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Article · January 2015

DOI: 10.11648/j.ijsts.20150304.15

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International Journal of Science, Technology and Society
2015; 3(4): 124-131
Published online June 3, 2015 (http://www.sciencepublishinggroup.com/j/ijsts)
doi: 10.11648/j.ijsts.20150304.15
ISSN: 2330-7412 (Print); ISSN: 2330-7420 (Online)

Development of Indigenous Engineering and Technology in Nigeria for Sustainable Development Through Promotion of Smes (Case of Design of Manually Operated Paper Recycling Plant)

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To cite this article:

Adefemi Adeodu, Ilesanmi Daniyan, Charles Omohimoria, Samuel Afolabi. Development of Indigeneous Engineering and Technology in Nigeria for Sustainable Development Through Promotion of Smes (Case of Design of Manually Operated Paper Recycling Plant). *International Journal of Science, Technology and Society*. Vol. 3, No. 4, 2015, pp. 124-131. doi: 10.11648/j.ijsts.20150304.15

Abstracts: Existence of small and medium scale businesses are essential to the growth and sustenance of any economy. SMEs serve as propellant to the development of large existing industries. Nevertheless, the rate of failure of SMEs globally is alarming. Notable in Nigeria as a case, the economy is suffering from structural defects and remains a consumer economy as a result of failure of indigenous engineering personnel to understand and take the lead role to process and utilize abundant natural resources for industrial development of the country. This paper presents an overview of development of indigenous technology in Nigeria through promotion of engineering based SMEs as a capacity building strategy for sustainable development and poverty alleviation. It is concluded that in order to achieve meaningful economic development and sustenance in developing nations like Nigeria, application of indigenous technology through promotion of engineering based SMEs should be considered. Also increase awareness among the public, policy maker and industrialist on the pivotal role of science and technology plays in national development.

Keywords: Commercialization, Indigenous Engineering, Innovations, Sustainable Development, SMEs

1. Introduction

1.1. Indigenous Technology Knowledge as an Engine for Sustainable Development

Sustainability addresses effectively the equity deficit of environmental sustainability [1]. Sustainability is a process which tells of a development of all aspect of human life affecting sustenance. It involves resolving the conflict between the various competing goals and simultaneous pursuit of economic prosperity, environmental quality and safe technology [2]. Sustainable development seeks to ensure better quality of life now and into the future in a just and equitable manner whilst living within the limits of supporting ecosystem [3]. On the other hand, capacity building involves diagnosing several challenges that prevent people, governmental and non-governmental organizations from achieving their developmental goals while helping them acquire competent and versatile skills that allow them achieve sustainable results.

Some of the challenges bedeviling third world have been identified as: inefficient use of available resources (human, financial, material etc.), low human capacity building, absence of good and safe infrastructure, and epileptic power supply amongst others. The resultant plaques are poverty and disease, environmental degradation and pollution, mass unemployment, poor quality of life, mass crime and insecurity just to mention a few. Great uncertainties surround the survival of both present and future generations in the third world as a result of growing population, food shortages, poor resource control, severe effects of environmental changes due to environmental pollution, fast depletion of

available resource, fuel scarcity, fluctuation of fuel prices etc. Hence, the need to stem the tide and increase security in critical sectors so as to sustain and increase the standard of living while averting its devastating effect on the economy, human health, quality of life etc.

The use of indigenous engineering and technologically based viable alternatives to transform key sectors for wealth creation in the third world while developing competent, resourceful and skilful man power that can add value cannot be over emphasized.

Sustainable development is an evolving process which involves the judicious use of available resources to create wealth, raise the standard of living of people, and enhance economic and social prosperity for both present and future generations in a secured environment [4]. It means the balancing of economic, social, environmental, and technological considerations, as well as the incorporation of a set of ethical values [5]. Modern indigenous engineering and technological inventions if prudently exploited will minimize waste and maximize value in critical sectors [4]. The goal of building human capacity is to inhibit challenges relating to policy making, sustainable development and method of development while considering the potentials, limits and needs of the people. The gap between what higher institutions offer and the demands of the labour market is widening by the day. Graduates are more exposed to theory than the practical aspects of their training. A careful appraisal of university education in the third world shows that there are not enough facilities for students. Engineering students are confronted with obsolete training equipment. Laboratories are either not well equipped or are unable to meet modern standard. The world is embracing a knowledge-based economy. Therefore, third world should toe the path of countries in Europe and the United States in the quest for sustainable development and also in the area of acquiring more knowledge for economic growth. Some of such technologies developed include post harvest food processing, industrial minerals beneficiation, textile and ceramic utilization, water treatment; electrical and electronic design and fabrication, plant tissue culture, application of nuclear energy and energy generation from biomass.

