

INDIGENOUS TECHNOLOGY AND ENVIRONMENTAL SUSTAINABILITY IN NIGERIA

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Abstract

Technology is the scientific application of knowledge and skills to productive activities. It refers to a device, tool or piece of equipment. It is a purposeful human exploit undertaken by man to manipulate his environment for his benefits. Indigenous technology (IT) is technology centred on the culture, tradition and needs of a people which are adopted for use in their environment. This paper takes a look at indigenous technology and sustainable environment in Nigeria. It started with definition of concepts, and thereafter examined some indigenous technological industries in Nigeria and the challenges they face. Relevant literatures and focus group discussion were used. The paper concludes that sustained indigenous technology is sustained environment.

Keywords: Technology, Indigenous technology, Environment, Sustainability, Environmental sustainability, Nigeria.

1. Introduction

Technology is the scientific application of knowledge and skills to productive activities. It refers to a device, tool or piece of equipment. It is a purposeful human exploit undertaken by man to manipulate his environment for his benefits. Indigenous technology (IT) is technology centred on the culture, tradition and needs of a people which are adopted for use in their environment. Existence of Indigenous Technology (IT) is crucial to the growth and sustenance of any environment. In a vast country like Nigeria with diverse cultures spreading across the face of the country there is hardly any part of the country that does not have a significant indigenous technology to show for its existence. The indigenous technologies among others comprise of the production of pots from clay and aluminium metal scraps, glass and beads, pottery and metal working, red mud technology, textile making, cloth weaving, pottery making, cloth dyeing, bronze casting, leather tanning, drug technology, beer and gin brewing and the like which stimulate industrial development and sustainable environment.

Undoubtedly Nigeria's indigenous technologies also present substantial prospects for local economic transformation and, to some extent, for international competitiveness. To enhance this, ITs are to be improved and standardized through the deployment of modern science and technology. With a focus on cottage, small and medium-sized enterprises, more businesses could be developed around these technologies which would foster national innovativeness, create additional

employment and generate wealth (Willie 2012). Nonetheless, a major challenge with IT is the limited attention it receives from governments and, as Manabete, (2014) posits “when a people’s indigenous knowledge, experiences, precepts, traditions and history are thrown off in favour of foreign ones, it beclouds and threatens the people’s corporate survival and identity”. Peoples’ indigenous technology and environmental sustainability is their identity.

2. Conceptual Clarifications

Environment

The word environment is derived from the French *Environ* which means surrounding. It is the aggregate of all the external conditions and influences affecting the life and development of an organism. The concept of environment refers to the physical, chemical, biological, social and cultural factors that are present in the natural or built environment with which humans have an interactive relationship. It is perceived above all as the human living environment on the state and the equality of which human activity has positive and negative impact (International Encyclopaedia of Social Sciences vol.v (19)). Environment has to do with all the external factors-biotic and abiotic such as temperature, rainfall, day length, wind and ocean currents affecting an organism which form an ecosystem. There is constant interaction between organism and their environment, which brings about changes in both (Olumati and Edoghotu, 2017:17). Humans have constantly changed their environment more than other living creatures and they have done this on a grander scale.

As it were, the environment relates to all conditions, circumstances and influences that surround and affect development and behaviour of the human adaptive system, considering the person and earth resources. That is to say that the environment and man are affected and influenced simultaneously.

Sustainability and Sustainable Environment

Sustainability is a process which tells of a development of all aspect of human life affecting sustenance. The goal of sustainability is to guide the economic and social forces of the earth’s nations to live within the goods and services provided by the ecosystems and naturally occurring sources of energy without reducing the availability of these goods, services, and energy sources for future generations.

Viewing human and environment as ultimate goals, Hall (2003) opines that sustainability requires a dynamic balance between a variety of factors including social, cultural and economic demands of population and the need to safeguard the natural environment of which humanity is a critical part. Therefore, sustainability suggests change and improvement that is compatible with environmental, social and other limits and it allows for the continuing improvement of standard of living without reversible damage to resources we need to survive in the environment. Consequently, environmental sustainability refers to the long-term maintenance of valued environmental resources in an evolving human context. For Goodland (1995) environmental sustainability is the maintenance of natural capital connected to, both social sustainability and economic sustainability. Given the foregoing, the primary importance of environmental sustainability and sustainable development is geared towards the enhancement of the value of life in all its ramifications.

