

Role of Technology Incubation in Science, Technology and Innovation (ST&I) Policy of Nigeria

Michael C. Amony and Patricia U. Chukwu

National Board for Technology Incubation, (Federal Ministry of Science and Technology) (NBTI)

Federal Secretariat, Phase II, Abuja.

Corresponding author: mikeamonye@gmail.com

Abstract: *The aim of this paper is to provide the role and effectiveness of using the Technology Incubation Programme (TIP) under the National Board for Technology Incubation (NBTI) in supporting the Science, Technology and Innovation (ST&I) policy of the Nigerian government. The study used available information on TIP and the ST&I policy documents. After analyzing the information in the documents and the achievements made by similar incubation programmes in other countries, appropriate measures which can be put in place to enhance the dividends of technology incubation in the Nigeria's ST&I policy were recommended. Therewith lies responsibilities of the Federal Government and the Ministry of Science and Technology as well systematic reforms and increased responsibility of the National Board for Technology Incubation which are to be geared to focus on R&Ds, their diffusion and assimilation into the Nigerian economy.*

Keywords: *Technology, Incubation, Science, Innovation, Policy, Business.*

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I. Introduction

The concept of Technology Incubation was introduced to the Nigerian Government by the United Nations Development Program (UNDP) and the United Nations Fund for Science and Technology for Development (UNFSTD) in 1988. The Federal Government then commissioned a consortium of three firms to advice on the desirability and implementation modality. Eventually, the first Technology Incubation Centre (TIC) in Nigeria was established in Agege in 1993, followed by the ones in Kano and Aba in 1994 and 1996 respectively (Adelewo et al, 2012). The objectives of technology business incubation in Nigeria as summarized by Adelewo et al 2012 are (a): to boost the industrial base of the country, commercialization of R&D results, upgrade and enhance the application of indigenous technologies. (b): to nurture the start-up and growth of new innovative businesses engaged in value added and low, medium, and high technological related activities over a period of time, and (c): to promote functional linkage between research and industry.

During the past twenty nine years Nigeria has established 36 TICs with 15 extensions, under the National Board for Technology Incubation (NBTI). An appraisal of the operations of the Board since inception shows successes and progress though in the arithmetic sequence. Whereas population and youth unemployment in the country grow geometrically, there is need to cause technology proliferation and assimilation of R&D results in the country to move at a faster rate to achieve our aspirations of industrialization leading to economic growth and general wellness of the citizenry.

II. Status of technology in Nigeria

Several Visions and Goals of the country which include the Vision 2020 and Sustainable Development Goals (SDGs) are dream statements to aim Nigeria into the league of developed economies in the world in few years to come. These are based on assessment of its abundant human and natural resources and on the assumption that the country's resources would be properly managed and channeled to set economic goals. (Eneh, 2011). Achieving this vision depends on our creation, assimilation, proliferation and utilization of science, innovation and technology.

Technology plays a fundamental role in wealth creation, improvement of the quality of life and real economic growth and transformation in any society. Analysis of technologically advanced economies shows that at each level of the economy, science and technology provide the engine for economic growth. For example, in the case of primary products, application of science and technology significantly increases the yield from agricultural production and mineral beneficiation. Similarly, new and existing industries do stimulate economic growth at the intermediate level, while the overall volume of activity at the tertiary level is amplified by increased use of science and technology associated with information technology and improved distribution/marketing networks. Therefore, the need for countries with the intention to grow, to invest significantly in

science and technology cannot be overemphasized. This is achieved by developing the talent, the human capacity required to compete in a globally competitive world of today. (Egbogah, 2012). The successes recorded by technologically advanced countries were all based on carefully designed roadmaps of plans and strategies. Nigeria in fashioning roadmaps and strategies for technological growth has established several research institutions for R&D in various areas of our economy and has established The National Board for Technology Incubation (NBTI) as the vehicle to move R&D results from these research institutes and tertiary institutions into the mainstream of the economy.

