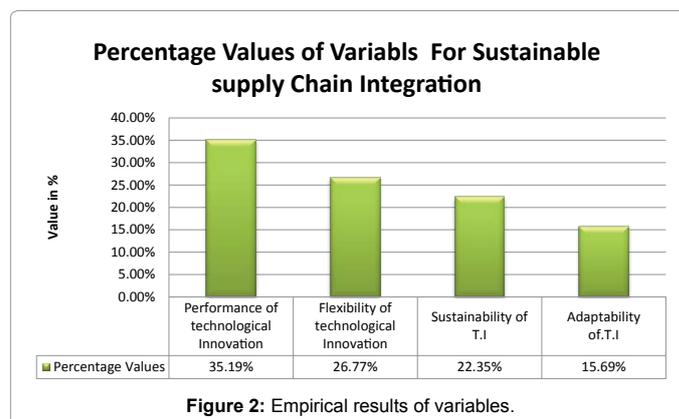
Graphical representation of variables the impact supply chain integrations (Figure 2).

The above graphical result shows that, the performance, flexibility, sustainability and adaptability of technological innovation is directly and positively influences sustainable supply chain integration on

manufacturing firms. This confirms by the previous study in a such a way that organizations with high innovative capacity might be likely to exchange more knowledge as a facilitator for supply chain integration by adopting integrated information systems so that other supply chain partners are satisfied, which may in turn enhance interdependence. Even though the level of those technological innovation variables that impact supply chain integrations are different one to other [7]. Since our theoretical findings supports by this empirical results, displayed in the figure above. However our findings provides to insights developing effective approaches for technological innovations with relation to supply chain integrations systems in manufacturers. Since the significant finding is that sustainable supply chain integrations is influenced by the level and type of technological innovativeness in supply chains firms.

This study assures that effective and technological innovation systems have as a potential vehicle for supply chain integration on manufacturing industries. Thus basic metal industries should stimulate technological innovation in their supply chains systems, to provide as a self-indicative progress tool for enhancing the sustainability of supply chain integrations.

Additionally to improve the competitiveness (in terms of innovation, technology, resource utilization, sustainability, health, education level, etc.) and enhancing the performance of firms, manufacturing industries apply numerous improvements systems and techniques. Given that, most of the time the performance improvement is achieved



Strong relation	Information shearing	Resource utilization	Sustainability	Technology and knowledge transfer	Production capacity and product improvement
Adaptability of technological innovation	14.04%	17.50%	15.34%	13.81%	16.45%
Flexibility of technological innovation	33.97%	28.94%	24.14%	27.61%	21.28%
Sustainable technological innovation	23.90%	24.63%	23.35%	19.53%	19.03%
Performance Technological innovation	28.08%	28.94%	37.18%	39.05%	43.24%

Table 2: Alternative-main criterion-matrix that impacts on sustainable supply chain integration.

Strong relation	The performance of technological innovation will have positive impact on sustainable supply chain integration	Flexibility of technological innovation have an impact on sustainable supply chain integration	Sustainable technological innovation have direct and positive impact on sustainable supply chain integration	The adaptability of technological innovation have highly impact sustainable supply chain integration
Production capacity and Product improvement	Consistency ratio: 0.04			
Information shearing	Consistency ratio: 0.02			
Resource utilization	Consistency ratio: 0.02			
Technology and Knowledge transfer	Consistency ratio: 0.04			
Supply chain sustainability	Consistency ratio: 0.05			

Table 3: The performance evaluation criteria.

by implementing appropriate improvement tools for manufacturing industries [27].

Key Elements and Procedures for the Conceptual Framework Development

A conceptual framework is defined as a network or a “plane” of linked concepts. Conceptual framework analysis offers a procedure of theorization for building conceptual frameworks based on grounded theory method. Although the advantages of conceptual framework analysis are its flexibility, its capacity for modification and its emphasis on understanding instead of prediction [28]. However, the drivers of supply chain innovation are the factors that motivate and in some cases force companies toward adopting innovations in the supply chain. According to the previous study shows that ,the main drivers identified in the following three groups [21]:

Market domain

The globalization of markets. This implies competition that is no longer limited to local or regional environments, but instead takes place in global markets with global competitors.