Technology

Technology has to do with man’s knowledge and application of same to his skill and arts in the manufacturing and use of tools. Abdulkareem (1992), defines technology as the art and science of applying man’s knowledge in human

endeavours so as to satisfy man's needs. It is the way "people modify the natural world to suit their own purposes...it refers to the diverse collection of processes and knowledge that people use to extend human abilities to satisfy human needs and wants." Technology is concerned with the developing and utilizing processes of production to solve man's material problems. It is so fundamental that it affects and is affected by most aspects of indigenous knowledge (Derefaka, 2002:221-228). The range of technologies covers from agriculture and food to other aspects of human activity. In other words, technology is a creative way of life of a people which encompasses the whole processes of craft and design which gives man fulfilment within his environment. When indigenous knowledge (IK) finds applications in tools, techniques, processes and methods that help in solving problems, indigenous technologies (IT) arise.

Indigenous Technology in Nigeria

A successful environment is predicated on economic growth and human progress which could be judged from basic infrastructural development and improvement of the standard of living of the people. In the view of Adelaga (1997), IT operations are founded on essential indigenous knowledge systems. It is a coordinated system of technologies developed by indigenes for their use based on available raw materials and tailored to meet local needs and conditions (Aliyu, 2003). The Native American Academy Silver Buffalo (n.d.) in Manabete (2014) outlined certain characteristics that are peculiar and distinct to indigenous technology as follows:

ITs emerge from the implicit order to reflect the art of skilful living. It is pragmatic, responsive and responsible to the ecology in which it lives.

IT attracts the learning spirit; it provides a learning ecology that supports the revitalization and transformation of awareness and knowledge.

Through meaningful interactions, IT seeks to engage and evoke significant knowledge and experiences reflective of the indigenous world.

ITs have the obligation to come into existence, to be used and to transform within an ethical space that is responsible to life in all its forms.

IT is coherent with the natural order. In other words, the ability or capacity to make something does not constitute a valid reason for its existence.

ITs have intrinsic value because we know their ancestry where they came from, what their place is in our world. We know they will transform and pass from this place to return to the realms of energies.

IT is therefore, regarded as any technology designed, fabricated, adopted and used in an environment for the advancement of people of that environment.

Nigeria is blessed with various types of indigenous technologies. Indigenous knowledge (IK) supporting these industries are generally passed from generation to generation. Hence, it is a tradition in specific locations to produce specific products (Willie, et al, 2012). The method of IK transmission and skills acquisition is largely through, oral transmission, observation and apprenticeship. From the pre-colonial period, indigenous technology was well expressed in the local manufacture of goods and implements. However, the introduction of western technology did not lead to complete demise of the local manufacture, but it inflicted grim damage on most of it (Okpoko, 1999). This damage was heightened by successive governments' licentious importation of all forms of foreign technology and the citizens' preference for foreign products as superior to the indigenous products. All the same, it is important to know that not only is indigenous technology important in the development of civilization, it also provides large share of data about ancient cultures.

Indigenous Technology Products Bronze Casting

Bronze casting which is predominant in Benin, Edo State, and South-South Nigeria is a male dominated trade like many other trades that require working with high temperature and high-level physical exertion. The raw materials are largely metal scraps obtained from the locality and outside. The pit furnace and clay crucibles are the major equipment which is built by the practitioners themselves with minimal import of low-tonnage graphite crucibles (Willie, 2012). The production technique of bronze casting is the lost wax process (*cire perdue*).

The process of bronze casting begins by mixing red sand with water to create a hard but brittle mud composite in the shape of the object to be casted. This initial image is then covered with bee's wax to form a wax mould referred to as runner which will take the shape of the mud mould. Another layer of wax is then used to cover the layer of the wax mould which would be allowed to dry before being held down by coils of copper wire as to hold it firmly in place. The copper wire is then covered with a thin layer of mud to prevent it from melting during firing. This contraption is then heated thoroughly until the wax melts completely and drains out of the mould to allow a space between the two layers of mud which is the same shape as the wax. The bronze is then heated until it gets a molten state, it is poured into the mould to fill up the hollow created by the drained-out wax, and adopting the shape of the wax. It is thereafter, allowed to cool down until it becomes solid. Then outer clay is chipped away and the carbonized core reamed out with the casting filed and thoroughly cleaned to shine.