But having prepared roadmaps and strategies, we need to evaluate the enormity of our technological backwardness and determine the magnitudes and directions of the forces needed to push us through the roadmaps and strategies till we arrive at technological stardom. As rightly styled as a vision and goals are, they can only be achieved if we are able to determine the distance between where we are standing and where we want to go. Where we want to reach is simple to infer. Where we are is summarized by Uwaifo and Uddin in the following manner:

A country is said to be technologically backward when:

- i. It cannot produce capital goods such as tractors, lathe machines, drilling machines, cars, trains, and other earth moving equipment.
- ii. It is unable to exploit her natural resources except with the help of foreigners who will normally provide the technology and expertise to undertake the exploitation of her natural resources.
- iii. It is unable to mechanize her agriculture i.e. crude implements are still used for agricultural production activities by a large percentage of those who are involved in agricultural production.
- iv. It depends on other countries for the supply of its spare parts for industrial machinery
- v. It exports raw materials to other countries as against finished products
- vi. It is unable to produce her own military hardware with which to defend herself if the need arises.

A critical examination of Nigeria reveals that all the points itemized above are present in the country. Thus Nigeria as spelt out in the items above is a technological backward country. (Uwaifo and Uddin 2009). Correlating this obvious fact Eneh opines that Technology diffusion is at the lowest ebb in Nigeria and that with Nigeria's educational system in prolonged crises of decaying infrastructure and the attendant agitation of staff for a change, R&D which is the most significant driver of industrial performance is poor and therefore cannot be appropriated for meaningful development in Nigeria. (Eneh, 2011). The fact is that we all know where we are and no matter the words different Nigerians choose to describe the situation, the truth is that we are grossly technologically backwards. It is comforting however that there are things the Federal Government can do, things the Federal Ministry of Science and Technology can do and reforms the National Board for Technology Incubation can infuse to revolutionize technology creation, assimilation and diffusion in Nigeria.

III. ST& I policy in Nigeria

The FMST is a Service Ministry of Government and as such, has the mandate to interact with all relevant agencies and organizations, synergizing and promoting the application of ST&I results in all sectors of the economy. (FMST, 2012). The areas expected to be covered 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. (FMST, 2012)

The vision of the policy is that by this time in our history, Nigeria would have a large, strong, diversified, sustainable and competitive economy that effectively harnesses the talents and energies of its people and responsibly exploits its natural endowments to guarantee a high standard of living and quality of life for its citizens. And the mission is to make Nigeria an evolving nation that harnesses, develops and utilizes ST&I to build a large, strong, diversified, sustainable and competitive economy that guarantee a high standard of living and quality of life for its citizens. The specific objectives of the policy are to:

- i. Facilitate the acquisition of knowledge to adapt, utilize, replicate and diffuse technologies for the growth of SMEs, agricultural development, food security, power generation and poverty reduction.
- ii. Support the establishment and strengthening of organizations, institutions and structures for effective coordination and management of ST&I activities within a virile National Innovation System (NIS).
- iii. Encourage and promote creation of innovative enterprises utilizing Nigeria's indigenous knowledge and technology to produce marketable goods and services.
- iv. Support mechanisms to harness, promote, commercialize and diffuse locally developed technologies for the production of globally competitive goods and services that intensively utilize Nigeria's raw materials.
- v. Facilitate and support the creation and maintenance of up-to-date, reliable and accessible database on Nigeria's ST&I resources and activities.

- vi. Promote activities that enhance effective ST&I communication and inculcation of ST&I culture in Nigerians.
- vii. Create and sustain reliable mechanisms for adequate funding of ST&I activities in Nigeria.
- viii. Initiate, support and strengthen strategic bilateral and multilateral co-operations in science, technology and innovation activities across all sectors of the economy.
The strategies designed in the policy to achieve the vision, mission and objectives are:
 - i. Science, Technology and Innovation Promotion
 - ii. Human Resource Development in ST&I
 - iii. Research and Development (R&D) in Agriculture, Biotechnology Research, Natural Products, Natural Medicine, Pharmaceutical Research, Energy, Environmental Science and Technology, Mines and Materials Development, Ferrous, Non Ferrous and Chemical Technologies Research, Space Research and Investments, New and Emerging Technologies (Nanotechnologies and New Materials), Raw Materials and Manufacturing, Defense & National Security, Youth, Sports and Tourism Development, Works, Land, Housing and Urban Development etc.
 - iv. Science Laboratory Technology (SLT)
 - v. Intellectual Property Rights
 - vi. Technology Transfer and Diffusion
 - vii. Standardization and Quality Assurance
 - viii. ST&I Information Management System
 - ix. Women and ST&I

