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INNOVATION IN FEED MIXING MACHINE: DESIGN FOR MANUFACTURING IN INDUSTRY

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ABSTRACT

Innovation is viewed as the application of better solutions that meet new requirements, unarticulated needs, or existing market needs. This is accomplished through more-effective products, processes, services, technologies, or business models that are readily available to markets, governments and society. The term “innovation” as something original and more effective and, as a consequence, new, that "breaks into" the market or society. It is related to, but not the same as, invention. Mixing machines are used in feed mills for the mixing of feed ingredients. The machine plays a vital role in the feed production process, with efficient mixing being key to good feed production. If feed is not mixed properly, ingredients and nutrients will not be properly distributed within a précised time. This means that the feed will not have even nutritional benefit and would be bad for the poultry that feed on them. Design is also a tool for innovation in mature markets where technological developments bring only marginal improvements to the end-user, and in low tech markets. Manufacturing is the production of merchandise for use or sale using labour and machines, tools, chemical and biological processing, or formulation. The term may refer to a range of human activity, from handicraft to high tech, but is most commonly applied to industrial production, in which raw materials are transformed into finished goods on a large scale. Such finished goods may be sold to other manufacturers for the production of other, more complex products, such as aircraft, household appliances, furniture, sports equipment or automobiles, or sold to wholesalers, who in turn sell them to retailers, who then sell them to end users and consumers. The idea of mixing various feed materials such as grains, feed supplements and other animal feeds to produce a homogenous mix ready for dispensing for animal consumption had being part of man's activities since the creation of man. This has always been done using crude method such as hands, sticks etc. in this recent time, the advancement in technology has brought about the use of machines to perform the same function much faster, accurate and less energy consuming. It is for this purpose that the feed mixing machine has been designed. The aim of this research are to design, model, simulate, analysis of the machine components and the sustain analysis of feed mixing manufacturing.

KEYWORDS: Innovation, Design, Feed Mixing Machine Analysis, Manufacturing and Industry.

INTRODUCTION

The virtual product can provide manufacturers with a new source of value. The idea of mixing various feed materials such as grains, feed supplements and other animal feeds to produce a homogenous mix ready for dispensing for animal consumption had been part of man's activities since the creation of man. This has always been done using crude method such as hands, sticks etc. in this recent time, the advancement in technology has brought about the use of machines to perform the same function much faster, accurate and less energy consuming. It is for this purpose that the feed mixing machine has been designed. **Innovation** is defined simply as a "new idea, device, or method". However, innovation is often also viewed as the application of better solutions that meet new requirements, unarticulated needs, or existing market needs. This is accomplished through more-effective products, processes, services, technologies, or business models that are readily available to markets, governments and society. The term "innovation" can also be defined as something original and more effective and, as a consequence, new, that "breaks into" the market or society. It is related to, but not the same as, invention. Design is a tool for innovation in mature markets where technological developments bring only marginal improvements to the end-user, and in low tech markets. Good design can increase sales revenues and profit margins by differentiating products and services, making them more attractive to customers.

The term "innovation" as such was used for the first time by Schumpeter at the beginning of the 20th century. His ideas and research have been developed by a number of other authors. Schumpeter defined innovations as product, process and organisational changes that do not necessarily originate from new scientific discoveries (Žižlavský, 2011), but may arise from a combination of already existing technologies and their application in a new text (Žižlavský, 2011). Innovation also originates from public research (Autant-Bernard, 2001). It is therefore possible to summarise that according to these definitions innovations do not cover only technical and technological changes and improvements, but in particular practical application and particularly originates from research. For Mixing machines are used in feed mills for the mixing of feed ingredients. The machine plays a vital role in the feed production process, with efficient mixing being key to good feed production. Feed mixing machine comprises of a frame structure, the mixing chamber (a cylinder and cone structure) where other components such as electric motor, shaft and hopper are mounted on. The mixing of feed to form a uniform ratio at a regular need for large stock poultry purposes. The mixing is performed by a vertical shaft which revolves continuously in a cylindrical cone suspended by an iron bar. The relative motion of the shaft about the frame (body) is achieved by the use of knuckle bearing. Designers make decisions on the use of resources, modes of consumption and the lifecycles of products and services. Environmentally sustainable design (also referred to as ‘green design’ or ‘eco-design’) aims to ensure that products, services and systems are produced and provided in a way that reduces the use of non-renewable resources and minimizes environmental impact.