However, there are variations in the style and weight of works, and time spent on production varies depending on the sizes of the product. Over time, with westernization, rasps and files were employed to enhance production within a short time, women are now allowed to practice bronze casting and the casters have become amenable to changes regarding the use of modern materials and methods. These have improved the quality of both their work and their economic base thereby contributing to the state and national economy. Therefore, the traditional bronze casting centres need more support from Federal, State and private individuals for more of the art equipment that will improve their output.

Leather Tanning: Tanning involves series of processes whereby raw skins and hides of animals such as goats, sheep, cow, crocodile, tiger, snake, and lizard are converted into more durable commodities which is aimed at making the skin or hide durable by making it non-putrefactive and equally yielding a product with high technical characteristics suitable for a wide range of purposes. Indigenous leather tanning referred to as *jima* are prominent in Northern Nigeria, notably in Sokoto, Kano, Jigawa, Zaria, Borno and Zamfara States.

Apart from the animals which provide the hides and skins for tanning, there are also the tanning auxiliaries which are readily available to the tanners in this area. These are potash, carbide or wood ash of specific plants, used for soaking, liming and unhairing the raw hide/skin (known as pelt). Pigeon dung and gaba-gaba plant (*cissus aralioids*) are used as delimbing and bating agents while full tannage is achieved by the use of bagaruwa pods (*Acacia nilotica*) which is a vegetable plant used by the tanners which has properties that have good coloration and penetrates rapidly into the skin of the animals.

In the tanning process a lot depends on the ability of the tanner to observe as to be able to know when a particular stage is successfully achieved or a process is completed, in order to produce good quality leather. Willie (2012), noted that the knowledge system around tanning has evolved to become much more systematic with advanced supporting technologies. This is because two federal research institutes- National Research Institute for Chemical Technology (NARICT) carries out advanced research in chemicals and leather, while the Federal College of

Chemical and Leather Technology (CHELTEC) provides courses for students, training and research in chemical, leather and leather products technology. Due to the activities of these institutions, the IK of leather training is now largely codified and science and technology applications in the industry are relatively been appreciated for further promotion by domestic firms.

Red Mud Technology

Red mud is abundant in the six geo-political zones of Nigeria. It is used in the building and plastering of houses. According to Onwuejeogwu (2012), houses built with red-mud bricks are more adapted to the tropics in terms of resistance to heat. Apart from their acoustic superiority to cement-block houses, well-built mud houses can stand for many years without dilapidating. For instance, most the red-mud anthills in Nigeria have stood for several decades in spite of their exposure to rain and other tropical weather conditions. But, the quest for European culture diverted Nigerian attention from the building of the mud houses which is indigenous, suitable and affordable to the western type house where cement is basic for house construction.

It is no gain saying that, uninhibited transfer of foreign architectural technology has resulted to large-scale devastation of the landscape of Eastern Nigeria by both sheet and gully erosion. Materials like galvanizing iron sheets, cement and plastic products used in these constructions have been found to be environmentally unsuitable since they generate heat in the tropical climate and at the same time, induce soil erosion, by their relative inability to absorb neither heat nor water (Okpoko, 1999). As it stands, research is ongoing on red-mud technology to find a less expensive but durable alternative to cement block houses.

Beer Brewing and Gin distillation

Brewers of indigenous beer in northern Nigeria are found among the Angas, Ankwa and Birom in the plateau and in the Middle-Belt area are the Tiv, Arago and Gwarsi. Millet, guinea corn, rice and corn are used in brewing different types of indigenous beer. Each ethnic group has different varieties and blends. They brewed pito and burukutu. Indigenous brewing is generally a woman's task, because beer is a local drink which goes with food. Brewing is part of cooking. Every mother teaches her daughter how to brew (Nchelem Ali, 2012).

However, local gin made from the raffia palm-tree juice is prevalent in the Niger Delta region, Nigeria. It is referred to as akpateshe/ ogoro/ kaikai. The Ikwerre of Rivers State refers to it as akameru. The raffia palm trees are normally found in fresh water swamp forests. The tapper set out in the morning to set their calabash on the raffia palm. The clay pot-ite ngwo is tied on the raffia palm in a position that the wine (maya-ngwo) would collect into it. For the production of akameru, the palm wine is distilled through a process which allows the palm wine to ferment. Thereafter, it is cooked in a drum, and the vapour channelled into a container where it is cooled to obtain the product (Chinda, 2015). The pito, burukutu and akameru are served in family entertainment ceremonies, akameru is used for embalmment and libation, and also enhance their economy as their children's fees are paid and other endeavours met.

