

TUNISIAN ENGINEERS: PROTAGONISTS OF TUNISIA'S MODERNISATION. TWO KEY MOMENTS: 1956 AND 1987

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ABSTRACT. Engineers have played a key role in Tunisia's modernisation process during and after its independence. They were crucial in almost all aspects of life. From the beginning of the reformist project, they were close to power and even made demands according to their interests. However, they did not know how to generate such cohesion within their group that would allow them to consolidate and have political influence. Two fundamental moments in the process of modernisation showing the evolution of a profession that went from the height of its splendour to its decline, with all that this meant and implied for all aspects of Tunisian life.

KEYWORDS: History of engineering, history of technology, Tunisia, contemporaneity.

1. INTRODUCTION

This article discusses the historical development of the figure of the engineer in Tunisia and his role in modernisation, focusing on the period following Tunisia's independence, identifying two key moments, 1956 and 1987. The purpose is to study the phenomenon articulated in its historical context of unprecedented changes, with implications in all aspects, from the political, economic, educational system, and mentality. This will allow us to think about the socio-professional category of the engineer from different angles, from his academic process, his professional networks, his link with power, but also to consider his motivations and expectations. In a way, the historicisation of this phenomenon allows us to think of the past in terms of the present situation.

The main objective is to study and analyse the development of the figure of the engineer in Tunisia during the post-independence period up to the present day, focusing on two key moments: 1956 and 1987. This will involve addressing the evolution of the socio-professional category *engineer* as a fundamental actor to understand the modernisation process of the Tunisian country, articulating them to a project promoted by the State, giving them a key role as the main actor in its modernisation. Likewise, it will be key to define and reflect on concepts such as modernity and modernisation, to understand the scope and impact of this project on social, political, economic, and cultural life. Likewise, to identify and describe the organisation of the higher education system to which the engineer is subscribed and to problematise the relationship between the know-how, the professionalisation of knowledge and its relationship with power, and to think about the circulation of students, as well as the transfer of knowledge and technology in the unequal logics of producers and receivers of the same.

Today, Tunisia's higher education system is recognised worldwide for its quality and massification, i.e. the democratisation of access to higher education has been a commitment for several decades. However, the growing unemployment of engineers is causing great concern and calls for historical reflection in order to decipher or try to understand why this fundamental figure of the country's economic progress has found itself in this situation of difficulty in entering the labour market, choosing and accepting precarious employment or leaving the country in search of better opportunities. As the path of this article, this problem opens up the possibility of asking other questions, such as: Were engineers really the protagonists of Tunisia's modernisation, or did they turn out to be only an instrument of state power to promote the development project adjusted to its interests? What results and impacts occurred for the working life, expectations, and motivations of engineers during the two key moments? Is the socio-professional category "engineer" homogeneous or can we find discriminatory mechanisms?

Methodologically, the *history of engineering* considers the central importance of the figure of the engineer from the industrial revolution to the present day, to discuss his role in the economic development of nations, as well as the relationship that exists between knowledge, engineering practice, and power. This perspective understands the importance of historicising the rationality of engineers, since this should not be confused with some kind of generic and abstract logic, but rather, that it is shaped by individual perceptions and interests that are at the same time linked to institutional, normative structures, etc [1]. Furthermore, this approach is interested in the engineering profession in its institutional framework, its evolution, and its forms of association, as well as in its technical achievements and its social dimension [2, p. 422].

From the perspective of the *history of technology*, it is essential to consider the role of political and social factors in technological advancement, i.e. there is no doubt that technology is socially constructed, but it also influences society [3]. And this interest of this historical perspective is directed to the study of the process of creating technological capabilities through learning that conduces to assimilating, using, adapting, and modifying existing technologies. This makes it possible to reflect on the unequal relationship between countries that receive and produce knowledge and technology, where in advanced countries, through research learning, the limits of knowledge are expanded and the accumulation of technological capabilities is guaranteed, as opposed to the situation in developing countries, where the learning process tends to be imitative, limiting the scope of creative development [2, p. 327]. This implies the act of transferring knowledge and technology without an effort to internalise it, and here the role of the State in implementing strategies and policies to promote the demand for technological learning and promote the supply of technological capabilities and, through financial and fiscal incentives, facilitate their interactions, is fundamental [4, p. 330]. Another element to consider is the circulation of knowledge, in this case corresponding to the movement of Tunisian students who are trained abroad, mainly in France. This process should be thought of as professional migrations that are multilateral and polycentric, although not multidirectional, since the flows always seem to be from less developed countries to more competitive locations in a global economy, which may result in the loss of control over their qualified citizens producing the phenomenon also known as "brain drain". Mobility has always been considered a normal phenomenon in the world of scientists and engineers, which is why the notion of nomadism and diaspora allows us to understand it as an intellectual, spatial, and social behaviour of actors who are not isolated entities, in which science and technology benefit, because these movements are articulated to dynamics of competition or cooperation. Once again, the asymmetric relationship between producers and receivers of knowledge and technology is judged negatively when concentration prevails over dispersion and redistribution. Taking up again the notions of *nomadism* and *diaspora*, we wish to highlight their characteristics of aiming to expand their professional and socio-cultural networks, but also of seeking to mobilise and connect them, wherever they are, with their country of origin. Furthermore, these notions have the effect of dislocating (relocating) knowledge [4, p. 352], and at the same time it is inevitable to come to the consideration of the concept of circulation as it implies a movement of knowledge that is continuously shaped in the process [5, p. 17].