Good design is an increasingly important means for businesses to hold their own in international competition. Design has the power to make products and services more attractive to customers and users, so they are able to sell at a higher price by being differentiated from the competition by virtue of new properties, values and characteristics. Innovation’ is the successful exploitation of new ideas. It is the process that carries them through to new products, new services, and new ways of running the business or even new ways of doing business. The beginning of industrial scale production of animal feeds can be traced back to the late 1800s, this is around the time that advance in human and animal nutrition was able to identify the benefits of a balanced diet, and the importance or role the processing of certain raw materials played in this Corn gluten feed mixer was first manufactured in 1882, while leading world feed producer Purina feeds was established in 1894 by William H Danforth. Cargill which was mainly dealing in grains from its beginning in 1865, started to deal in feed mixer production at about 1884. The feed industry expanded rapidly in the first quarter of the 1900s with “Purina” expanding its operations into Canada and opened its first feed mill in 1927. In 1908 Herbert Johnson, an engineer for the Hobart manufacturing company, invents an electric standing mixer. His inspiration came from observing a baker. mixing bread dough with a metal spoon; soon he was toying with a mechanical counterpart. By 1915, his 80-quart mixer was standard equipment. In 1908 the feed industry was revolutionized by the introduction of the first feed mixer used for mixing pelleted feeds. It could be cited that the poor quality products of feed could be as a result of improper mixing of feed. Again, large quantities of feed will be very difficult to mix by hand if not impossible, thereby producing poor quality products and reducing production rate. lowers the profits margin of the products. On the other hand, the cost of importation of foreign machine for mixing feed is very high compared to the producer's mega resources. The oldest programmes date from the end of the 19th century, when design programmes with roots in the crafts sector were implemented in Scandinavia (Sweden, 1845 and Finland, 1875). The USA followed in 1913. Since then, schemes have spread to practically all developed Countries and some developing countries, and have evolved in scope, complexity and ambition.During the period 1940-1960, a number of countries saw the establishment of professional organizations for industrial design: Australia, UK, Canada, France, Germany and Italy. These associations aimed at promoting the use of design in mass production and as an asset for trade and export.97 The UK Council of Industrial Design was created in 1944, the German Design Council in 1953. The Polish Institute of Industrial Design was also created in the 1950s. Eli Whitney is one person from an earlier period whose work is notable as an example of the use of some DFM approaches. Whitney was engaged in design for Manufacturability over 180 years before use of the term became widespread. At the turn of the nineteenth century Whitney developed, for the U.S. government, a system for manufacturing muskets that incorporated the concept of interchangeable parts. Prior to his innovation, all U.S. muskets were handmade by individual craftsmen who each made the complete product.

Simulation is a powerful approach to modeling manufacturing systems in that many complex and diverse systems can be represented See simulation process. Fig 1-9 Can predict system performance measures that are difficult to assess without a model. It is a proven, successful tool and has been in use since the 1950s.

SIMULATION OF FEED MIXING MACHINE

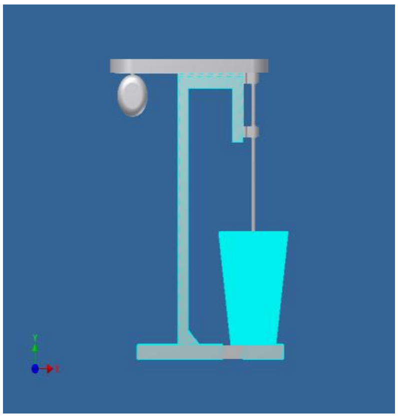

Fig. 1: Fixed Constraint: 1.