Business domain

The product variety of the company. It serves as a proxy for the level of complexity and for a crisis related to business policies rather than external factors, which the company must be able to handle to be competitive in the marketplace.

External domain

The impact from external factors. This includes governmental support and stakeholder pressures. Innovation is achieved through financial incentives, financial resources or training program since, some authors address the importance of the external context of the company's competitive situation and its competition, as this context can influence the new investments and efforts necessary for a specific supply chain innovation [29]. However, as we have discussed and shown in the previous study, improvement model development is follows the following approaches [27]:

1. Implemented/Adopted the existing tools and models to manufacturing or business sectors. for example apply from one of the following, business model and innovation, technology adoption cycle, technology push, they used by the firms to improve the systems.
2. Sequence implemented or used the existing models in such a way, first to use one model as improvement programs and used as an aids companies to achieve fretful improvement results [30]. If this tool not the achieve the whole improvements, we can be implemented additional to one or more approaches, systems or model so as to improve the business performances. Since in one manufacturing industry use two improvement tools sequentially in order. For example, first they use technology adoption cycle and then apply technology push models.
3. By integrating two or more continuous improvement approaches or tool to use in the industry as a means of improvement systems or models. In addition to this in research work, we are incorporates the next concepts. For example integrating the phase gate model with technology push. Since there are feedback loops and time variations between steps, and establishes readiness criteria for moving between major

phases of innovation development are enhancing by the phase gate model. Afterward technology push provides small change from the linear model where marketing and sales is added after production. Thus to integrating this together we developed power full models for technological innovations.

4. A model is developed based on the existing facts and context to chive the firm goals. Since facts-based practice usually represents a decision-making process centered on justifications of relevant information's. Where as context allows filtering out more useful information. Although the uses the filtering of contextual information to support evidence-based decision making in the area of crime prevention is presented to validate the framework. As a result in this study it is possible to follow the fourth option and to develops technological innovation models to achieve sustainable supply chain integrations. Although The technological innovation system is provides a concept developed within the scientific field of innovation cram which serves to explain the nature, the subsistence, progress and rate of technological change. As a consequence the technological innovation used as weapons for supply chain integration framework should concerns in points and ideas. Since based on field study, literature reviews, assed technological innovation conceptual framework development should consists the following points.

A. Technology (Level, innovation, integration, cooperation and collaboration) process in a supply chain firms either in the internal or external level. As we know that the technology encompasses fundamentally, tools and instruments to enhance human ability to shape nature and solve problems (such as a airplane, lathe machine and nail), knowledge of how to create things or how to solve problems (such as how to make planes, how to constructs ships, to make an atomic bomb) and culture (our understanding of the world, our value systems) [31]. This concepts directly or indirectly related to environment and sustainability. Since the level of technology strongly influence the development of sustainable supply chain integrations with technological innovations. Since level of technology and innovation having been recognized as the means for creating and sustaining competitive advantage within an increasingly complex and changing environment, it has become essential for organizations to proactively strive towards consistent and persistent, innovation.

B. Benchmarking and Environment either innovation or the technology itself or the supply chain process, should considered healthy environments. the integration process and technological improvement should be in line with sustainable and mutual benefits from the present to the coming generations for constraining resources. Hence the integration process controls natural and manmade disasters as a controllable ranges. while Benchmarking also a critical tool to, when to develops a new models either considering the performance of the bench-marked one's or incorporating the missed pointes for the existing conditions. This means that the establishment of an innovative business or services or the improvement of accessible ones can be viewed as a continuing process improvement rather than a fixed fact. By focusing on the gap between where your company is and where it needs to be, priorities are set for making improvements. Since benchmarking provides for model performance improvement systems by analyze and improve your processes, enhance performance, gather the information we needs to assess our present and plan our future, identify some better approaches to accomplish our mission, vision and goals. Thus benchmarking can be part of the initial stages of planning, as you assess

current performance and set goals for improvement. This can also be part of the accomplishment of strategies, as you study outstanding organizations for alternative approaches to how your unit does its work.