We can define technology as a cultural system referring to the relationships between humans and their environment and technology transfer as a chaotic and

disordered process involving groups and individuals who may have different views on its value and potential use. The social sciences define technology as a socio-technical process involving the transfer of cultural skills that accompany the movement of machinery, equipment, and tools. The concept of technology transfer is not only the concern with the transfer of knowledge or technological information, but also the ability of the recipient of the technology to learn and absorb the technology into the production function. There is no doubt that technology and knowledge transfer are inextricably linked because when a technological product is transferred or disseminated, the knowledge on which it is based is also disseminated, i.e. technological development occurs when there is a transfer of knowledge, because knowledge is the key to controlling technology [3].

In the case of Tunisian engineering, works carried out by sociologists, political scientists, demographers, and historians, some from Tunisia and others of French origin, using qualitative and quantitative methodologies, focus on training, social origin, positioning in the labour market, but hardly on professional activities and tasks. The outstanding texts of the Tunisian sociologist Lilia Ben Salem, recognised for her work on higher education and social change in contemporary Tunisia, are [6] and [7], in which she defines the conditions for the emergence of Tunisian engineers as a very recent phenomenon and establishes their fundamental participation in modernisation. The author also presents contradictory and paradoxical aspects such as the impact on the massiveness of higher education, which allowed a wider access, but produced a situation of increasing unemployment among engineers and *brain drain*. In [8, 9] and [10], Sociologist and political scientist Eric Gobe focuses on the case of Tunisian engineers in their political, economic, institutional, and social context since independence and the decline with economic liberalisation, as well as aspects regarding the professionalisation of engineers by describing the training and association systems and analysing their operating logic and articulating these to the dynamics of the job market and the various discrimination mechanisms in a neo-liberal context. Similarly, in [11], from a gender perspective, to emphasise the incorporation of Tunisian women in the institutional frameworks of engineering training, but highlighting their situation of unequal opportunities when it comes to entering the employment market. Anousheh Karvar has carried out research on engineers from an international perspective and the politics of their initial and continuing training. The text [12] confronts questions regarding the Tunisian developmentalist model implemented since the independence and examines the role of the State in the management of the reform crisis and the pressure of international financial institutions in the failure of this model. François Sino in [13] approach the relationship between science, development, technology, and power, where the na-

tionalist element permeates the development-science discourse and which is instrumentalised by the state, first to legitimise its developmental project and then to incorporate it in the construction of the higher education system. For the author, the science and scientific activity are determined by political decisions, institutional choices, and administrative regulations. Sofiane Bouhdiba in [14] examines the evolution of the situation of the French language in the Tunisian educational system. Mohammed El-Aziz Ben in [15] raises the ramadan crisis framed in the modernisation process undertaken by Bourguiba, but establishes that what happened was not a rupture with the Muslim religion, but rather an instrumentalisation of that religion to legitimise the country's economic development project, incorporating a discourse of the holy struggle, the "jihad", against underdevelopment and exhorting to break the fast during Ramadan if it affects productivity.

2. A MULTIPLE CONTEXTUALISATION: THE TWO FUNDAMENTAL MOMENTS FOR UNDERSTANDING THE MODERNISATION PROGRAM, 1956 AND 1987

The key moments, 1956 and 1987, were chosen as two scenarios of rupture and continuity. The first, concerning the emancipation from French colonial power, was a break with a history that had left Tunisians frozen in time, but it did not imply a radical break with that past, either because the traces were so deep or because the legacy was reappropriated. It is here that reformism, under the leadership of Bourguiba, achieved to shake the dormant or aligned spirits, beginning an awakening of the Tunisian conscience. The second scenario does not stand out because of the Ben Ali's military takeover, which is already a spectacular event, but because Tunisia had to react and adapt to a global change, the world was no longer the same as it was in the middle of the twentieth century, and in trying to reach this encounter with historical changes, but we perceive a continuity with the reforms of the first moment, which showed the inability to respond to these global transformations.

Since before independence, i.e. the departure from French protectorate status in 1956, it is possible to refer to the first signs of a reformist movement in Tunisia. But would it be correct, once emancipated, to consider this as a process of modernity, or are we facing a modernisation scenario? To do so, we must define what is meant by modernity and modernisation. We must start from the premise that modernity refers to a general transformation within society that shakes all its structures. We are talking about changes ranging from a change in political power to a change in mentality. And although it is true that power changed hands in independent Tunisia and its reforms expanded educational coverage and citizens' freedoms,

it does not cease to cause concern that the political system installed a regime that co-opted all powers, that censored freedom of the press, that limited political participation, that is to say, it was an authoritarian regime that gave some hopes for freedom, but did not completely separate political power from religious power. So, we are facing a process of modernisation, which refers to a process, unequal and unfinished, of technological, political, economic, and educational development, where great importance is given to the technical dimension and the overvaluation of technical skills and competences [6, p. 60]. Of course, there were some changes in the mentality of the society, but it was not general, probably before the imposition of Western ideas caused the reaction and the Tunisian resistance and its values.