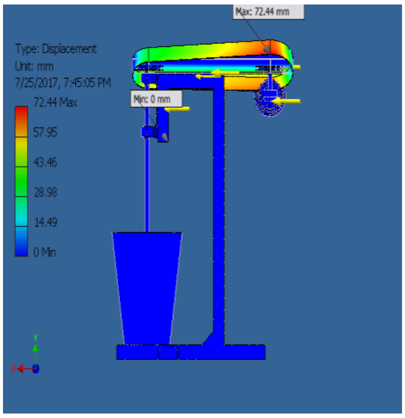

Fig. 2: Displacement, max 72.44m.

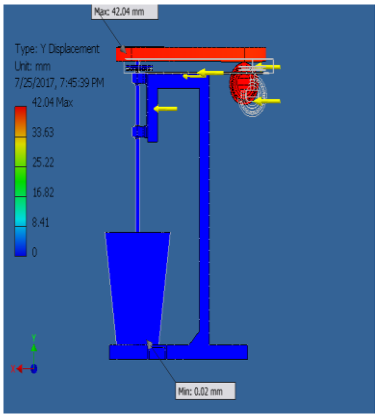

Fig. 3: Y displacement max 42.04mm.

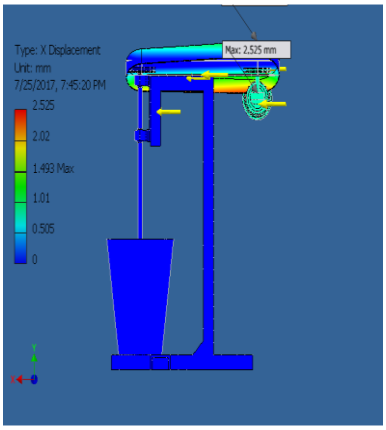

Fig. 4: Displacement max 2.52mm.

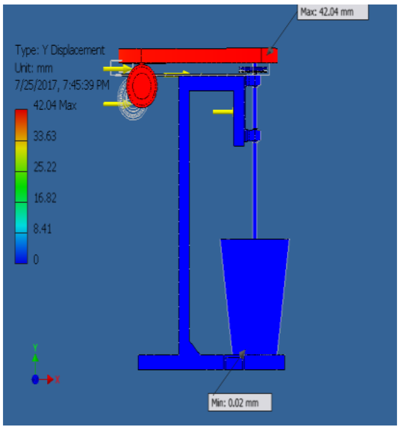

Fig. 5: F3 0.00 Hz Z Displacement.

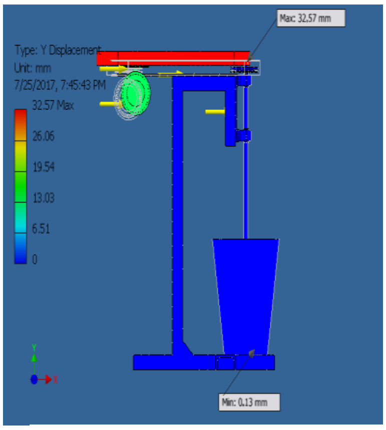

Fig. 6: F5 0.13 Hz Z Displacement.

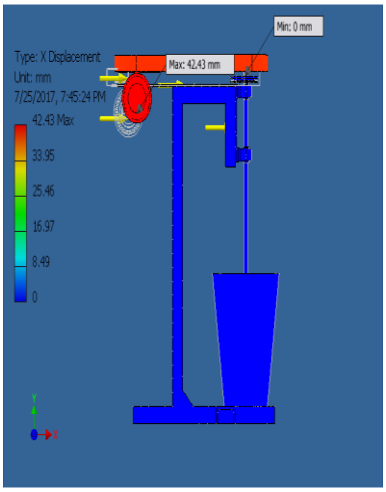

Fig. 7: Displacement 42.43.

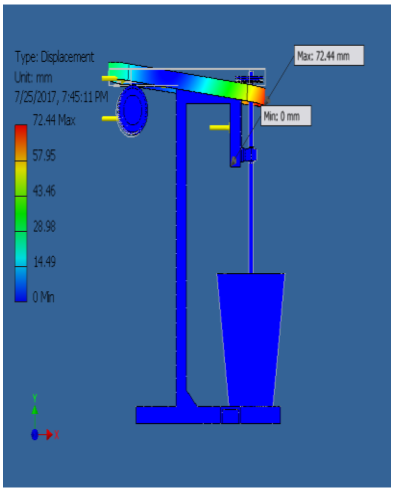

Fig. 8: F4 0.11 Hz X Displacement.