C. Firm type and Strategy The business area provide to serve their and sensing customer needs, engaging with those needs, delivering satisfaction, be competitive to the market, improve their performance trough proper modes, contribute to the GDP .Since this achieve by using proper technology and enhancing technological innovation in the sector. Thus technological innovation process and activities should be linked with the goal and mission of business sectors (industries). There for technology and innovation should be use as a vehicle to solves the problem of customer needs, improving the quality of the product, enhance mutual benefits between the firms, environmental friend, improve competitiveness of the firms. This concept is supported by the previous study technology development can facilitate new business approach's the most obvious historical example is way the invention and development of steam power facilitated the mass production business model [32]. Also in a highly competitive environment, technological innovation is the essential key to a firm obtaining a dominant position and gaining higher profits. Consequently, to meet the strategies of the country, it is crucial to know which technological innovation systems and practices lead to success is very important (Figure 3).

Since this conceptual framework establishes technological innovation systems on basic metal industries to enhancing sustainable supply chain integration and firm performances. Because this conceptual

framework is a coherent system to enhance technological innovation between firm organizations [33-35]. As the framework indicates that, the application and adoption of technological innovation in lies with competitiveness of the firm, globalization, customer, ecological point of views. Because the suitability or competitiveness of the organization always under this concepts, as a result this model mainly considered these. Although the driving gear of manufacturing industries to reach sustainable supply chain integration cons ties on technologic, benchmarking and environment issue, and firm type and strategy (firm, country). Since, to accomplished the ultimate goal of any manufacturing industries, the above three points are the main things and power full ingredients to make outputs. Since this framework used as vehicle for the manufacturing industries to begins achieve sustainable supply chains gradually rather than drastically. Thus in the performance evaluation ion stage, the contribution of the improvement system should be evaluated whether the companies are improve their competitive advantage, recover their performance, improve sustainability and attain their expectation or not. If the evaluation is in a good condition, manufacturing industry approaches to over all organizational performance and business Success, sustainability. Doing so, depending on the industry standpoint they apply different performance evaluation/measurement systems.

Conclusion

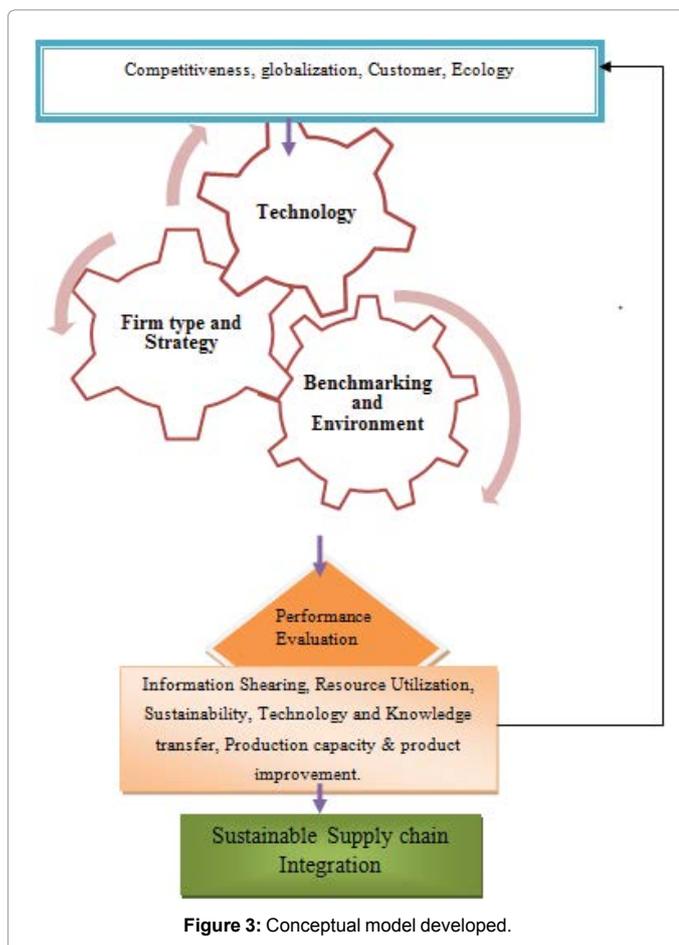
This investigation indicates that, there was a considerable positive relationship between sustainable supply chain integration with technological innovation, sustainability, performance and flexibility of technological innovations of basic metal industry. Improving the extent and the level of technological innovation in different context is to ensures sustainable supply chain integration on basic metal industries [36].