The temporality that corresponds to us, i.e. the two key moments in 1956 and 1987, but a brief exploration of the near past to allow us to think about a reformist precedent. In the second half of the 19th century, the debate on European scientific and technological superiority within the Ottoman Empire arose, which caused not only astonishment but also fear, since there was a feeling that the *Muslim world* was backward. According to them, it was through Islam that Europe gained access to science and they gave it the place that it deserved, perfecting it, enriching it, and dominating the Muslims [13, p. 33]. The reformist movement in the Tunisian territory began at the hands of the Ottoman Empire between 1839–1880, with the westernisation of the state apparatus, justice, finances, army, and education. Previously, the *Bardo Polytechnic School* had been founded in 1837, where the translation of masterpieces of European military art took place. Outstanding figures include Ahmed Ibn Abi Dhiâf (1802–1874), who was ahead of his time in considering that studying in the West would allow to reach their scientific level in order to import knowledge and integrate it culturally; and Khayr ad-Dîn, who found no contradiction with the specificity of European civilisation and the Muslim religion, and even considered that global access was the very condition for the preservation of Islamic specificity. He founded the *Sadiki* educational institution in 1875, and it became the place where "modern elites" were formed, among them the great leader of Tunisian independence, Bourguiba. This institution, which was tuition-free at all levels, meant taking away the educational monopoly of the religious authorities of education, the ulama, and making it a state affair, without leaving aside religious education, but incorporating legal instruction and "profane" sciences (mathematics and natural sciences), in addition to foreign languages, such as French, Italian, and Turkish. In 1896, the *Al-khaldûniyya* was constituted as an association aimed at organising courses and conferences on history, geography, French language, political economy, hygiene, physics, and chemistry. These first reformist steps allow us to understand that it was no coincidence

that the so-called “Tunisian youth”, a group of liberals, nationalist, and secular ideology, emerged in 1907 and whose objective was the defence of Tunisian rights until 1911. The entry of the French colonist into Tunisian territory occurred in 1881 and was declared a protectorate, prevailing over the domination exercised by the local rulers of the Ottoman Empire, and through the figure of the protectorate, avoided its formal annexation, usurped its sovereignty in administrative, judicial and financial decisions and reforms. As a consequence, a local bourgeoisie and a working class emerged, particularly linked to the mining sector, encouraged the development of salaried agricultural work and favoured a remarkable accumulation of educational capital, particularly bilingual [16, pp. 9–11]. It was only after the First World War that the French colonial power began to exercise considerable control in Tunisia through a project of rational exploitation in the face of the scarcity of raw materials and to increase agricultural production and medicine, which was masked in the discourse of the “civilising mission”, of the benefits of science and progress.

With the proclamation of independence in 1956, Bourguiba's leadership co-opted the executive and legislative powers, abolished the monarchy, and proclaimed Tunisia a republic, establishing a presidential regime and freedom of association or legal political opposition only with the consent of the government, that is, an authoritarian reformism, which was based on the idea of a “modern state” and a secularised society, and transferring the application of justice to the ordinary courts. This did not mean a secular State, since the eligibility for the presidency of the Republic was conditioned by belonging to the Muslim religion, but the subordination of the religious sphere to the State [16, p. 18]. The religious aspect was fundamental in the Tunisian reformist process, since the modernisation would have been impossible without the first important Muslim identity element, religion. The leader of the developmentalist project, Bourguiba, ably instrumentalised it to legitimise his project. He defied one of the most respected mandates, the Ramadan fast. Not only had he had taken the administration of justice and education out of the hands of religious power, but he now also encouraged people not to fast if it affected productivity. He appealed to references of the prophet Mohammed who decided not to fast during the holy war, that is to say, Bourguiba exhorted to carry out the *jihad* against underdevelopment, to break the fast invoking the interests of the nation [15, p. 341], because, for him, the Muslim religion should not conflict with the prosperity of its faithful. Of course, he encountered resistance, but also support, especially from the new bourgeois elite who identified with the ideals of progress and modernity. A few decades later, the consequences were felt with the resurgence of Islamist movements that perpetrated violent acts in the name of the recovery of Muslim values and against the betrayal and

decadence of these values because of reformism. In 1960, the observance of Ramadan fasting was limited in the name of the fight against underdevelopment, and university students and soldiers were allowed to abstain from Ramadan fasting. The reform had to pass through mentalities, the impact had to spread over the population as well, and science had to become an authentic culture of modernity, for the reformers considered that backward mentalities, archaic traditions, bestial instincts, superstitions, abject passions, tribalism, clan spirit, and corruption had to be overcome [13, p. 57]. This implied, in the words of the leader Bourguiba, *decolonising minds*, getting rid of complexes particularly in the intellectual and scientific fields [13, p. 58].

Regarding the economic reforms of this first stage, the central bank was created, the French concessionary companies of railroad infrastructures, ports, water distribution, and electricity and gas production were nationalised, and half of the mining companies were bought. They also recovered the most fertile lands that were in the hands of the colonists. Companies were created in the steel, metallurgical, chemical, cellulose, and paper sectors, and private capital was directed towards the textile, construction and public works, agro-industry, and tourism sectors. In this stage of reformism, two visions converged: a liberal perspective with a socialist one based on a system of state corporatism which, while seeking structural changes, avoided class struggle and the radical abolition of private property [13, p. 20]. The policy of intervention in the economy continued in the late 1960s and 1970s, but an openness was practiced encouraging foreign investment through tax exemptions. The State continued to invest in infrastructure and heavy industries, such as petroleum, phosphate, cement, and hydraulic lime production, favoured by the increase in the price of olive oil on the international market, as well as the increase in remittances from Tunisian immigrants working in Europe. To increase national production and achieve social balance through the distribution of wealth [17, p. 56], it regulated the labour market thanks to the income from oil, mining, and tourism exploitation and nationalised the large companies that had been in the hands of the colonial power. In 1975, the objective was to strengthen the manufacturing industry in order to create jobs through import substitution and tariff protection, and to provide tax advantages for exports.