IV. National Board for Technology Incubation (NBTI)

The role of NBTI is to coordinate the Technology Incubation Programme (TIP) in Nigeria while the actual incubation process takes place at the Technology Incubation centers (TICs) spread all over the country. The functions of NBTI inter alia are policy implementation and coordination which involves development of operational guidelines. Other roles include supervision, monitoring and evaluation; Financial Management and Control; Sourcing of fund; National and International Liaison; Program Planning and Development as well as provision of legal services. (Obaji et al, 2012). At the TIC level the incubation process is initiated if a prospective entrepreneur has an idea and wants to be incubated. He will then put his proposal in writing together with the technical and business plans for consideration by the management of the TIC and if it is analyzed and found to be proactive, then he will be admitted.

The goal of TIP is to assist small scale budding entrepreneurs to overcome the initial hurdles of carrying viable R&D results as well as innovative efforts into profitable enterprises (FMST, 2005). And the mandates are:

- i. Provide a platform for speedy commercialization of technologies by effectively linking talents, technology, capital and knowledge.
- ii. Create, nurture and develop value-added technology-based enterprises.
- iii. Promote the establishment of and management of viable science and technology parks, technology incubators and technology-based enterprises.
- iv. Enhance linkage of tenant/technology know-how and capital in order to develop techno-entrepreneurship culture based on continuous value addition.
- v. Promote and facilitate the application of indigenous technologies and knowledge.
- vi. Set standards for and regulate the establishment and management of Science and Technology parks and Incubators

Business incubation

The National Business Incubation Association (NBIA) defines business incubation as a business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services. These services are usually developed or orchestrated by incubator management and offered both in the business incubator and through its network of contacts. A business incubator's main goal is to produce successful firms that will leave the program financially viable and freestanding. These incubator graduates have the potential to create jobs, revitalize neighborhoods, commercialize new technologies, and strengthen local and national economies.

In general, a business incubator will focus on a range of services on clients that are designed to help them launch well managed businesses. This mix of services is generally drawn from: administrative services (photocopying, bookkeeping, etc.); business advice services (coaching, counseling, mentoring, training), technical services (technical advice, access to expensive equipment, etc.), finance raising, and networking opportunities (between clients, links to wider business community). Other services (loan & venture capital funds, lobbying for special services/bureaucratic treatment, etc.) are sometimes developed to help clients overcome specific problems in the given business environment. Clients can be resident, non-resident or

affiliated to the incubator. The services targeted on clients are costly in relation to many other types of business development services (training programs, advice services) but are justified by supporters as “investment in success” because the concentrated support services should lead to higher survival and growth rates of incubated businesses (InfoDev., 2010).

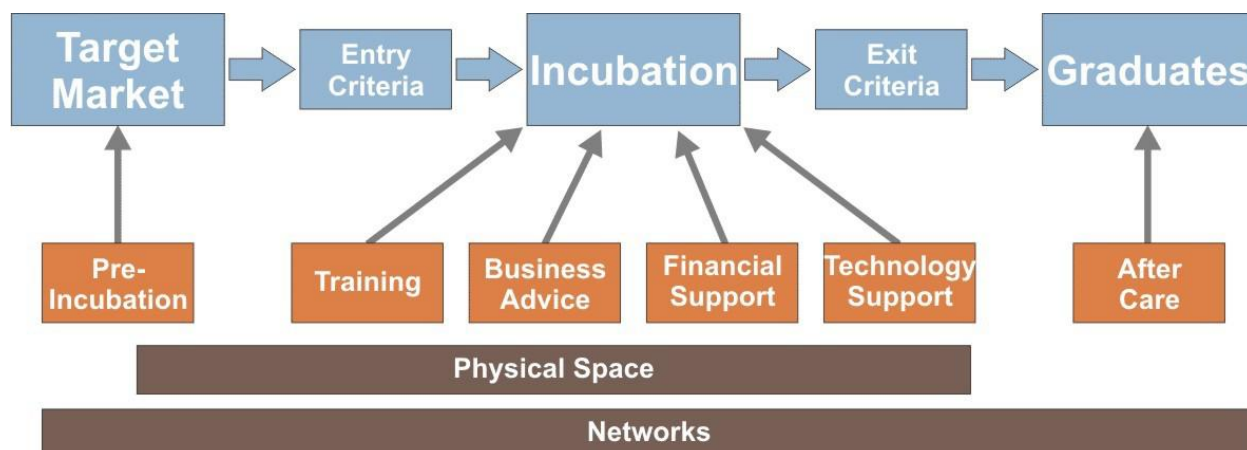


Figure 1: A typical business incubation process (InfoDev., 2010).