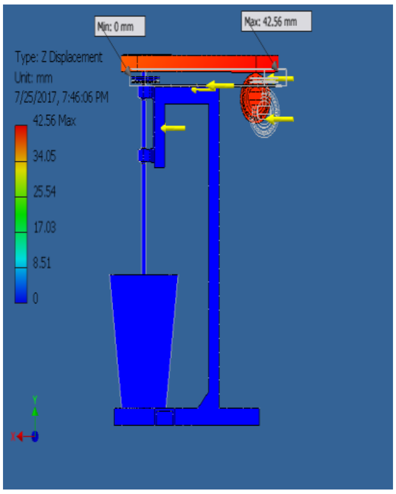

Fig. 9: Displacement max 72.44.

Table 1: Illustrated the Result of Selected Materials during the Simulation.

Force: 1

Load Type	Force
Magnitude	150.000 N
Vector X	-149.813 N
Vector Y	0.000 N
Vector Z	7.491 N

Operating conditions Gravity

Load Type	Gravity
Magnitude	9810.000 mm/s^2
Vector X	0.000 mm/s^2
Vector Y	-9810.000 mm/s^2
Vector Z	0.000 mm/s^2

Simulation: 1

General objective and settings

Design Objective	Single Point
Simulation Type	Modal Analysis
Last Modification Date	7/20/2017, 8:07 AM
Number of Modes	8
Frequency Range	Undefined
Compute Preloaded Modes	No
Enhanced Accuracy	No

MATERIAL(s)

Name	Stainless Steel AISI 440C, Welded	
General	Mass Density	7.75 g/cm^3
	Yield Strength	689 MPa
	Ultimate Tensile Strength	861.25 MPa
Stress	Young's Modulus	206.7 GPa
	Poisson's Ratio	0.27 ul
	Shear Modulus	81.378 GPa
Stress Thermal	Expansion Coefficient	0.0000104 ul/c
	Thermal Conductivity	24.23 W/(m K)
	Specific Heat	160.57 J/(kg c)
Part Name(s)	frame mixer	
Name	PET Plastic	
General	Mass Density	1.541 g/cm^3
	Yield Strength	54.4 MPa
	Ultimate Tensile Strength	55.1 MPa
Stress	Young's Modulus	10.367 GPa
	Poisson's Ratio	0.417 ul
	Shear Modulus	3.65808 GPa
Stress Thermal	Expansion Coefficient	0.0000253 ul/c
	Thermal Conductivity	0.3 W/(m K)

	Specific Heat	2287 J/(kg c)
Part Name(s)	bucket	
Name	Iron, Ductile	
General	Mass Density	7.1 g/cm^3
	Yield Strength	332 MPa
	Ultimate Tensile Strength	464 MPa
Stress	Young's Modulus	168 GPa
	Poisson's Ratio	0.29 ul
	Shear Modulus	65.1163 GPa
Stress Thermal	Expansion Coefficient	0.000014 ul/c
	Thermal Conductivity	21 W/(m K)
	Specific Heat	540 J/(kg c)
Part Name(s)	bearing housing bearing housing	
Name	Aluminum 6061	
General	Mass Density	2.71 g/cm^3
	Yield Strength	275 MPa
	Ultimate Tensile Strength	310 MPa
Stress	Young's Modulus	68.9 GPa
	Poisson's Ratio	0.33 ul
	Shear Modulus	25.9023 GPa
Stress Thermal	Expansion Coefficient	0.0000236 ul/c
	Thermal Conductivity	167 W/(m K)
	Specific Heat	1256.1 J/(kg c)
Part Name(s)	pulley pulley	
Name	Steel	
General	Mass Density	7.85 g/cm^3
	Yield Strength	207 MPa
	Ultimate Tensile Strength	345 MPa
Stress	Young's Modulus	210 GPa
	Poisson's Ratio	0.3 ul
	Shear Modulus	80.7692 GPa
Stress Thermal	Expansion Coefficient	0.000012 ul/c
		56 W/(m K)
	Specific Heat	460 J/(kg c)
Part Name(s)	shaft	