In the educational dimension, the reforms had a great impact. Under the influence of the French model of the Third Republic, education became an instrument for teaching new behavioural models that broke with traditional religious teaching, and its reach was greatly extended throughout the territory. During the colonial period, the absence of education was a characteristic that was a huge challenge to overcome for the independence reforms. It is at this point where the objective of education had to involve every citizen,

since they were destined to occupy a specific place in the national project. The public sector provided free education and the possibility of access to salaried employment in public institutions, which was carried out until 1980. This had a positive impact on the popular social sectors and middle classes, as the democratisation of the education system was a measure to combat the high levels of illiteracy of the population and the impossibility of accessing the higher levels of education that marked Tunisian history before the independence. In 1960, the illiteracy rate was 91 % and only 5 % of the population had completed primary school [13, p. 88]. Reforms included the dismantling and absorption by the University of Tunis of the former University of the Zitouna Mosque, which was the historical centre for the dissemination of knowledge based on religious exegesis. These transformations were accompanied by the expansion of infrastructure works, scholarships, and the emergence of a nationalist and modernist elite, coming from the petty bourgeoisie and from the Sadiki school, who identified with the model inherited from the protectorate, with the desire to control the educational sphere by establishing a new space for education. Education was reorganised at all levels, incorporating the teaching of more practical knowledge. The State's control of the contents of education showed the intention of instrumentalising them to respond to the challenges of modernisation and attention was directed towards higher education, which was characterised by two segments: first, university institutions, with a professional vocation, and second, technological higher education institutions, under the tutelage of the Ministry of Higher Education. The notable increase in the number of higher education establishments was initially concentrated in the capital city, which began to balance out only after 1975. Moreover, engineering schools continued with the dualistic French model of "big" and "small" schools or institutes, which persisted even after the 1990 reform that put an end to the duality of the formation of the design engineer and the production engineer [18, p. 36]. In this way, the education began to be perceived as the path to progress, guaranteeing employment in professions with high status and remuneration. The colonial element permeated all aspects of Tunisian life. The French language had a strong influence on the educational system, which has been crucial and still is, especially in the higher education system. This put it at the centre of the debate, as the French language in Tunisia could be considered as a means of access to modernisation and socio-economic development by some, and an overlapping strategy of post-colonialism by others [14, p. 1]. These motivated the actions of linguistic resistance that considered the importance of Arabic as a fundamental identity value for Muslims. Arabic is the language of the Koran, the language of the translation of Greek works of mathematics, philosophy, and literature that had made possible the dissemination of ancient knowledge to medieval Eu-

rope [14, p. 2]. It is, therefore, important to examine the evolution of the situation of the French language in the Tunisian educational system. The era of bilingualism between 1956 and 1972, was characterised by the pressure from monolingual Arab nationalists, the abolition of Koranic schools, the creation of the secular university, state control of private schools, and a progressive Arabisation of education to ensure bilingualism. Secondary education was taught in classical Arabic for religious education, and in French for history, geography, philosophy, and scientific subjects. Another stage lies between the two key moments of Tunisian modernisation and corresponds to the Arabisation movement between 1973 and 1990, characterised by the decline of French teaching in schools and institutes, and the reinforcement and expansion of the use of Arabic in the social sciences and human sciences, while French continued to be used in the natural sciences. A third stage corresponds to the maintenance of Arabisation and the gradual return of French between 1991 and 2010, when French regained its status as a synonym of modernity and the alternative on the international scene, becoming the language of all engineering courses and of work in the engineering corps, a brake on Arabisation in the face of the Islamist advance in the university [14, p. 7].

Between 1960 and 1970 there was a phenomenon of politicisation of the universities, which demanded more independence, since the reforms did not mean greater autonomy for the universities, since the political authorities controlled them and pointed out that the educational institutions had to adapt to the needs of the national economy, which led to numerous conflicts, especially in the context of the resistance of the student movements of 1968. It was not until 1973 that a process of relative openness to autonomy began. In the 1960s, an extreme Marxist-Leninist left emerged that questioned the appropriation by governments of the values of progress, development, and equality. At the same time, the power of the Islamist movement has grown considerably as a result of the exhaustion of the national modernisation project, defending the need to assert one's own identity against the West and to use a language that is part of the Islamic cultural heritage.

The second key moment in understanding Tunisia's modernisation process happened in the year 1987, when General Ben Ali¹ overthrew President Habib Bourguiba. This event was preceded by the crisis that began in the 1980s, marked by the pressure of the Islamic movement, the struggles for the succession to the Bourguiba regime, the multiplication of strikes supported by the postal services, transport, tourism, and other organisations, led mainly by young people,

¹Ben Ali, (1936–2019). Born in Hammam-Sousse in the Sahel in 1936, he was a law enforcement technician. Coming from a modest background, he joined Neo-Destour while studying at the boys' high school in Sousse. After independence, he joined the young national army, which sent him to study in France.