Unfortunately, when British colonial government in Nigeria placed a ban on brewing and local gin, the production of local gin dwindled, the ban also it restricted the number of female brewers of pito and burukutu. This reduced the participation of women brewers and the quantity of brewed pito and burukutu. With the restriction, most of the girls now found pastures in other economic interests. On the other hand, Nigerian elites were introduced to drinking of

imported western beer and the multinationals brewers of western beer took over brewing western beer.

Textiles

Textiles are knitted and woven fabrics made from fibres such as silk, wool, cotton, jute and hemp. The art of cloth weaving could be related to the “physical unity of mankind”, and basically for the functional purpose it served-coverage of the skin from nakedness and adverse weather condition. However, many other uses to which it was put manifested as each civilization developed. In Africa, the art of cloth weaving existed even much before the advent of the Europeans. Apart from raffia and bark fibre which were initially used for weaving in some areas, cotton was the predominant raw material used in cloth weaving. It was identified to grow easily in the continent, and its existence has been traced back to at least 5000 years. The cotton fibre is usually processed and spun into yarns for different kinds of weaving. This is also evident in Nigeria where a large variety of weaving cultures abound. Picton (1992) in Folorunsho (1999:140), states that locally made textiles include fabrics manufactured within the pre-industrial technological traditions, using hand-spun cotton, rayon and lurex and it has continued to evolve. Connah (1975:236- 251) noted that Benin yielded evidence of cloths made of cotton and raffia being in use as early as the thirteenth century. What is important here is that Nigeria’s indigenous textiles represent a wide range of textiles with a wide variety of colours, textures, designs and classes. The types of attire worn by peoples from the different geographical zones are true reflections of Nigeria’s vast varieties. Apart from adorning themselves with cloths, cloths are used in many lifetime cultural activities such as, marriages, funerals, and rituals.

Akwaete Cloth

The widest hand-crafted cloth in Nigeria is the Akwaete cloth, with an average width of forty-eight inches and a length of six feet. Akwaete originally called Akuruaka Ndoki is native to the Ndoki in Ukwa East and North Local Government Areas of Abia State. Weaving grew from part time activity that occupied some women, to full-time occupation in which all Akwaete women participated. Then, Akwaete weavers responded to the patronage of neighbouring Ijaw people of Niger Delta, devising novel techniques to create desired patterns in new textile materials. Tradition has it that the art of weaving Akwaete cloth was introduced by a woman, Dada Nwakata of Akwaete who was reputed to produce the finest Akwaete cloth of her time. She invented the technique of the designs and wove it in secret as to prevent copying of her ideas. She flourished about the people’s early contact with the Portuguese, and the impact she made on traditional weaving technology remains a living guide in the search for sustainable innovativeness and creativity in traditional textile.

The basic Akwaete cloth is made of cotton thread, whilst the decorative pattern and effects are added with thread of heavier texture or contrasting colours. The elaborately modern versions of the cloth could be made entirely of silk, rayon, polyester and Lurex. Thus, materials used and techniques of the production are loom, heddle, beater or sword, yarn, twine, brass spatula, wooden shaft shuttle, wax, ropes, warp spreader, weaving and lurex. The decorative motifs have names suggestive of their appearance or the innovators. Initially, the “Ikaki” motifs could be worn only by chiefly families, and if an ordinary person attempted to wear it, he could be sold into slavery.

The weavers claim that certain motifs and designs were revealed to them in the dream. Just like women are weaving throughout Nigeria, Akwaete weaving is done on an upright frame loom with continuous warp and other accessories. The

production is from spun cotton fibres which are dyed to achieve different colour effects. After dyeing, they are rolled into balls and later transferred into the shuttles. However, due to the creativity of the weaver, special and several weaving designs are produced. The weaving process involves passing the shuttle which carries the weft thread through the created shed, by pulling the heddle and subsequently beating it down onto the cloth with the beater stick. From the other side of the cloth, the shed stick or beater is pulled out of the wooden shaft fastened. The beater is inserted again through the new passage (shed) created. The shuttle is passed again, through to the other side, and so it continues until the cloth is woven to the top. At this point, the tension ropes holding the horizontal beams are released so that the unwoven parts are drawn to the back of the loom.