Figure 1 depicts the general incubation process. The prospective incubatee after meeting the entry criteria is admitted and during incubation is supported with training, business advice, funds and technology knowledge. On graduating from the TIC is still eligible to access some advice as “After Care Services” (referred to as Post incubation in the TIP scheme) till he becomes financially viable and freestanding. Business incubation practice, all over the world is structured in the pattern shown in Figure 1 above, but the objectives may differ from country to country. For instance the Jewish State of Israel in 1991 launched Nationwide Technology Incubation programme to utilize the S&T potentials of immigrants from the Soviet Union. The programme is a tremendous success. When the United States recognized the existence of critical mass of scientists, technical infrastructure, ethnically diverse and world-class universities in the system they launched the “Silicon Valley Incubator” which generated 7,000 electronics and software companies, 300,000 top scientists (1/3 born abroad) with many new firms and new millionaires made almost every month. (Adelewo et al, 2012).

Role of NBTI in ST&I policy of Nigeria

Out of the eight specific policy objectives listed above, five are critical to the mandate and activities of the NBTI. This underscores the importance of the role the present government of Nigeria expects NBTI to play in driving the economy using science, technology and innovation. The five pertinent specific policy objectives in the ST&I policy achievable through technology incubation are to:

- i.** Facilitate the acquisition of knowledge to adapt, utilize, replicate and diffuse technologies for the growth of SMEs, agricultural development, food security, power generation and poverty reduction.
- ii.** Encourage and promote creation of innovative enterprises utilizing Nigeria’s indigenous knowledge and technology to produce marketable goods and services.
- iii.** Support mechanisms to harness, promote, commercialize and diffuse locally developed technologies for the production of globally competitive goods and services that intensively utilize Nigeria’s raw materials.
- iv.** Facilitate and support the creation and maintenance of up-to-date, reliable and accessible database on Nigeria’s ST&I resources and activities.
- v.** Promote activities that enhance effective ST&I communication and inculcation of ST&I culture in Nigerians.

The National Board for Technology Incubation (NBTI) in working within the framework of its mandate is expected to achieve the specific objectives of this policy especially in the above five pertinent areas of the ST&I policy. The basic objectives of any technology or business incubation programme is to boost a country’s industry base through commercialization of R&D results, nurture start-ups and grow new innovative businesses thereby promoting functional linkage between research and industry. Israel achieved the above stated objectives and reaped immensely because it was keyed to certain potentials and need. The United States has many incubators but the most successful has remained the “Silicon Valley” which was keyed to the conspicuous existing potentials and targeted at need in the electronics and software development. Similar examples abound in China and Korea. Nigeria’s Technology Incubation Programme is generally guided by the basic objectives as written in the mandate and affirmed by Nigeria’s S&T policy objectives. Though it has keyed to exploring potentials of R&D results from our higher institutions, but because of little defined focus of

the R&Ds, it has not very clearly targeted to address the problems that would lift us from technological backwardness. Even the much talked about R&D results from our universities and research institutes require reality evaluation and classification. It is to be observed that despite huge expenditure in R&D by way of funding our research institutes and universities, the country virtually imports everything.