1.2. Challenges of the Application of Indigenous Engineering and Technological Discoveries

The following were the challenges experienced with regard to application and development of indigenous engineering and technological discoveries:

- Lack of appreciation of the role of indigenous engineering and technology in national development by policy makers and the general public as they were viewed to be inferior to foreign technologies
- Inadequate financial and material support to institutions mandated by Government to facilitate the application of scientific and technological discoveries
- Most research and development activities were conducted in isolation from industry and this resulted in research outputs not being taken up by industry.

1.3. The Way Forward

In order to solve problems militating against the application of indigenous engineering and technology, the following considerations should be made:

- increase awareness amongst the public, policy makers and industrialists on the pivotal role engineering and technology plays in national development;
- Government must strength the capacity of its institutions to promote the application of indigenous engineering and Technology in the nation; and
- Lobby Government to increase its financial obligation to the engineering and technology sector.
- A comprehensive proactive policy framework is the best way to conserve indigenous knowledge that has helped produce, use and maintain diversity in the region.
- A strong sustainability connection exists between indigenous and modern knowledge

1.4. Converting the Challenges into Opportunities for Growth Through Innovation

The above scenario can be overcome by looking forward for a fruitful collaboration with advanced countries for technology commercialization. Since technology failure is a global phenomenon. Even in the most advanced countries the success rate is 30-35%. In addition, the obsolescence of technology is a real threat to technology failure. Furthermore, the release of alternate products to the market as well as the power, capability and penetration of the market by promoters are also threats. In Nigeria, tying up the balance finances with other financial institutions is hog in the' development and commercialization of indigenous technology in Nigeria. The speed of innovation, promotion of indigeneity in new ventures cannot be stopped or slowed down just on the plea of threats of speed breakers being on the road. The technology commercialization gets acceleration due to globalization. There is an apparent dearth of engineering and technology entrepreneurship capital in Africa, a situation that has led to the near non-existent productive capacity of the continent, with very minimal potentials for value addition [6], [7]. The result of the foregone scenario is low capacity for wealth creation and increasing levels of unemployment. Entrepreneurship (especially technological entrepreneurship) and innovation (technological innovation) are the twin pillars of socioeconomic development in this modern era.

Since, knowledge and innovation are two key drivers for sustaining economic growth in the 21 century. Nigeria will have to key in to harness its strong engineering and technology foundational ecosystem to industry-relevant research with a strong focus on commercialization, and to extend the ecosystem to facilitate innovation and enterprise development. The areas expected to be covered in this paradigm include: human capital development, agriculture, industrial growth, health, environment, energy, banking and finance, information and communications technologies, women and youth empowerment, job creation, tourism, trade, science acculturation, natural resources management,

building and construction, national security, nuclear science and technology, sports and recreation, diplomacy and transport management among others.

This can be achieved through three broad priorities include:

- Boosting skills in every job via a comprehensive national effort to boost productivity and make enterprise innovation pervasive, supported through both broad based and targeted sectoral programmes.
- Deepening corporate capabilities to seize opportunities in Africa, entrenching Nigeria as the essential base in Africa for both multi-national companies and global small and medium enterprises through increasing private sector research and development (R&D) expenditure, developing stronger alliance to promote technology transfer, test-bedding and commercialization, and helping SMEs develop multi-national companies and global SMEs.

Small and Medium Enterprises constitute a significant part of most economies valuable contributions to its growth through innovation and competition. SMEs form proportion of enterprises of most developed and rapidly developing countries because of their contribution to GDP, employment and socio-economic development. Given their limitations of size and resources, SMEs need special attention and assistance to survive and compete in the global market place. Technology Business Incubation therefore becomes a constructive intervention process to establish a positive environment that can nurture technology-based SMEs for sustainable development.