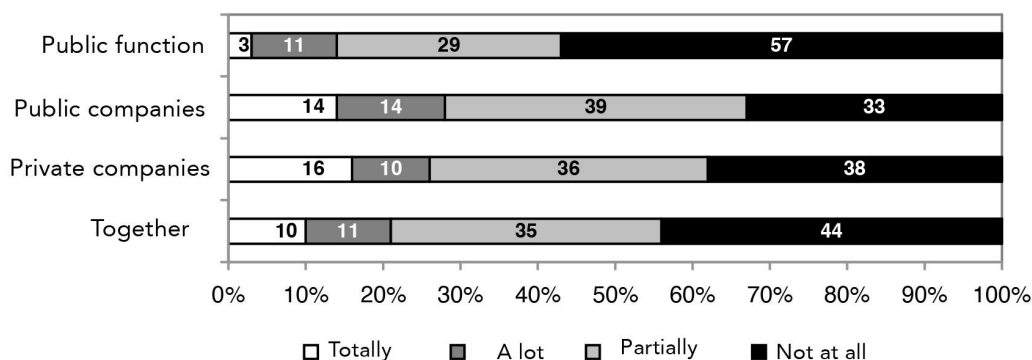


FIGURE 1. Distribution of engineers according to the legal status of the employer, depending on whether the engineer is more or less encouraged to take initiative in his work [10, p. 101].

the unemployed, students excluded from the education system and the newly urbanised rural areas, by acts of vandalism [16, p. 36]. In 1986, the situation was aggravated by the devaluation of the currency, the decline in phosphate and oil extraction, and the paralysis of tourism – as a result of the Islamist attacks. The regime imposed by Ben Ali did not constitute an overthrow of the Bourguibian regime, but rather its continuation, which now wanted to appear as a defender of Islam and its values, oscillating between the guarantor of religion and supporter of the modernisation of the country. This meant a revival of the symbols of Islam and a return to an important role for the University of Zitouna. Despite some moves towards greater freedoms, censorship continued, but also to control the electoral process and confine opposition parties to a narrow political space [16, p. 54].

In the economic scenario, this moment is characterised by the implementation of neoliberal policies that privileged the private sector, giving place to other commercial, management, and information technology sectors. This program of complete modernisation of the economy, supported and financially conditioned by the FMI, sought to stimulate private initiative, restructure public enterprises through the privatisation of sectors, such as tourism, textiles and construction, and the progressive liberalisation of the economy, measures that had a strong impact on the labour market. The 1990s were marked by the establishment of a market economy integrated into the world economy. The application of international neo-liberal recommendations, such as the liberalisation of the economy and the reduction of the State and its interference in the various sectors of Tunisian life. The private sector offered different pay conditions, which were inferior to those offered by the public sector in addition to job instability. According to the researchers, the variables that most influenced and still influence labour market integration are gender and type of diploma, with women facing more obstacles, and technical engineers having fewer opportunities compared to senior engineers. Tunisia does not have an unemployment insurance, so public authorities must intervene with strategies or “active employment policies” that generate support

and build networks between employers and potential candidates. Strategies such as specific employment offices, loans for graduates to create companies, subsidies to private companies to hire graduates who need experience.

In 1989, a major reform was launched to reform the education system with the aim of opening schools to society and the modern world, stipulating that education should be compulsory from the age of 6 to 16, with all humanitarian, scientific, and technical subjects taught in elementary and high schools in Arabic. But the reform was widely criticised because the 1991 reform restored the status of French, making it compulsory from the third year of elementary school (Table 1).

One of the consequences was the decrease in the illiteracy rate, from 84% in 1956 to 35% in 1990, in the secondary cycle it went from 8.6% in 1966 to 47.2% in 2004, and in access to higher education it grew from 3.6% to 33.3% [20, p. 101]. One of the concerns in this second stage of the reforms was linked to the lack of structural links between the higher education institutions and the labour market, which placed the phenomenon of the massification of education in a process of opening up the educational system in a context of economic liberalisation and low growth of qualified employability. This phenomenon delayed the entry into the employment market, but mainly impacted women with 14% compared to 9% for men. This massification must be confronted with the reality that institutions are increasingly operating in precarious conditions, with repercussions on the internal performance of higher education [21, p. 110]. There is no doubt that the promotion and financing of Tunisian education was the flagship of the reforms undertaken since the time of independence. In 1990, 1.2% and in 2004, 1.98% of GDP was allocated to higher education. This also creates the problem of financial support, which is largely the exclusive responsibility of the State and which, because of the most recent economic crisis and the neoliberal logic in Tunisia, has tightened the budgetary restrictions. Solutions such as involving the private sector in areas of training have been proposed. In addition, the State must participate directly or indirectly in the

Date	Law number	Contents
November 4, 1958	58-118	The law delineates educational requirements and teaching organisation across various academic levels in both the private and public sectors, as well as the personnel requirements and approval criteria for private educational institutions.
July 20, 1965	65	The legislation covers education training, including course duration, admission criteria, penalties, privileges, internship modalities, supervision, and examination.
July 29, 1991	91-65	The law prioritises Tunisian identity, Arabic proficiency, and free education for children aged 6 to 16, while also regulating private education and imposing sanctions for guardians neglecting enrolment or withdrawal of their child before the age of 16.
July 23, 2002	2002-80	The law emphasises holistic development, moral values, and problem-solving skills at primary levels and extends to secondary education in both public and private schools.