V. Recommendations

There are very few products in Nigeria that has been well developed to beat the imported alternatives to the extent that the masses would prefer the indigenous product rather than the imported alternatives. R&D direction needs to be determined within the mandates of the various organizations, wherefore the development of technologies that would lift Nigeria from dependency and technological backwardness should be fostered with maximum dexterity. It is opined that a time has come when the arbitrary choice of projects to develop in R&D institutions should not be encouraged. The Federal Ministry of Science and Technology should be empowered to itemize researches in line with the need to cure the country's technological backwardness and in keeping with the various mandates of the institutions, allocate justified problem statements to the institutions to tackle. When this is done, NBTI would have access to enormous technologies which the consequent incubation process would turn into geometric multiplication by way of growth, spillovers and spin-offs with the underlining benefit of lifting the country from technological backwardness to technologically developed nation. In order to achieve the objectives of ST&I policy, the following recommendations on how to use NBTI's role in achieving the policy are presented::

- i. Many Federal Ministries in Nigeria have research institutes and R&D departments in which most of their mandate areas entail the utilization of science and technology. For Nigeria to become a developed country, the Federal Ministry of Science and Technology (FMST) should be empowered to co-ordinate all science and technology related R&Ds in the country. The Ministry should have analysis desk to understudy the country's developmental needs and allocate researches to all research institutions singly or in collaboration with each other. The R&D shall be monitored by the Ministry until conclusion and when completed the Ministry should physically supervise the test-run and evaluate its societal value before passing to TICs under NBTI for diffusion into the economy. This procedure is in tandem with best practices where R&Ds are initiated from reality problem statements and not out of the will and emotions of an individual chief executive of an establishment. R&Ds that involve utilization of public funds should not emanate from somebody's feelings about a problem but by an actual quantifiable establishment of a problem which its solution would positively influence the economy in no small way. When the federal government promulgate an instruction to this effect and the Ministry of Science and Technology executes a mindful programme, R&Ds in Nigeria apart from being focused shall also be need driven and of immense value to the country. Lack of proper co-ordination hitherto has led to unnecessary R&D duplications.
- ii. Many agricultural research institute and even some non-agricultural institutions in Nigeria would lay claim to R&D in Garri processing and Maize threshing which are already assimilated local technologies. In as much as such developments are within their mandate, if they had been directed to channel research energies towards a new technology (mass development of fertilizer for instance), the impact on the economy would have been better. It is pertinent to note that within the mandate of any research institute, there exist chains of possible innovations and R&Ds which the institute can embark on. The Minister of Science and Technology can be assigned to be the coordinating Ministry for Research and Development in Nigeria, just as we already have Minister for Finance as the Coordinating Minister for the Economy. The gains from such a structure would be enormous. Technology creation, value addition shall abound in the right directions. R&D results incubation, proliferation, dissemination, diffusion and assimilation would become simpler and all R&D shall be channeled towards achieving the goals that would launch the country to industrialization.
- iii. Universities and other higher institutions in Nigeria need better infrastructure and increased funding as this would move the educational system to the next level, the R&D results achieved with existing infrastructure and funds have not been assimilated into the economic system. While the Incubation policy expect the NBTI to take up the output of science, technology and innovation from these institutions and commercialize them, a vehicular framework need to be established to marshal R&D results into the economic mainstream directly or through the activities of the NBTI. It is thus recommended that student projects from the higher institutions at degree, higher national diploma level and above in science and technology related areas should be enlisted for execution only if they are at the instance of registered companies or co-operatives in Nigeria and/or be approved by the FMST. This would not only key the R&Ds to the need of the country but also enable graduating students from such institutions to initiate R&D based businesses (technology-based enterprise) which would be easily and successfully incubated by NBTI.
- iv. NBTI can close the gap by accessing the existing scarce R&Ds in our institutions; understudy the technical details to completely understand the technology to be able to transfer it to prospective entrepreneurs while protecting the design and patent rights of the technology creators where applicable. It is adduced that

when a letter of collaboration for commercialization of R&D results is sent to research institutes and Faculties and Departments of Engineering and Technology in our higher institutions by NBTI, there will be positive responses from most institutions which would lead to the accessibility of most R&Ds and their eventual passage into the economic mainstream directly or through entrepreneurial incubation. The research institute or faculty or department whose R&D result shall be commercialized under this collaboration, shall prepare a 'Project Handbill' for each project developed and ready for commercialization.

The handbill for each project shall contain relevant information stating amongst others, the current starting cost estimate including cost of equipment, installation, weekly raw material requirement, expected profit and project break-even and the area or people of the country where the technology business would thrive. Such handbills shall not be more than six pages or less than three pages. The developing research institutions shall supply these handbills to the National Board for Technology Incubation (NBTI) in quantities needed. By this process NBTI shall become a Technology Knowledge and Expertise Bank of sorts.