1.5. Concept of Small and Medium Scale Enterprise

An enterprise is a project, an undertaking, a company, or an individual that is engaged in one form of economic activity or the other, with the aim of producing some goods or services for sale to others [8]. The definition of the size of the enterprise and their classification into micro, small, or medium has been generally based on criteria such as volume of sales turnover, number of workers in employment, or value of assets and investments [9]. Other definitions of the term small and medium enterprises (SMEs) vary from country to country. And also varies between the sources reporting SME statistics. The commonly used criteria at the international level to define SMEs are the number of employees, total net assets, sales and investment level [8]. If employment is the criterion to define, then there exists variation in defining the upper and lower size limit of a SME [10]. For instance in Australia, a small business is defined by the Fair Work Act 2009 as one with fewer than 15 employees. By comparison, a medium sized business or mid-sized business has fewer than 500 employees in the US, and fewer than 200 in Australia [8].

In Nigeria, there have been different definitions of SMEs by different institutions. These institutions include the Central Bank of Nigeria (CBN), the Small and Medium Industries Equity Investment Scheme (SMIEIS), the Nigerian Institute for Social and Economic Research (NISER), Federal Ministry of Industry (FMOI), the National Association for Small and Medium Enterprises (NASME) and the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN). For instance, a SME has been defined by CBN as an outfit with a total capacity outlay (excluding land) of between N2 million and N5 million, while SMIEIS recognizes an SME as any industry with a maximum asset base of N200 million, excluding land and working capital, with the number of staff employed by the enterprises not less than 10 and not more than 300 [11]

Table 1. *Classification of Nigerian SMEs adopted by the National Policy on MSMEs.*

S/N	Size Category	Employment	Assets (N Million) (Excluding Land And Building)
1	Micro Enterprises	Less Than 10	Less Than 5
2	Small Enterprises	10-49	5 Less Than 50
3	Medium Enterprises	50-199	50 Less Than 500

Source: [8]

1.6. Role of SMEs in Nigeria

The role of small and medium scale industries in developing countries, Nigeria in particular is progressively becoming elaborate. It is highly imperative that all available resources in any given situation in the economic well-being of a nation must be developed for industrialization and ultimately consumption through the small and medium scale businesses [8]. Hence the impact and potential contribution of small and medium scale business base as well as their accelerated effect in achieving macro-economic objectives pertaining to full employment, income distribution and the development of local technology makes the existence most inevitable [8]. Therefore, the importance of small and medium scale industries in particular to the general economic development of any nation especially a developing one like Nigeria cannot be overemphasized [12]

According to SMEDAN the following give some key roles of the small scale enterprises sector in Nigerian in actual terms.

i. Economic Contribution: The overall economic activities of small and medium enterprises in Nigeria have been estimated to amount to less than ten per cent of the country Gross Domestic Product (GDP) (SMEDAN 2006).
ii. Enterprise Creation: As in most parts of the world, micro, small and medium enterprises currently represent about 87% of enterprises in the country (Chemonics International report for PRISM for USAID)
iii. Employment Generation and Poverty Reduction: in spite of valid data, Nigeria lacks adequate census on relevant economic indices, it is estimated that Small and Medium Enterprises in Nigeria currently account for

over 75% of employment in the country [13].This relatively high percentage is however a paradox as 60% of Nigerians still lives below the poverty level [14]. When the 26 percent of Nigerians that are unemployed and 60 percent living below the poverty line are taken into account the share those gainfully employed in the SME sector is more likely to be in the region of 10% as recorded by US Industry Small Business Administration (SBA)

iv. Export Earnings: The contribution of SMEs to the nations export earnings is a dismal 2%. This shows the lack of competitiveness of Nigeria's SME sector in this regard

1.7. Problems Facing the Growth and Development of Nigeria Engineering Base Small and Medium Scale Enterprises

Although SMEs are seen as veritable and viable engines of economic development, the growth and development of SMEs in Nigeria have been hindered due to challenges confronting this all-important sub- sector of the economy. The poor performance of SMEs in Nigeria relative to their counterparts elsewhere by revealing that although about 96% of Nigerian businesses are SMEs compared to 53% in US and 65% Europe, average they contribute approximately 1% of GDP compared to 40% in Asian countries and 50% in both US and Europe [15].