TABLE 1. The Four Educational Reforms in Tunisia [19].

financing of continuous education in such a way as to reduce the uncertainties of private companies. Currently, the National Engineering School of Tunisia (ENSIT), a public establishment of higher education and scientific research, belonging to the University of Tunis, formed in 1973 under a different name, reports that in recent years, there has been a general decrease in the number of students [22, p. 29]. Other sources report that in 2007, more than five hundred students dropped out of the university system. In the first decade of the 21st century, the unemployment rate among graduates have been 46%, and the delay in entering the labour market is up to 18 months [23, p. 165].

3. SCIENCE, TECHNOLOGY, AND POWER

A remarkable element in this period of transformation of all aspects of Tunisian life has to relate to the prominent place of science, which came to occupy a central place at the heart of the national mobilisation, in education and in the creation of the university system. Science was at the centre of the world view, and its relationship with political power is evident. This interaction between political power and science resulted in the development of scientific public policies emanating from the State, which attributed to itself the responsibility of intervening in all aspects of social life. The State and an elite appropriated the Western notion of “progress” and development, legitimising it through the discourse of science. For them, science was a neutral, apolitical phenomenon, an abstract heritage of humanity, a form of knowledge that could not be subject to nationalist interests and its transfer was transparent and could be appropriated and adapted. The result of this optimistic “technology transfer” was inevitable development [13, p. 44]. But scientific policies had to be carried out through concrete governmental actions under the advice of developed countries, establishing

political-administrative structures responsible for coordinating research activities. Thus, the discourse of “progress” was attached to the relationship between science, technology, development, and financing. It affirmed that the “intellectual backwardness” of society is the main cause of underdevelopment. But science would have to be accompanied by an element which, according to the reformers, was characteristic of Muslim culture, the development of a moral sense, which made them feel above the values of the West and which made them think that science should be at the service of human welfare. The colonial element influenced all aspects, it was crucial in the Tunisian scientific development even after the independence, for in Bourguiba’s words, “the emerging Tunisian science was the daughter of French science” [13, p. 65]. But if we talk about science, we must refer to scientific research as it was an issue that mobilised the political authorities responsible for higher education. It was characterised by various moments in which the authorities gave it importance, by the relevance of international financial support, especially in agriculture, and to a minor scale of medicine and social sciences. This was reflected in national scientific research committees unable to promote it, and in the case of the first generation of young scientists trained abroad, accustomed to the French infrastructure, which clashed with the reality at home, without laboratories, without funding, with more traditional orientations as opposed to the avant-garde of their own, which made communication with colleagues formed in Tunisia difficult, consolidated a highly competitive hierarchy of merit and the development of a fragmented and individualised research disconnected from the more concrete problems of the country. This marginalisation of scientific research was due to the disinterest of the government, which favoured the training of technicians without investing many years and who did not see scientific research as decisive for the advance-

ment of their professional careers. Between 1981 and 1985, the budgetary situation for scientific research was characterised by a notable increase, especially with respect to its destination for the “engineering sciences”. At the same time, efforts were undertaken to process, centralise, inventories, and disseminate scientific and technical documentation of Tunisian and foreign origin. Laboratories were set up to work on their own problems with data produced by them. What seemed to be an improvement to the situation of marginality was criticised by the utilitarian vision as it was directed and programmed according to national economic needs. In 1991, with the creation of the Ministry of Education and Science and the influence of the United States, the political interest in scientific research was reactivated, especially in new areas, such as information technology, telecommunications, electronics, and biotechnology. Between 1992 and 1996, technology and research were included in the action planning program. By the year 2000, 1% of GDP was allocated to research. The central argument of these changes in science policy was to boost the private sector, but the demand for this sector was minimal [13, p. 92].

With the intention of guaranteeing employment, technology transfer from Western companies was promoted, but it was insufficient to compensate for the increase in the active population and the scarce technology transfer was not accompanied by training, but was limited to technology consumption. This challenged the supposed neutrality of techniques through imitative transfer, a phenomenon that prevented real assimilation of technical knowledge. This showed that technological transfer was not an expression of the benevolence of the West, but rather that it was articulated to the interests of a specific trade in a context of marked inequality that ended up affecting countries that were only recipients and not producers of technology. This aspect produced such indignation that during the *United Nations Conference on Science and Technology for Development* in Vienna in 1979, this situation of unequal distribution of scientific and technological resources and the imminent need to restructure international relations around the problems of technology transfer were highlighted.

4. ENGINEER: HISTORISATION OF A SOCIO-PROFESSIONAL CATEGORY IN TUNISIA

Since independence, engineers played an assigned role in the project of development and dynamisation of society. They played a fundamental role in various aspects, from the occupation of high positions in state enterprises after the departure of the French, to the restructuring and modernisation of the higher education system and the legitimisation of the developmentalist project. However, it is necessary to know and analyse the evolution of the social and formative origin of

Tunisian engineers, articulated to the various dynamics of political power and the contingent evolution of life.