- v. Most Nigerians would want to become successful business owners, many are reluctant to change their locations; and whereas accommodation, power accessibility and common utilities are not the only assets needed to guide the entrepreneur to financial self-reliance and independence, NBTI have spread its tentacles and emphasize Virtual and Affiliate Technology Business Incubation schemes, even as Resident Incubation scheme which has already taken root shall still be fostered and enhanced.
- vi. Knowledge is power and the world is moved by knowledge-driven ideas of great men and women. Hence, apart from sourcing knowledge from our orthodox institutions, NBTI shall also source and disseminate technologies from the local economy where spillovers and spin-offs lead to value added technologies. In the same vein, business management and market knowledge alongside the knowledge and information of loan and grant accessibility and modalities from government, financial institutions and international organizations shall be adequately covered and harnessed through the NBTI Knowledge and Expertise Bank. The operational system is depicted in Figure 2.

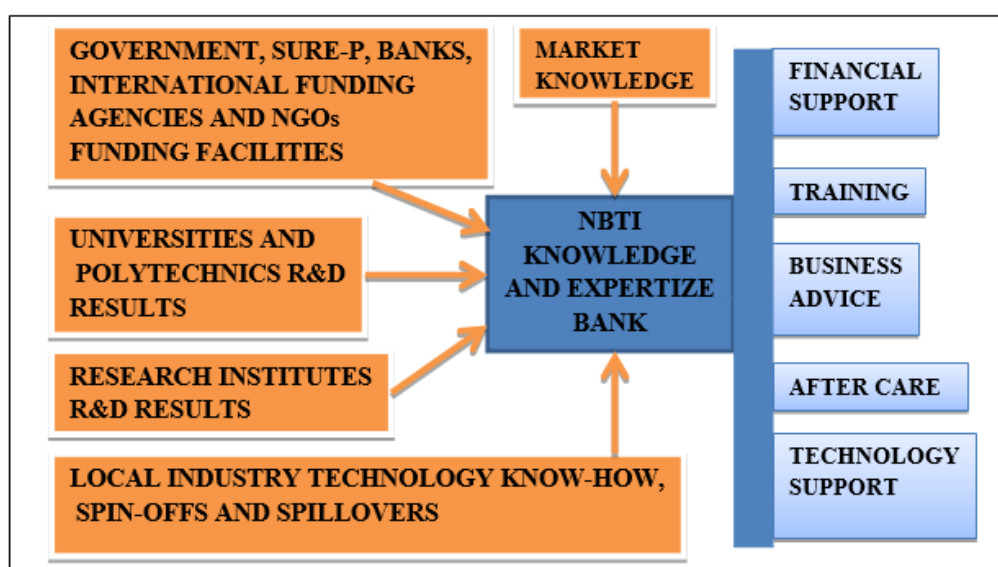


Figure 2: NBTI knowledge and expertise bank

From this knowledge bank, entrepreneurs under any class of incubation shall access financial support, training, business advice, technology support and after care services, when NBTI has stocked the bank with requisite knowledge in all of its operational areas. Thus when a prospective entrepreneur comes with an idea, the idea shall be sharpened with the knowledge stock of NBTI provided to the TICs. Apart from their own ideas, prospective entrepreneurs shall have access to hundreds and thousands of viable technology business ideas. Also multiple services and guidance to the Virtual and Affiliate Incubatee is sure and easy. Information dissemination shall be enhanced and Nigerian youths would be encouraged to register with NBTI under the Residency, Virtual or Affiliate schemes.

VI. Conclusion

This paper attempted to align the role of NBTI to the objectives of the revised Science, Technology and Innovation (ST&I) policy presented to the public in 2012 by the Minister of Science and Technology. Recommendations were proposed on how to achieve the objectives of ST&I policy in the context of Nigeria and

how the ST&I systems in the country can be used to ensure the fast-tracking of wealth and job creation through the supportive effort of NBTI as well as industrialization of the country through creation of innovative technology-based businesses [R&D based Small and Medium Enterprises (SMEs)].

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