The major challenges that SMEs are faced with, in bracing up to operating in a challenging business environment are briefly enumerated below:

i. Poor Infrastructure: Poor infrastructure is definitely the most significant contributing factor to the critical state of the SME sector. Energy supply is epileptic, bad road networks; rail lines are non-functioning. In addition to high operating costs arising from infrastructural deficiencies, SMEs also have to contend with the high cost of imported raw materials, equipments and spare parts. Thus SMEs are uncompetitive when it comes to pricing and are faced with stiff competition from cheaper imported goods. Thus, infrastructural inadequacies contribute well above 30 percent to the cost of doing business as revealed in a recent study by MAN.

ii. Funding Constraints:
Inadequate funds: Apart from the insufficiency of funds to match the financing needs of SMEs, specialized funding windows are non-existent. Most developed and emerging countries long ago realized the intricacies of business start-ups, the peculiarities of business slips, the imperatives of credit guarantees and export promotion and the need to make them more resilient [8]. Such countries had taken measures to ensure specialized funds and windows were available to SMEs for each of the stages and aspects of SME development. Nigeria is yet to adopt such practices in SMEs development.
Poor access to funds and advisory services: Access by SMEs to the limited funds available is impaired by their short tenure and high interest rates. This is hardly surprising since these funds, which should ideally have medium to long term tenures, are not tailored to SMEs. Securing of loans from the Banks and Financial institutions takes time and in most cases only exists on paper. Many banks require the satisfaction of much conditionality before loans are granted, and the small scale industries find it difficult to secure the loans [16]. Leading banks are not committed to granting SME loans probably because most of them are cash collecting centers with insufficient enough staff, specialized in appraisal and management of SME funding, capable of providing the requisite advisory services associated with SME funding.

iii. Weak Corporate Governance, Management and Accounting Practices: Most SMEs, especially at the micro level, are privately funded and privately owned. Management is at the whims and caprices of the owner and accounting books are not professionally kept. There is little dichotomy between personal and enterprise funds and some SME proprietors deliberately divert loans obtained for project support to ostentatious expenditure. Auditing is only functional to satisfy regulatory demand, where one exists, is often manipulated to avoid taxation and is of no value in enhancing managerial competence. Workers, in most cases, are disregarded and usually work in appalling working conditions hence motivation is low. Key management positions are not subject to merit but are usually occupied by relation of the owner. All these translates to absence of business planning and the non-existence of actual planning strategies makes it difficult to remain firm in changing, dynamic and every unpredictable economic and business condition [16]. These problems retard growth and development of Small Scale Enterprises.

iv. Social Responsibility Issues: The operations of all SMEs contribute to environmental hazards in some form or the other. Unfortunately most SMEs are ill equipped to carry-out environmental impact appraisals of their activities and fail to meaningfully engage host communities in dispute and conflict resolution consequent on their activities. In many cases, social responsibility activities are constantly dislocated resulting in loss or closure of the enterprise.

v. Poor Business Partnership/ Alliance Culture: SMEs are typically linked to more than one business or sector of the economy usually as suppliers. However there is usually a lack of mutual trust amongst business partners. SMEs should be encouraged to create strategic win-win relationships to develop certain aspects of their operations or supply chain and thus grow their activities/businesses. To increase the quality of their products and services and thus their competitiveness, they should also be encouraged to develop links with R&D institutions and partner to leverage more modern technologies.

vi. Low Human Capital development: Entrepreneurial skills are poor and insufficient to drive and sustain the sector. SMEs are not equipped with technical management, marketing and ICT capabilities as a result of the low level of training of their operatives. Regular failure to upgrade technical competencies through training results in poor utilization of available technology.

vii. Low Level of Technology: Many SMEs still employ labour intensive production processes, particularly in the agricultural sector. Also in manufacturing, the use of ICT to enhance productivity is limited. Equipment and machinery are in most cases obsolete and cannot cope with modern challenges.

viii. Institutional Support:

Poor Policy framework: Although a policy on SMEs exists, it is lacking in comprehensiveness.