In the beginning, it was the State that urged its best students to undertake engineering studies, since in 1956, there were only 84 Tunisian engineers, most of whom had little experience and had not held positions of responsibility [7, p. 91]. In other words, the formation of engineers in Tunisia is recent because, according to Lilia Ben Salem, it was the consequence of blockades by both local and colonial authorities that obstructed their formation as early as in the 19th century and during the colonial period. Some precedents of the crisis of scientific knowledge in the Maghreb since the 18th century may give clues to the phenomenon. In 1830, military engineering and technical instruction began in Tunisia and in 1840 the Bardo Military Polytechnic School was founded, which stood out as a novelty since it was not under religious authority, and where military arts, science, and mathematics were taught. Under pressure in 1854, it was only responsible for the training of military officers. The official discourse also discouraged technical vocations and young people belonging to the elites refused to use foreign languages and scientific training, as there was a collective negative imaginary of technical functions as insignificant manual practices compared to law or medicine [6, pp. 66, 69]. The Tunisian engineer must be described as a professional category because a distinction was made between senior engineers and technical engineers, which was not without conflict. This implied a distinction between design engineers (A, bac+6), trained by the *National Engineering School of Tunisia*, who were capable of inventing systems and were experts in organisational management, which enabled them to enter the administration as chief engineers; and production and maintenance engineers (Bac+4) who were only able to use the systems developed by the design engineers and had access to the degree of public works engineer. There were four sectors: A for engineering doctorate degrees, with 8 years, reserved for the “excellences” who would be formed in France; B for engineers graduated in 6 years of duration divided into three cycles; C for technical engineers, 3 years; and D for senior technicians, which was the equivalent of the current French university institutions of technology. This conflicting duality was maintained until 1990 and was eliminated through the standardisation of education to five years.

The post-independence Tunisian engineer benefited greatly from what was called the “model of technical organisation of the State”, in which one can see the technocratic vision of the project, but above all the instrumentalisation by the State of engineers. The figure of the “state engineer” was prominent independence until Ben Ali came to power in 1986 and the subsequent liberalisation of the economy. They were privileged by the occupation of administrative posi-

tions of the State and public companies, especially in the agricultural sector, which was the great dynamiser of the Tunisian economy and the employment of engineers and the field of scientific predilection. Its precedent was the Colonial School of Agriculture in 1898 intended to train settlers, some Tunisians belonging to the upper classes. This institution changed its name, once it was nationalised, to the *National School of Agriculture of Tunisia* in 1963. This sector was the first to be affected by the transition to neoliberal policies in 1990, thus directly affecting the main source of employment for engineers. The importance that the reformist project gave to the formation of engineers is also reflected in the effort to create national engineering educational establishments as of 1969, since these were linked to the State and trained its future human capital. Although there was a precedent in 1947 with the Polytechnic, access for Tunisians was minimal, whereas the ENIT, founded in 1968, the only one until 1970, gave a major impetus to the objective of rapidly training national engineers. An interesting fact, articulated in the context, was the support of the USSR for the financing of the construction of the ENIT in the face of the refusal of the USA. This institution will require French teachers to start the process of teaching students while the transition was being made and the locals would be trained abroad and return to occupy those positions. The ENIT model was followed by the opening of other schools, such as the National School of Engineering in Gabès in 1975 and in Sfax in 1985.

5. PROFESSIONALISATION AND ENGINEERING ASSOCIATIONS

Studying the historical development of the engineer implies investigating the framework of the conditions imposed by institutional legitimisation. Professionalisation as a condition for practicing the profession, but which has generated some criticism insofar as it may be a mechanism that restricts the development of freedom of thinking, since it is centred on the preparation of individuals to incorporate them into the productive structure. The notion of authoritarian or state corporativism, based on Philippe Schmitter's idea, allows us to understand the systems of association in which socio-professional groups are incorporated into vertical mobilisation structures for the benefit of a national development project, which is characterised by preventing the expression of pluralistic and competitive interests and by being an instrument of control and supervision, and the defence of their interests. Professionalisation as the process of acquiring the character of a profession as a requirement of a corporation, based on shared characteristics among its members, such as a long apprenticeship, a set of peer-controlled standards, and support for a fundamental value of society. Professionalisation can be considered as a form of awareness of a group that shares common

knowledge, competencies, practices, interests, and objectives, and the society becomes the association of people of the same profession with a common objective, the defence of their interests and the criterion par excellence of belonging to these forms of association is the title [24, p. 276]. These associations have relatively insufficient resources, which is why they rely on registration fees and the publication of specialised journals, which at the same time serve as a means of action and dissemination of their ideas.

As the formation of Tunisian engineers is a recent phenomenon, there was no structure incorporating only engineers before the independence, so professional organisations were linked to the times of the above-mentioned phenomenon. We find the *Association of Engineers and Technicians of Tunisia* (AITT) founded in 1937, which functioned until 1972, made up of technical agents, technical assistants, and some qualified engineers. It had an active participation in the national movement in 1950. Then, with the increase in the number of engineers, it fragmented into two, one where engineers created an autonomous association, generating discomfort among technicians. The *National Unit of Engineers of Tunisia* (UNIT) founded in 1981, demanded the regulation of the profession in defence of the title of the engineer in the public sector, ethics, and professional conduct. It was an organisation with a syndicate character. They published a quarterly magazine in French titled *L'ingénieur Tunisien*. Subsequently, the *Order of Engineers*, established by decree with a strong gremial character, was founded in 1982. This association played roles, such as controlling the practice, access, and code of ethics of the profession. It was the consultative body of the State after the establishment of the special statute of the corps of engineers and technicians of the administration. Membership of the association was compulsory in order to practise the profession and even went so far as to make demands on the government. During the period of the liberalisation of the economy, the Order ceased to have the control over the practice of the profession, a crisis of representativeness began and the Order lost its appeal for the new generation of engineers and, in neoliberal times, circumstances had already changed. In 1988, they began publishing a monthly newsletter in French and Arabic, called *COI-Informations*. Other associations without the same magnitude were The Association of Graduates and the *National Association of Design Offices and Consulting Engineers*, both from 1976, and associations of friendly or aid type that in 1920 helped young Tunisians to be able to continue their studies abroad [6, p. 66]. This associative phenomenon have to be linked to the greater Maghreb region, since in most of the Arab countries, there were associations or unions of engineers belonging to the *Federation of Arab Engineers*, whose objective was to create links and channels of communication and cooperation [25, p. 323].