RESULTS

Frequency Value(s)

F1	0.00 Hz
F2	0.00 Hz
F3	0.12 Hz
F4	0.12 Hz
F5	0.14 Hz
F6	0.15 Hz
F7	0.16 Hz
F8	0.17 Hz

Result Summary

Name	Result Value
Volume	10532400 mm^3
Mass	68.0314 kg

METHODOLOGY

DESIGN

Engineers use CAD to create two− and three−dimensional drawings, such as those for automobile and airplane parts, floor plans, and maps and machine assembly while it may be faster for an engineer to create an initial drawing by hand, it is much more efficient to change and adjust drawings by computer. In the design stage, drafting and computer graphics techniques are combined to produce models of different parts. i. Using a computer to perform the six−step 'art−to−part' process: The first two steps in this process are the use of sketching software to capture the initial design ideas and to produce accurate engineering drawings. Next, engineers use analysis software to ensure that the part is strong enough. Step five is the production of a prototype

Manufacturing Simulation

The simulation of technical systems and processes is considered to be one of the key technologies for computer-supported product development and production technology. The goal of manufacturing simulation is to provide error-free manufacturing processes, optimization of machining times, and overall improved safety and profitability of the entire production process**.** Simulation refers to the reproduction of a system together with its dynamic processes in a model capable of experimentation shown in fig 1-9 in XYZ displacement and result in table 1.

Machine Model

A **machine model** refers to the true-to-original emulation of the physical machine on a computer. At the least, a machine model contains the following components: Geometric models of machine elements such as the frame, guides, and cover plates The kinematic structure The control model or virtual control system At a, the **geometric elements** of the machine model have to describe the workspace precisely. Additional machine elements such as parts of the enclosures may be relevant in terms of collisions but also have recognition value. For the purposes of simulation, they can be made transparent or hidden entirely shown in fig 1 Fixed Constraint.

Optimization

In series production, simulation is used not only for the verification of programs but also for cycle-time optimization. The exact geometric and temporal reproduction of the machining process in the simulation system makes it possible for the user to optimize motion in the machine/machine periphery using methods that would be too risky or too complicated if simulation were not used. When one considers that a production process may have a service life of several years, even a single-digit percentage reduction in the cycle time may result in potential savings that far exceed the expense of achieving such optimizations.

SUSTAINABILITY

Simulation technology has been a significant tool for improving manufacturing operations in the past; but its focus has been on lowering costs, improving productivity and quality, and reducing time to market for new products. Sustainable manufacturing includes the integration of processes, decision-making and the environmental concerns of an active industrial system to achieve economic growth, without destroying precious resources or the environment. Sustainability applies to the entire life cycle of a product, selection of materials, extraction of those materials, of parts, assembly methods, retailing, product use, recycling, recovery, and disposal will need to occur if simulation is to be applied successfully to sustainability illustrated in table1and fig1-9.

DESIGN FOR MANUFACTURING (DFM)

The term manufacturability gradually became ascendant among those interested in the approach, and about 1985, design for manufacturability and its shortened form, DFM, came into wide use. John B. Rae writes that durability and simplicity were "achieved in 1907 with the Model T....Its 20-hp, four-cylinder engine was a marvel of mechanical simplicity, as was its planetary transmission." It can be seen that much of what Ford accomplished is now referred to as DFM. Design for manufacturing, i.e. methods that aim to ensure that the product can be manufactured at a feasible cost, is presented followed by the computer-based area of virtual manufacturing for simulating manufacturing operations. Illustrated in fig 1.Traditionally, the design was done for functionality and less effort was used to evaluate how well the design would be manufactured. Therefore, methods to promote design for manufacturing (DFM) have evolved since the 1970s (Kuo et al., 2001). DFM refers to the effort of ensuring that the engineering design satisfies the customer requirements and complies with the manufacturing facilities of a company, e.g. machines, staff knowledge and resources available. Design for the producibility and manufacturing are sometimes used interchangeably and according to Priest and Sánchez (2001) p. 247,