Lack of coordination among various programmes: Coordination amongst the various SMEs related programmes are not coordinated and there seems to be no deliberate effort to dovetail activities to meet specific SME needs such as the commercialization of Research and Development findings, upgrading of SME products and services, enhancement of productivity, provision of assistance to participate in trade missions etc.

Absence of linkage programmes: There are yet any programmes to forge inter-firm linkages amongst SMEs and between SMEs and multinationals. The local content policy needs to be strengthened, training of SMEs in new skills needs to be encouraged and quality control facilities, targeted at suppliers to large firms, need to ensure specifications are met.

Inadequate legal framework: The country's legal framework brings under its ambit, business registration, recognition of individual property rights and dispute resolution. However provisions within this framework are not regularly updated to reflect the current reality and hence are unsupportive of SMEs development. The present framework to grow the SMEs sector in ineffective; hence there are more SMEs in the informal sector than formal.

1.8. Development of Small and Medium Scale Enterprises in Nigeria

To facilitate the growth and development of small scale enterprises in a country or in a region, it is necessary to identify those creative branches that have a potential for growth, their location in the country or region, and to quantify their potential for inducing socio-economic growth [8].

The environment in which SMEs in Europe, South East Asia and America operate provides stable power and water supply, standard road and rail network, efficient water and air transport system, advanced technology, modern communication facilities, efficient and responsive financial system, and above all good governance. Unless Nigeria puts its policies right, many SMEs may not survive this competitive drive. The following are the suggested tips to assist in creating the enabling environment for development, competitiveness and growth of SMEs in Nigeria.

- Financing Small and Medium Scale Enterprises: Creative businesses can sometimes access funds/benefits from such sources as personal investments, grants for promoting creativity, for business start-up, private R&D spending, tax deductions, loans and philanthropy, amongst others. However, as may be expected the lack of financing is impeding the growth of the sector, even in developed economies. The capital required for the development and implementation of promising ideas is frequently lacking.
- Availability of Research Findings: The system of making available the results of research institutions in new production techniques to SMEs through extension outreach for popularization, demonstration and adoption should be further strengthened. This will reduce cost of production, distribution and marketing, which will raise competitiveness, allow expansion and create more jobs. A well established and operational Business incubator system should be supported to warehouse critical data and information on these results, as well as locally available raw materials and their uses.
- Fiscal Incentives and Support through Tax Rebate: for SMEs that put effort on local sourcing of raw materials, serious in adding value to commodities for exports and other business ethics, which government may wish to foster. Similarly, government could increase funding for the development of the sub-sector through direct budgetary allocations and enhance private sector investment opportunities that will focus on specific areas of capacity enhancement.
- Infrastructural Development: Develop and upgrade rural/urban road and rail network, water and air transport system, and communication infrastructure by Government and the private sector
- Cluster Formation: encourage networking among SMEs operators and use of shared facilities such as Common Facility Centre (CFC). This also involves development of and access to information and, communication technology, and partnership among operators, which, will help reduce cost of production and improve product quality and competitiveness. In this way, SMEs would be positioning themselves to benefit from the implementation of the proposed programme of NEPAD.
- Marketing Channels: provision of effective marketing and distribution channels for SMEs products to penetrate sub-regional and global markets.
- Vertical Integration: encourage linkages between SMEs and large-scale industries to ensure patronage rather than competition among them.
- Capacity Building: a system of technical skills and entrepreneurship training should be developed by Government and the private sector for the operators of

SMEs, so that they can improve on product quality, upgrade their operations to international standard and attract investment for expansion. With globalization, it should be noted that the SMEs that cannot meet the acceptable standards would be compelled to close down.

- Efficient Financial System: efficient and responsive financial system that could serve the economy and the introduction of delivery mechanisms of financial supports to SMEs in particular [17].