Since to secure sustainability, individuals, organizations, firms and nations should be work to mutual benefits. As the study indicates that, developed and developing world basic metal industries imperative the efficiency, they integrate their systems in line to cooperate in solving the environmental, social, economic problems, achieve sustainable growth, enhancing mutual benefits from the common world [18]. This sustainable benefit are assured by sustainable technological innovation systems. Subsequently, this study has contributed to a new model which spread out sustainable supply chain integrations contexts, whereby shows the direct and positive relationships between sustainable supply chain integration with technological innovations. Since this model contributes the improvements long-term cooperation and competitiveness on the supply chain firms.

In conclusion, this results propose that strong technological integration is highly improve the performance of supply chains integration sustainability and firm performance but it is requires high cooperation and collaboration from individual level to firm and country wide. In addition under different circumstances specific integration practices or patterns might be required for supply chain sustainability.

Recommendation

A detail study of technological innovation impacts on sustainable supply chain integrations were investigated and this have potentials approach for further investigations of other optimization and improvement tools. Since, is recommended to study the relation between on technological innovation with quality in specific, how integrate these two concepts to improve manufacturing industry performance needs for further research.



Acknowledgement

My spirit thanks goes to almighty GOD at first because I did it he kept me alive and thereby to my supervisor prof. Frank Ebinger in supporting and giving this opportunity to take action on writing this papers. The other thank goes to my dear colleagues who supported me in idea sharing while we were doing together our work through similar formatting. My grateful thank goes to editor-international journal of swarm intelligence and evolutionary Computation editorial assistant, reviewers, editors and the publishers/OMICS Internationals well give this opportunity to work with me. Managers, engineers of selected Ethiopian manufacturing industries and related organizations and team providing all necessary documents and support on basic metal industries in Ethiopia and other Institute staffs for their collaboration, as awhile in providing any information I requested.