MANUFACTURING

Manufacturing is the means by which the technical and industrial capability of a nation is harnessed to transform innovative designs into well-made products that meet customer needs. This activity occurs through the action of an integrated network that links many different participants with the goals of developing, making, and selling useful things. Manufacturing is the conversion of raw materials into desired end products. The word derives from two Latin roots meaning **hand and make**. Manufacturing, in the broad sense, begins during the design phase when judgments are made concerning part geometry, tolerances, material choices, and so on. Manufacturing operations start with manufacturing planning activities and with the acquisition of required resources, such as process equipment and raw materials. The manufacturing function extends throughout a number of activities of design and production to the distribution of the end product and, as necessary, life cycle support. Modern manufacturing operations can be viewed as having six principal components: materials being processed, process equipment (machines), manufacturing methods, equipment calibration and maintenance, skilled workers and technicians, and enabling resources.

Modern manufacturing includes all intermediate processes required in the production and integration of a product's components. Some industries, such as semiconductor and steel manufacturers use the term **fabrication** instead. The manufacturing sector is closely connected with engineering and industrial design. Examples of major manufacturers in North America include General Motors Corporation, General Electric, Procter & Gamble, General Dynamics, Boeing, Pfizer, and Precision Cast parts. Examples in Europe include Volkswagen

Group, Siemens, FCA and Michelin. Examples in Asia include Toyota, Yamaha, Panasonic, Mitsubishi, LG and Samsung.

INNOVATION

Human capital and creative research work are according to Zemplinerová (2010) and Autant-Bernard (2001) considered the most important determinants of innovation. Adair (2004) states that any innovative organisation should have a bucketful of ideas. According to Košturiak & Chaľ (2008), Skarzynski & Gibson (2008), Tidd, Bessant & Pavitt (2007) an innovative process can be divided into two essential parts. One part is inventive – associated with the generation of the original idea, thought or concept – and the second innovative, during which the invention is implemented and marketed. Pitra (2006) states that innovation is the result of employees' creativity in an organisation and must be always targeted at customers and bring added value. It is therefore necessary to realise that the inventive part is based on people's knowledge, skills and experience (Molina-Morales, Garcia-Villaverde & Parra-Requena, 2011). The human factor is an indispensable element in the process of innovation and people generate ideas that might help an organisation gain a competitive advantage. The word 'innovation' refers to 'something newly introduced'. Innovation is about applying ideas to create new solutions. This solution may be a new product, a new approach or even a new application of an old product or approach. Innovation is: production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome. Two main dimensions of innovation were degree of novelty (patent) (i.e. whether an innovation is new to the firm, new to the market, new to the industry, or new to the world) and type of innovation (i.e. whether it is process or product-service system innovation) In business and in economics, innovation can become a catalyst for growth. With rapid advancements in transportation and communications over the past few decades, the old-world concepts of factor endowments and comparative advantage which focused on an area's unique inputs are outmoded for today's global economy. Economist Joseph Schumpeter (1883-1950), who contributed greatly to the study of innovation economics, argued that industries must incessantly revolutionize the economic structure from within, that is innovate with better or more effective processes and products, as well as market distribution, such as the connection from the craft shop to factory. He famously asserted that "creative destruction is the essential fact about capitalism Entrepreneurs continuously look for better ways to satisfy their consumer base with improved quality, durability, service, and price which come to fruition in innovation with advanced technologies and organizational strategies. A prime example of innovation involved the explosive boom of Silicon Valley startups out of the Stanford Industrial Park. In 1957, dissatisfied employees of Shockley Semiconductor, the company of Nobel laureate and co-inventor of the transistor William Shockley, left to form an independent firm, Fairchild Semiconductor. After several years, Fairchild developed into a formidable presence in the sector. Eventually, these founders left to start their own companies based on their own, unique, latest ideas, and then leading employees started their own firms.