2. Case Study

2.1. Design of Manually Operated Paper Recycling Plant

Paper Recycling, which is the extraction and recovery of valuable materials from scrap or other discarded materials, is employed to supplement the production of paper. The design of a used paper recycling machine is therefore a welcome development as it will ensure that the source of raw material for paper production is multiplied and also waste paper that could have constituted into wastes are recycled for various productive purposes. Design of paper recycling machine ensures that a cheap and non-complex method of production of paper product is guaranteed.

2.2. Description of the Recycling Machine

The design of a waste paper recycling machine includes the determination of the volume of the refiner, hydropulper and head box and also the selection of a convenient material for the construction of the individual units. The majority of the parts of the plant are to be fabricated using mild steel, this is because it is the easiest to be joined among all other metals. It is a very versatile metal, necessitating its use by many industries for fabrication of process unit equipment. Apart from its versatility, it is also very cheap and readily available compared to other metals. Some basic properties of mild steel that enhance these qualities include:

- Tensile strength: 430KN/mm;
- Yield stress: 230KN/mm;
- Percentage longatum: 20%;
- Tensile modulus: 210KN/mm^3
- Hardness: 130APLS

Figure 1. *Manually Operated Paper Recycling Machine.*

3. Unit Design Calculations

3.1. The Disc Refiner

The unit consists of three main parts: a hopper for charging in the pulp slurry, a screw type conveyor for moving the slurry to the treating element blade and a treating element.

Volume of hopper is a frustum of a pyramid and the volume is given by V = Ah/3, where V is volume, A is area of base of pyramid, and h is height of pyramid.

- Using similar triangle theorem, height:

$$\frac{h}{8}=\frac{H}{30},\ H = h + 29,\ \frac{h}{8}=\frac{h+29}{30},\ 30h = 8h + 232,$$

$$h = \frac{232}{22},$$

h = 10.545 cm

- Total volume of pyramid V_p: $V_p = (1/3)(300)^2 \cdot (10.545 + 29) = 11863.5\ cm^3$
- Volume of truncated pyramid: $V_S = (1/3) \cdot Ah =$

$(1/3)\cdot 8\cdot 8\cdot 10.545 = 224.96\ cm^3$

- Volume of cylinder enclosing shaft: $V_C = \pi r^2 h$, r = 2.5, h = 8cm then $V_C = 157.08cm^3$
- Total volume of hopper refiner is $V = (V_p - V_s) + V_c$ and then: $V = (11863.5 - 224.96) + 157.080 = 11795.62cm^3$

3.2. The Hydropulper

This is an open cylindrical vessel incorporating one bladed rotating element that serves both to circulate the slurry and to separate the fibre from each other. It makes the paper source become disintegrated, transformed and well blended into fibre slurry. This unit is operated manually. It follows:

- Volume of Hydropulper, V_r it result from its mass and density. Using a scale up factor of 10 (for the whole plant) mass of pulp slurry leaving hydropulper, mass is $7.14675\cdot 10 = 71.46750$ Kg = 71467.5 g; Density of pulp is 1.172 g/cm^3, then volume of pulp slurry V_C is 60979.096 cm^3. Total Volume of Hydropulper: Vr = Vc + 0.32 Vc = 1.032Vc, and replacing the numeric values: $V_r = 60979.096 + 0.032\ (60979.096) = 62930.427cm^3$;
- Diameter of Hydropulper (a cylindrical vessel) it result from volume of cylinder $V = \pi r^2 h$, where height of 50 cm is used i.e. h = 50 cm;
- Radius of circular cylinder: $r^2 = V/\pi h$; $r = \sqrt{\frac{V}{\pi h}} = \sqrt{\frac{62930.43}{\pi \cdot 50}} = \sqrt{400.628} = 20.016$ cm.
- Diameter of cylinder $D = 2r = 2\cdot 20.016 = 40.032$ cm.
- The total surface area of cylinder A: $A = 2\pi r(h+r) = 2\pi\cdot 20.016(50+20.06) = 8805.51\ cm^3$
- Circumference of cylinder, C: $C = 2\pi r = 2\pi\cdot 20.016 = 125.764$ cm.

3.3. Blade Design for Hydropulper

The blade is design in a way that it has more mixing effect than cutting. The diameter, D_a vary from 1/2.33 D_T to 1/3 D_T.