References

- Rosil MM, Sidek S (2013) The impact of innovation on the performance of small and medium manufacturing enterprises evidence from malaysia. J Innovat Manage Small Medium Enterprise 2013: 1-16.
- Taylor G, Rhey W (2008) Strategic supply chain innovation: A strategic management perspective for business education. Calif J Oper Manage 6: 109-114.
- Forum WE. The global competitiveness report 2013-14.
- Muzeyin M (2014) Enhancing the competitiveness of ethiopian steel manufacturing industrie. Addis Ababa University Insititute of Technology, Ethiopia.
- Lemma Y, Kitaw D, Gatew G (2014) The impact of foreign direct investment on technology transfer in the ethiopian metal and engineering industries. Int J Sci Technol Res 3: 242-249.
- Rakhman A (2016) The effect of supply chain integration, supply chain flexibility and supply chain management practices on competitive advantage and their performance moderated by environment uncertainty in manufacturing industry go public in jabodetabek. Int J Arts-Based Educational Res.
- Kwak DW, Dinwoodie J, Seo YJ (2014) The impact of innovativeness on supply chain performance: Is supply chain integration a missing link? Supply Chain Manage: An Int J 19: 733-746.
- Hana U (2013) Competitive advantage achievement through innovation and knowledge. J Competitiveness 5: 82-96.
- Lahovnik M, Breznik L (2014) Technological innovation capabilities as asource of competitive advantage: A case study from the home appliance industry. Transform Bus Econ 13: 144-160.
- Barbara BF, Huo B, Zhao X (2010) The impact of supply chain integration on performance: A contingency and confugeration approch. J Oper Manage 28: 58-71.
- <http://www.heldref.org/env.php>
- Banomyong R (2005) The impact of port and trade security initiatives on maritime supply-chain management. Marit Pol Manag 32: 3-13.
- Evangelista P, McKinnon A, Sweeney E, Esposito E (2011) Supply chain integration: Challenges and solutions. In: Supply chain innovation for competing in highly dynamic markets challenges and solutions, National Institute for Transport and Logistics.
- Mannan B, Khurana S, Haleem A (2015) Technological innovation challenges and opportunities in India and the developing countries. Annual IEEE India Conference (INDICON).
- Roy SC, Kar S (2015) Globalization of technological innovation: Challenges and opportunities.
- Nazzal MNS (2016) The effect of supply chain integration on sustainable development of jordanian phosphate fertilizers manufacturing companies. Middle East University, Jordan.
- Dahlman C (2006) Technology, globalization and international competitiveness: Challenges for developing countries. Industrial Development for the 21st Century, New York.
- Diaconu M (2011) Technological innovation: Concept, process, typology and implications in the economy. Theor Appl Econ 18: 127-144.
- Incea H, Imamoglu SZ, Turkcan H (2016) The effect of technological innovation capabilities and absorptive capacity on firm innovativeness: A conceptual framework. Proc Soc Behav Sci 235: 764-770.
- Dametew AW, Ebinger F, Abebe BB (2016) Supply chain integration for improving performance on manufacturing industries. Global J Res Eng: J Gen Eng 16: 21-33.
- Vallack H, Timmis A, Robinson K, Sato M (2011) Technology innovation for energy intensive industry in the United Kingdom. Centre for Low Carbon Futures.
- Hekker M, Negro S, Heimeriks G, Harmsen R (2011) Technological innovation system analysis. University of Uterchet Copernicus Institute for Sustainable Development and Innovation.
- Li B (2015) The effects of new technology flexibility on innovation performance in the post implementation age. Int J Bus Soc Sci 6: 22-27.
- Beng JM, (2009) Supply chain flexibility aspects and their impact on customer satisfaction. Open University the Netherlands.
- Kopecka J, Penners G, Santerna S (2009) Flexibility in supply chain management. Work in Progress Paper.
- Taylor P, Quintas P, Storey J, Tillsley C, Fowle W (2000) Flexibility, networks and the management of innovation.
- Dametew AW, Kitaw D, Ebinger F (2017) The roles of TQM and JIT for basic metal industries global competitiveness. Ind Eng Manage.
- Jabareen Y (2009) Building a conceptual framework: Philosophy, definitions and procedure. Int J Qual Method.
- Bello UM, Madekurozwa MC, Groenewald HB, Aire TA, Arukwe A (2014) The effects on steroidogenesis and histopathology of adult male Japanese quails (*Coturnix coturnix japonica*) testis following pre-pubertal exposure to di(n-butyl) phthalate (DBP). Comp Biochem Phys C 166: 24-33.
- Kai Y (2014) Continuous improvement in global competitiveness arena, conceptual framework for integrating JIT in TQM implementation program. School Mech Ind Eng (SMIE).
- Vergragt PJ (2006) How technology could contribute sustinable world. GTI Paper Series-8, USA.
- Baden-Fuller C, Haefliger S (2013) Business models and technological innovation. Long Range Plann 46: 419-426.
- Vasant P, Voropai N (2016) Sustaining power resources through energy optimization and engineering. IGI Global.
- Vasant P (2015) Handbook of research on artificial intelligence techniques and algorithms. IGI Global.
- Vasant P, Barsoum N, Webb J (2011) Innovation in power, control and optimization: Emerging energy technologies. IGI Global.
- Vasant PM (2014) Handbook of research on novel soft computing intelligent algorithms: Theory and practical applications. IGI Global.

Citation: Dametew AW, Ebinger F (2017) Technological Innovations as a Potential Vehicle for Supply Chain Integration on Basic Metal Industries. Int J Swarm Intel Evol Comput 6: 159. doi: [10.4172/2090-4908.1000159](https://doi.org/10.4172/2090-4908.1000159)

OMICS International: Open Access Publication Benefits & Features

Unique features:

- Increased global visibility of articles through worldwide distribution and indexing
- Showcasing recent research output in a timely and updated manner
- Special issues on the current trends of scientific research

Special features:

- 700+ Open Access Journals
- 50,000+ editorial team
- Rapid review process
- Quality and quick editorial, review and publication processing
- Indexing at major indexing services
- Sharing Option: Social Networking Enabled
- Authors, Reviewers and Editors rewarded with online Scientific Credits
- Better discount for your subsequent articles

Submit your manuscript at: <http://www.omicsonline.org/submit>