Every fabric has its own uses as it applies to the culture of the weavers. Apart from the fundamental use of fabric-coverage of nakedness and protection against bad weather, Akwaete cloth could be used as wrapper for women-club uniforms, dancing groups, and special outings; men use it as shirt-Jumper, Wokor or Etibo and wrapper for special occasions. It is also used as table, cushion and lectern cover, academic hoods and priestly stoles. The productions of Akwaete fabric have transcended cultural barriers as a result of marriage and socialization. Aso Oke: The production of aso oke is particularly associated with Ilorin, Iseyin and Oyo, the Yoruba speaking areas of Nigeria. Due to the conducive soil and climate for the cultivation of cotton, many people engage in it. It is estimated that one out of every five male workers, is a weaver. Yarns, looms, winders (ero ikawu), racks (akata), standards (sugudu), shuttles (oko), pulleys (okeke), hanks, reeds (asa), pedals (itse) among others are material used for aso oke production. Varieties of aso oke are won to different occasions and these varieties are grouped according to the treatment given to the yarns and they generally have influence on the quality and price of the aso oke.

There are other cloths like the otegwu/Akwa ocha which is predominantly of white background. The oja or baby-tie fabric produced by the Yoruba and the Obuofia and Agbani women in Nkanu Local Government area of Enugu are often used by women to strap babies firmly on their backs. Men used it as loin cloths and towel, as burial cloth often referred to as Ishiofa and for Omaba masquerading (Okpoko and Igbo, 2012).

Pottery Making

Pottery is one of the tangible products of man's culture that is the first synthetic activity to be discovered by man. In Africa, pots are usually made by women (African Encyclopedia, 1974:408). Pottery making has remained relevant in the economic, social and cultural activities among the people of Nigeria. The products are clay cooking and storage utensils such as plates, drinking pots, and in some cultures, as part of their sacred objects. Clay, the fundamental raw material for pottery making is spread across the country. It is a product of disintegration of the field spathic, highly resistance to weathering, one of the most common materials on the earth surface and easily accessible to obtain. Local clays are usually identified by their colour and plasticity when wet and are predominantly high in iron oxide content and they influence the character of the finished work of the potter.

The commonest technique in pottery making is the coil building method in which the coil is continually added to raise the walls of a pot. The coils are rolled out in snake-like strips and these wet strips of clay are systematically used to build pots by arranging the coils one on top of the other in a concentric firm. The coils are joined by pressing and rubbing them together. The process of production has a chain reaction, which means that careless handling or by passing any of the

processes will adversely affect the entire product. The complete pots are then sun-dried before they are carefully arranged and covered with grass ready for open air firing, which lasted for about an hour to a temperature sufficiently high to change the physical and chemical properties of the original clay into a usable substance of hardness and durability resulting in the final product.

The production process starts with digging out the clay from its deposit and moving it to the production site. Traditionally, some cultures claim that clay digging and wining is an exclusive function of the men. The Afikpo potters of Ebonyi State, dig and transport their clay themselves, usually during dry season as almost clay pits are water logged during the rainy season. Besides, the period enables the potter to identify those clays with resistance quality to thermal shock and the proper plasticity for fabrication. In digging out the clay, the potter uses *Mma* (knife) and *Uwele* (a small hoe). The clay is dug out in bits and carried to the pit for processing. The production process is one of the essential stages as it determines the quality of the clay used. In some part parts of the country, sacrifices are offered to the earth goddess before commencement of the production. Traditionally, potters use simple and non-sophisticated tools that are localized. Bare fingers constitute the primary tool for the potter. The secondary tools include *Ntiti* for adjusting the form of the pot, *Mma* for scrapping, *Oba* (calabash) for smoothing and polishing the pot and *Mkpisi* (piece of stick) for decoration and smoothing the inside, damp dried leaf for shaping and smooth stone.