From the lower value, Blade diameter = 1/2.33 D_T, where D_T = 40.032 cm (diameter of tank), $D_a = 1/2.33\cdot 40.032$ (Diameter of blade) = 17.181cm.

It follows:

- Height of blade (H) from blade of cylinder: $H = 0.15\ D_T - 0.12D_T$
- The lower value: $H_i = 0.12\ D_T = 0.12\cdot 40.032 = 4.804$ cm.

3.4. The Head Box

This unit is made out of an 18" gauge flat sheet into a square tank. Its purpose is to ensure that a continuous flow of stock at constant velocity across the width of the machine is provided. Its principal design involves the use of a single slice to develop a free jet of pulp that is then deposited onto the moving felt conveyor. It has an inlet medium fitted with a 2" pipe socket that allows for a continuous flow of pulp slurry. It follows:

- Volume of Head box, using a scale up factor of 10 (for the whole plant) result from mass of slurry leaving the hydropulper to the head box, equal to $7.14675\cdot 10 = 71.4675$ Kg.
- The density of the pulp, 1.172 g/cm^3.
- Volume of the pulp slurry = $\frac{\text{mass}}{\text{density}} = \frac{71.4675}{1.172}$ $=60.979096m^3$
- Volume of the headbox = 60979.096cm^3.
- Free jet area is length × breadth = 2.5 × 25.50 = 63.75 cm^2.
- Free jet displacement sheet area, A_{fj}, $A_{fj} = (a+b)\cdot J = (19.2+9)\cdot 25.5 = 71.91\ cm^2$
- The total area of headbox slices covering top edge: $A_{hs} = (40.60\cdot 4.00)\cdot 4 = 649.60\ cm^2$
- Entrance area from the hydropulper to the headbox is of: Internal diameter = 4.00cm = Φ; External diameter = 6.00cm = Φ_{ex}, and then:

Internal area = $\frac{\pi\cdot(4.00)^2}{4} = 12.57cm^2$,

External area = $\frac{\pi\cdot(6.00)^2}{4} = 28.77cm^2$

3.5. Felt Blanket Conveyor

The design of the felt is to serve three (3) main purposes:

1. A conveyor to assist the sheet through the manufacturing process;
2. A porous media to provide void volume and channels for effective water removal;
3. A texture cushion for passing moist sheet without crushing or significant marking.

As a tension band to maintain sheet feltness and ultimate contact with followings:

- hot dry surface length of cylinder (50cm);
- radius of cylinder (7cm);
- circumference of cylinder ($2\pi r = 2\pi\cdot 7 = 43.99$cm);
- AB = 43.99/2 = CD = 21.99cm;
- Total length of felt: AB + CD +BC + DA = 21.99 + 21.99 +140 +140 = 323.98 cm.

3.6. The Dryers

This unit consists of two hollow cylinders design in the form of a roller, an external mild steel metal cylinder and an internal ceramic cylinder.

The internal cylinder 7" in diameter is made of ceramic material. It is hollow in form and serves as the heating plate. The choice of a ceramic material for the heating plate is hinged on the fact that ceramic does not conduct electricity and is resistance to heat. Each heating plate consists of two heating elements, connected to electric mains outside. The external cylinder encloses the internal cylinder as a casing.

The external cylinder has:

- Diameter of roller = 14cm, therefore radius = 14/2 = 7

cm;

- Length of cylinder = 50 cm;
- Circumference of external cylinder = $2\pi r = 2\pi 7 = 43.98$ cm.

Therefore, circumference of cylinder is 43.98cm.

Internal cylinder has:

- Diameter of pipe = 8 cm;
- Length of ceramic pipe = 30 cm;
- Radius = 8/2 = 4 cm;
- Circumference of internal ceramic = $2\pi r = 2\pi \cdot 4 = 25.132$ cm.

Therefore, circumference of internal ceramic is 25.132 cm.

Since the other rolls have same dimension as the external cylinder of the dryer, therefore the circumference and diameter of all the six cylinders have equal values. The external cylinder of the dryer i.e. 43.98 cm = $4.398 \cdot 10^{-2}$ m.

