ROLE OF PRODUCTION ENGINEERS IN THE PUBLIC SECTOR

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Igor Rosa Dias de Jesus [1] [2], Helder Gomes Costa [1]

[1] Federal Fluminense University – UFF, Brazil
[2] Brazilian Agricultural Research Corporation – EMBRAPA, Brazil

Abstract

This paper aims to investigate the role of production engineers in the public sector. In the past, engineers used to be hired in the public sector only to work with technical issues in some departments. But nowadays, technical competency is not the only issue an engineer must have, and at the same time, there are some other approaches than technical ones that demand the presence of engineers in the government. In this scenario, production engineers rise as an important player on public affairs. It is explored in this paper the role of production engineers in public policies, technology and innovation issues, integration between technical and management approaches, and the holistic and systemic view that drives the career. This paper is constructed under some bibliographic information, as well as some empiric data and case studies. At the end of the work, one can conclude that as well as in the whole society, engineers' role in the public sector and government has been increasing and being crucial to build and sustain the competitiveness of the municipality / region / country and the effectiveness of the public services delivered to citizens.

Keywords

engineers' role; production engineer; public sector; government; public management.

1 INTRODUCTION

Public management has been passing through a period of constant changing in the last 30 years. It has recently moved to a position in which the paradigm was the Bureaucratic State towards the Managerial Reform and the New Public Management. It means that bureaucracy, that was characterized by rigid structure of authority, hierarchy and rigid control of rules and norms has been substituted by a new model where the state is more flexible, results-oriented and has more capillarity to achieve citizens needs and expectations [36].

This new model is known as New Public Management, NGP. According to Pollitt, New Public Management drifts could be seen as thinking system characterized by an importation of ideas from the private sector onto the public sector [38]. This view is emphasized by Pacheco that presents the New Public Management as an emergent model of public management modernization, characterized by a set of principles and practices coming from the private sector, in order to develop alternatives and solutions to the challenges that were and still are placed (such as scarcity of public resources, increased pressure from society for quality and equity in service provision, etc.), and for which the bureaucratic model does not proved able to answer satisfactorily [36].

This new way of facing public management is guided by some principles. According to Pacheco, the guiding principles of New Public Management are: democratic governance, results-driven actions, attitude and entrepreneurial environment, services decentralization, empowering people, articulation of public and private resources and accountability and contracting system [36].

Although it has been a drift that has occurred in different ways in each country according to its own sociopolitical and economic scenarios, and although this principles pointed by Pacheco are still valid in most of the countries that has passed through a Managerialism Reform in the last 30 years, some authors point out that New Public Management is an overtaken concept.

According to Dunleavy et al., New Public Management has been replaced by Digital Governance, in which the techniques and tools associated with the information management are understood as more relevant to public policies formulation than those ones associated with organizational structure [15]. This argument is strengthened by Margetts, which indicates that the decentralization of services provided in the model of New Public Management is in direct contrast to the integration of data and operations advocated by Digital Governance [32]. Osborne, however, identifies as a future trend a new perspective called New Public Governance, blending aspects of New Public Management and Digital Governance [35].

Regardless of what public management paradigm one consider, public sector now has some characteristics that are established: importance of learning and training for public employees [20], cooperation and a good comprehension about mission and values for the development of a good professional in the public sector [37], conversion of good governance in good public services delivery [16] and complexity of public sector in comparison with private one [6] [17].

So, with all these changes, public sector is increasingly demanding some new roles for engineers and, specially, for production engineers. Next topics will discuss these engineers' roles in the State.

2 ENGINEERS' ROLE AND THE PUBLIC SECTOR

"The design of agricultural and biological technical works can easily be traced back to the irrigation systems, food storage, fermentation facilities, and other works in Mesopotamia and elsewhere in the Middle East at least four thousand years ago. From the earliest signs of social

order, the role of engineer has persisted. In all cultures some folks are recognized and rewarded for having the gift of invention, design, and problem solving. Some are even anointed with the title of engineer." [13]

Dym et al. consider engineering as the result of a complex human endeavor that requires analytical thinking to make complex problems simpler [16]. The Accreditation Board for Engineering and Technology set some competencies as outputs of an engineering graduation, in which ones are included the ability to apply knowledge of mathematics, science and engineering, the ability to analyze and interpret data and the ability to identify, formulate and solve engineering problems [1].

Although these definitions and considerations are consistent and reliable, general perception about what is and engineer's role and what is not is not so clear for most of the people. Karatas et al. tried to understand the ideas people make about engineering and engineers. Conducting a process that includes surveys, drawing and interview with children, they concluded that these ideas are fragile, unconstable and conflicting [24].

Akay makes some considerations about the nature of engineering in the last years. In a post-9/11 world, or, in other terms, in the 21st century, it's not conceivable that engineers look only to technical matters on a subject or on a projected artifact. It is necessary to understand the world in its cultural and socioeconomic elements to use technology on the right way, what is, to goodness of people [4].

In order to better understand the engineer's role in society, Apelian organized a roundtable to discuss the role of engineers in the 21st century [5]. This roundtable showed us some affirmatives and tendencies of a perspective in which engineering is going through. One of them is linked to the holistic approach that must be developed on these engineers, because the world has been changing. The engineer of the future will have more skills on engineering judgement, the ability to motivate global teams and the ability to recognize signals about the future and connect the dots than the ability to do stress analysis calculations, for example. Another concept that rose from this roundtable was that engineers are the practical people who convert concepts to reality.