In preparing the pot, the potter collects the required quantity of clay, clears it of any trace of debris and other foreign materials, and properly sieved out with perforated calabash dish to remove large aggregate and other non-sand particles. The preparation is carried out on a hard surface usually a rocky or concrete floor, free from any non-clay particles to prevent contamination. The potter proceeds by sprinkling *Ezi-ura* or the builder's sand on the floor, followed by *Uvura* on the clay and then the kneading. During the kneading process, *Ezi-ura* and water are introduced at intervals until there is a proportionate distribution of the three constituents. Finally, the clay so formed is wrapped in a dried banana leaf to keep it moist pending when it will be used. Firing (open-air-fire/born-firing) is the peak of the production process and the most crucial stage in the creative process. Afikpo potters fire their works in an open place referred to as *Ohuhu* usually located at the outskirts of the village. Most pots are used for storing food and drink and cooking, and ceremonial uses; and in some cultures, as part of their sacred objects.

Nigerian traditional pottery began to be synthesized with developments in western world in 1952 during the colonial era. This led to the founding of Abuja pottery centre-pioneering centre for studio pottery in contemporary Nigeria, by bringing together potters from different parts of the country. It was this centre that brought *Ladi-Kwali*, the famous *Gwari* potter to lime light. Some other established pottery centres are *Okigwe* in Imo State; *Gboko Pottery Centre* owned by Benue State Government, *Maraba* and *Jacaranda* pottery centres in Kaduna State, both owned by private individuals. Unfortunately, pottery making is challenged by the lack of interest of the young generation in the industry and their preferences for foreign goods.

Canoe Carving

The 'dug-out' canoe is a long, narrow boat made from a hollowed tree-trunk. They are commonly used as means of transportation across rivers, lakes and coastal waters, and for fishing. Canoes are paddled by one or more people who direct their movement in the water. Canoe carving is associated with Niger Delta coastal communities. Among the *Ikwerre* of Rivers State the communities of *Oginigba*, *Ogbakiri* among others are known to engage in canoe carving. Canoe is

traditionally made by burning and cutting the inside trunk. The finishing includes forcing the sides to the right distance apart and shaping the ends with axe. The sides of 'dug-out' canoes are raised by attaching planks of wood (strakes) to them as to prevent water from filling the canoe while in use in the sea.

The process of canoe carving begins with the carver or his associate locating a tree in the forest that would provide the desired size of the canoe. The tree is felled down and cut into trunks depending on the size of the canoe. Before commencement of work on the trunk, he will make some incantation with native gin (khai-khai), alligator pepper (ise-aji) and kola (aji-diali). He will make his prayers to appease the gods and ask for their protection and blessings. The carver uses the axe and the knife to mark the shape of what he intends to carve and deepen it to certain extent. He places chaff and charcoal on the marked spot and ignites it with fire. As the fire is burning, he will focus directly on it to ensure it does not extend beyond the desired area. Thereafter, he uses the axe to give it the desired finishing.

Challenges Facing Nigerian Indigenous Technology

Indigenous technology has been challenged by western education and western science and technology. It is no gainsaying that, colonialism largely inhibited the development of indigenous technology in Africa and de-stabilized some of the existing processes of technical growth and the indigenous manufacturing capability was deliberately undermined to facilitate European exports. Also, laws were enacted that justified all their actions and captive markets that encouraged the dumping of cheap mass-produced textiles, glass and iron products in African markets.

Indigenous technology is further challenged by successive governments' licentious importation of all forms of foreign technology and the citizens' preference for foreign products as superior to the indigenous products.

3. Conclusion

One nexus to environmental sustainability is predicated on indigenous technology. Consequently, the importance of indigenous technology in Nigeria can therefore not be over stressed. In addition, indigenous technology also provides enormous data about ancient cultures. Thus, restoring the basic view of both nature and culture embodied in the traditional customs and beliefs is viable for the sustainable development of our environment.

Consequently, there is need for re-orientation of the social value system of the citizens from the current huge craving for foreign products and technology to a culturally and environmentally suitable technology is most viable option towards suitable indigenous technology.

Centres and institutes of African studies should be able to project indigenous knowledge which includes technology, in their researches and teaching for both academic and utilization purposes as to develop indigenous ways of making them available.

Policy makers and policy implementation, should take into cognizance our traditional industries and techniques and such, inward-looking planning will enhance the exploitation of local material, and these techniques could also be stored in database where it can be retrieved for further usage.

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