4. Conclusion

SMEs easily thrive where there is an enterprise culture or a business oriented society, that is, a society where the way of life is focused on the importance of individual creating their own wealth through their business. It is clear that engineering personnel are imbued with entrepreneurial potentials yet to be tapped. The solution to countries dismal performance and deficient economic structure is to promote workable enterprise culture. The engineering personnel need to play leading role by establishing technology based businesses, formation of consortium and adopt strategies for mergers and linkages.

References

[1] Agyeman J., (2004). Sustainable Communities and the Challenges of Environmental Justice. New York, USA. New York University Press.

[2] Hasna A. M., (2007). Dimensions of Sustainability. Journal of Engineering for Sustainable Development. Energy, Environment and Health. 2(1) 45 – 57.

[3] Agyeman J., Bullard R. D., and Evan B., (2003). Just Sustainabilities: Development in an unequal World. Cambridge M A, USA, MIT Press.

[4] Daniyan I. A., Daniyan O. L., Adeodu A. O., and Aribidara A. A., (2014). Towards Sustainable Development in the third World: Design of a Large Scale Biodiesel Plant. Journal of Bioprocessing and Chemical Engineering 1(1), Pp 1 – 9.

[5] Council of Academics of Engineering and Technological Sciences (1995). The Role of Technology in Environmentally Sustainable Development. Kiruna, Sweden.

[6] Gordon M. Bubou and Festa N. Okrigwe, (2011). Fostering Technology Entrepreneurship for Socioeconomic Development: A case for Technology Incubation in Bayelsa State, Nigeria. Journal of Sustainable Development, 4(6): 5539/jsd.v4n6p138.

[7] Adelowo Caleb M., Olaopa R. O., and Siyanbola W. O., (2012). Technology Business Incubation as Strategy for SME Development: How far and how well in Nigeria? Science and Technology, 2(6): 172-181.

[8] Mohammed Sani Haruna, (2013). Development of Small Scale Enterprises: The Role of Engineering Personnel. Invited paper presented at the 22nd Engineering Assembly of Council for the Regulation of Engineering in Nigeria (COREN). International Conference Centre, Abuja. August 20-21.

[9] Joseph E. A. and Michael D. O., (2013). Promoting Small and Medium Enterprises in the Nigerian Oil and Gas Industry. European Scientific Journal. 9(1), ISSN: 1857-7881.

[10] Shambhu Ghatak (2013). Micro, Small and Medium Enterprises (MSMEs) in India: An Appraisal. www.legalpundits.com/Content-folder/SME Arti 1506010.pdf.

[11] Lawal W. A. and Ijaiya M. A., (2007). Small and Medium Scale Enterprises Access to Commercial Banks? Credits and their Contributions to GDP in Nigeria. Asian Economic Review, Journal of the Indian Institute of Economics. 49(3), 360-368.

[12] Jimah M. S., (2011). Establishing Small and Medium Scale Enterprises: Problems and Prospect. Being a paper presented at the Institute of Chartered Accountants of Nigeria (ICAN) Zonal Conference held in Jalingo, Taraba State.

[13] National Policy on Micro, Small and Medium Enterprises – SMEDAN (2006).

[14] AFDB, OECD, UNDP, UNECA (2012) 'Nigeria 2012'' African EconomicOutlook.http://www.africaneconomicoutlook.org/fileadmin/uploads/aeo/PDF/Nigeria%20Full%20PDF%20Country%20Note.pdf

[15] Oyelaran oyeyinka B., (2012). SMEs: Issues, Challenges and Prospects. International Conferences on Financial Systems Strategy 2020. United Nation.

[16] Ayozie Daniel Ogechukwu, (2011). The Role of Small Scale Industry in National Development of Nigeria. Universal Journal of Management and Social Sciences. 1(1) (cprenet.com/uploads/archive/UJMSS-12-1021.pdf).

[17] Olorunsola J. A. (2003). Problem and Prospects of Small and Medium Scale Industry in Nigeria. Seminar on Small and Medium Industries Equity Investments Scheme (SMIES). Publication of CBN Training Centre, Lagos, CBN No. 4.