6. DIASPORA OF ENGINEERS AND “BRAIN DRAIN”

Historicising and describing the phenomenon of the Tunisian engineering diaspora is fundamental to understand it as articulated in the logic of mobilisation of people, of international relations that reflected a relationship of dependence with former colonial powers, but also in the dynamics of inequality of opportunities that were restricted to “excellent” students leaving many others aside, revealing discrimination mechanisms of categories, such as social origin and gender, and finally, a means by which many decided not to return to their country of origin, especially in times of the liberalisation of the economy and the precariousness of labour opportunities. Most of the Tunisians trained abroad, promoter by the Tunisian State, in countries such as France and the United States, belonged to the upper classes, either because they were able to afford their education abroad or because they achieved the status of excellence thanks to their economic privileges that allowed them to access an education for their studies abroad. The opposite is the case of the sectors of working-class origins, they were trained in Eastern Europe and Tunisia.

With respect to the students who did not return, this phenomenon is known as “brain drain”, which began to be a trend after 1990, which is related to the policies of economic liberalisation and the change in the dynamics of labour supply due to the abandonment of the State as the main contractor of engineers, but also to the reforms of higher education that failed to balance the superiority of the number of graduating engineers with the capacity to generate employment. As a measure to stop the “escape” of human capital, the government carried out a project to follow up on students being trained abroad in order to encourage them to return and join the private sector, but it did not produce great results [26, p. 60]. Tunisian expatriates face two particular situations: either they want to return to their country of origin, but it does not provide them with the conditions and opportunities, or they remain expatriates in a country other than their own with more opportunities but are unable to reach the highest positions because these are reserved for nationals [27, p. 18].

7. ENGINEERS: A GENDER PERSPECTIVE

The engineering profession was a predominantly male-dominated field. There is historical evidence of this, even in developed countries. However, the case of Tunisia presents some characteristics that does not exclude the remarkable phenomenon of feminisation of the profession, with a significant growth in the number of female engineers between 1958 and 1980. Paradoxically, the neoliberal economic opening up directly affected them, because the female engineers were more closely linked to public companies [11, p. 216]. One characteristic of Tunisian women's incursion into engi-

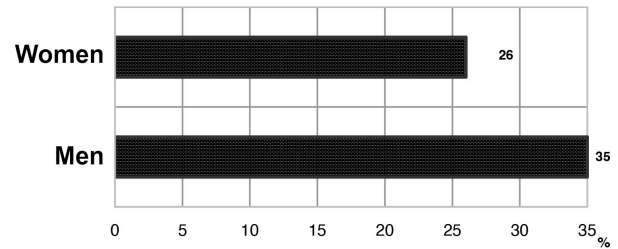


FIGURE 2. Rate of access to continuous training according to gender [10, p. 120].

neering is that they are more present in the sectors of agronomy, information technology, electricity, teaching, and, to a lesser extent, electromechanics and mechanics. Another interesting fact that should be studied is the *National Union of Tunisian Women*, an association with the purpose of supporting government programs [16, p. 20], which demonstrates a change in mentality and an important place in society that is even ahead of its time. But this should not hide the fact that there are several factors that determine the incorporation of graduate engineers into the job market and into positions of responsibility, and one of them is the gender condition, because as already discussed and demonstrated by a statistical research, women were more likely to be unemployed than men.

8. THE LOSERS

At the beginning of the reform, engineers enjoyed opportunities and status, but this changed in the second moment with the economic liberalisation. Not only the abandonment of the State as the great creator of labour opportunities for these professionals affected them, but also when neoliberal policy measures, which privileged the private sector in higher education training before other sectors, made access to engineering training more difficult due to its high tuition. These new economic conditions impacted professional aspirations and their employment integration, as it encouraged competitiveness through lower salaries, and only those most able to adapt, or desperate to find a job, could find a place. For this reason, state engineers, mainly linked to the agricultural sector, were the ones who lost the most due to the liberalisation [21, p. 120].

However, it is possible to think that the labour tragedy of engineers, reflected by the high unemployment rate, is responsible for the failure of the developmentalist model initiated by the Tunisian independence. Anousheh Karvar's hypothesis is interesting because it states that the ambivalence of the state engineers' political commitment and their inability to build a political lobby and ensure their social reproduction, because once in command of the key sectors of the economy they vindicated a political impartiality in contrast to their previous commitment to their strategic mediating role of modernity. This distanced them from having a key place in political power and isolated them [12, p. 205].

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