INDUSTRY

Industry is the production of goods or related services within an economy. The major source of revenue of a group or company is the indicator of its relevant industry. When a large group has multiple sources of revenue generation, it is considered to be working in different industries. Manufacturing industry became a key sector of production and labour in European and North American countries during the Industrial Revolution, upsetting previous mercantile and feudal economies. This came through many successive rapid advances in technology, such as the production of steel and coal. Following the Industrial Revolution, possibly a third of the world's economic output are derived that is from manufacturing industries. Many developed countries and many developing/semi-developed countries (China, India etc.) depend significantly on manufacturing industry. Industries, the countries they reside in, and the economies of those countries are interlinked in a complex web of interdependence.

Importance of Adopting Innovation and Government Policies

Given the noticeable effects on efficiency, quality of life, and productive growth, innovation is a key factor in society and economy. Consequently, policymakers have long worked to develop environments that will foster innovation and its resulting positive benefits, from funding Research and Development to supporting regulatory change, funding the development of innovation clusters, and using public purchasing and standardisation to 'pull' innovation through.

Innovation is the route to economic growth. Industries are maturing. Products are maturing. Innovation is the creation and transformation of new knowledge into new products, processes, or services that meet market needs. As such, innovation creates new businesses and is the fundamental source of growth in business and industry.

Innovation is importance on a number of levels.it is important for nations and regions, for economic growth and it is important for firms for survival and growth.

The European Commission is formulating, influencing and, where appropriate, implementing policies and programmes to increase Europe's innovativeness. The Commission is trying to make sure innovation is thoroughly understood and approached comprehensively, thereby contributing to greater competitiveness, sustainability and job creation.

Nations see innovation as important, it is a driver of economic growth, It is linked to increased welfare, the creation of new types of jobs and the destruction of old ones. In a recent book, Baumol noted that virtually all of the economic growth that has occurred since the eighteenth century is ultimately attributable to innovation" the Economist intelligence unit undertook a survey in 2007 which noted that "long-run economic growth depends on the creation and fostering of an environment that encourages innovation. Innovation is considered an important driver of long-term productivity and economic growth. It is argued that countries that generate innovation, create new technologies and encourage adoption of these new technologies grow faster than those that do not.

It is comforting to know that research/statistics support the fact companies who are innovating are more succeful than those who are aren't. The road to innovation is not without its obstacles and set-back, but those who perservere are often rewarded for their insight and effort.

Innovation in Feed Mixing Machine: Design for Manufacturing in Industry

Because of economic crunch prevalent in Nigeria today, it is no longer economically feasible to import food processing machine from abroad. It is necessary to encourage local fabricators and design innovation in Nigeria. It is against this background that our research theme was derived and if Government will adopt the policy the following are the benefits.

1. Encourage innovation through usage and observation by local fabricators.
2. It cost effective.
3. Increase in production.
4. Economic development and industiazation.
5. Encourage direct and indirct investment.

CONCLUSION

Manufacturing industry became a key sector of production and labour in European and North American countries during the Industrial Revolution, upsetting previous mercantile and feudal economies.

Modeling and simulation play increasingly important roles in modern life. They Contribute to our understanding of how things function and are essential to the effective and efficient design, evaluation, and operation of new products and systems. Modeling and simulation results provide vital information for decisions and actions in many areas of business and government. Lawrence (1994) p. 2, argues that virtual manufacturing is: "…a modelling and simulation environment so powerful that the fabrication/assembly of any product, including the associated manufacturing processes, can be simulated in the computer." 'Good design is an increasingly important means for businesses to hold their own in international competition. Design has the power to make products and services more attractive to customers and users, so they are able to sell at a higher price by being differentiated from the competition by virtue of new properties, values and characteristics.

Simulation is a powerful approach to modeling manufacturing systems in that many complex and diverse systems can be represented. Can predict system performance measures that are difficult to assess without a model. It is a proven, successful tool and has been in use since the 1950s. Innovation is about applying ideas to create new solutions. Innovation is still seen as a critical drive of economic performance. If an organisation is not capable of introducing innovations on an ongoing basis, it risks that it will lag behind and the initiative will be taken over by other entities. It is possible to state that innovations are and will surely continue to be a means for organisations to survive in today's turbulent and highly competitive environment.

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