Besides of understanding the role of engineers in the 21st century, it has been a challenge for researchers to understand the engineers out of the private sector. This challenge is not so much the technical engineering but the "sociopolitical engineering" that must go with it to move our society and government into doing the right things. According to NAE, engineers should acknowledge the importance of public service and its role in society, accepting the challenges posed by public management [33].

"Engineers, regardless of their specific field of work, are becoming more and more involved in dealing with their nation's public sector. This role is no longer confined to economists, lawyers and political scientists. Public organizations need interdisciplinary teams where the engineers participate in an active role to analyse and take decisions. The engineer's role in the public sector stems from the professional identity, associated with problem-solving through the use of scientific, mathematical and technological knowledge within a limited-resource framework. These competences are necessary for public sector engineers to make effective economic, political and social decisions. Public sector engineers focus on the analysis of complex situations by using analytical tools for decision making." [2]

Acevedo et al. propose a course (structured in a game form) to develop some important skills to engineers that will work on public sector [2]. These skills are associated with the understanding of economic, social and political contexts in each scenario, the prevention and acting on corruption, some notions on modern public management, and the cohesion of the State.

Engineering is changing as well as government [11] [39]. Before entering the questions of which factors lead government to hire engineers, it must be looked, on the other hand, why engineers are searching for public sector positions. First, there are some countries, like Brazil, in which public services may be high-valued jobs. Some engineers can earn more money working for the public sector than the private one, but it is not the most common situation. An important issue in this matter is about some careers in engineering when you have two agents: an employer and a contractor. These kinds of situations, which are very common on civil engineering and consulting companies, will probably be avoided because State is also the employer and the contractor. Lina points out that this double role is very harmful to the exercise of the professional tasks, and the engineers' role should be driven towards a more neutral position, which can lead some engineers towards the public service [28].

Another good reason is the will of acting direct for the people, in the sense of their goodness. This is the same way that can lead some engineers to work in NGOS and in social projects. Oliveira et al. points out there are some interfaces between organization strategy and social issues. According to authors, sustainability plays an important role on strategy and work, which leads organizations and engineers to look for works that associates finance targets with economic, social and environmental viability [34]. Dagnino and Novaes argue that engineers reinforce the capitalist social relations of production and keep social classes each time far from each other [10]. Following this line, for engineers, working for public sector is a good way to work directly for the people, and to avoid these possible internal conflicts inherent to the work in the private sector.

3 PRODUCTION ENGINEERS AND THE PUBLIC SECTOR

3.1 Public policies

Bañares-Alcántara defines policy as a set of effective and acceptable courses of action to reach explicit goals. He points out that engineers are the professionals that response for formulation, implementation and enforcement policies [7]. Author uses some specific tools of engineering as multicriteria decision making and systems engineering to empower these professionals as policymakers, since that ones are crucial tools to make and develop policies. Although the author has not moves on towards public policy issues, most of appointments done for 'policies' in general apply to public policies.

According to Dietz, issue areas that demand input from engineers include, but are not limited to, federal support for research and development, patent law reform, transportation, electric-utility deregulation, technology-transfer initiatives, standards, and technical barriers to trade [12]. These areas should have engineers working on public policies. Kevin explores some more modern approach and says that engineers also must lead public policies in areas such as climate changes and environmental issues [25].

A good example of production engineers' role in public policies is the EGP-RIO, the governmental project

management office of the State of Rio de Janeiro, in Brazil. EGP-RIO manages the strategic projects and partnerships of the State and has some production engineers that act as project managers. Since its beginning, in 2007, production engineering has been one of the most significant careers the office has been hiring.

It is important to emphasize that this strategic projects are the natural deployment of public policies promised by the Government. So, working in these governmental projects is, in the last sense, the same as working with public policies.

Managing projects in the public sector has been a task that production engineers have been being done with other careers as economists and administrators, for example. The main difference production engineers have, in comparison with others, is the point of view of the engineering, what is, the objectivity in solving problems considering the public, the resources and the stakeholders, to deliver the better results possible.

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3.2 Technology and innovation issues

According to Bommert, innovation in the public sector is usually not for a physical artifact. In comparison to private sector, in which the great goals are to achieve competitive advantage and to increase revenues, innovation in the public sector is driven to improve service performance and add value in terms of public benefits and Apelian says that a key role of engineers is extremely critical in society because engineers are unique and that key role is in the area of inventions and innovations [8] [5].

Although innovation as increasingly becoming more global, it is also used as country strength. Freeman and Soete put some effort on formulating the paradox between the actual paradigms of "research without boundaries" and the development of country strengths and competitiveness through innovation capabilities and competencies developed inside the boundaries [19].

But when it is used as a governmental instrument or a public policy, innovation is strictly linked to the competitiveness of the country [21] [3] [22].

One case of production engineers work in the technology and innovation field can be seen at Embrapa, the Brazilian Agricultural Research Corporation. Embrapa, which is a public enterprise, has a large set of actuation in technological issues. Patents, technology transfer, development of innovation networks, technological prospection, all of these are tasks Embrapa must do if it intends to remain as one of the most important corporations in the agricultural research field all over the world.

Embrapa has a decentralized structure, so that there are almost fifty decentralized unities, by theme, scattered through Brazil. In some of them, there are production engineers working with these subjects. One can see that production engineers are able to understand the market and to realize technology is an issue that much more attention should be driven.

It is important to highlight the technology transfer processes. This process consists in transferring the technology developed in Embrapa either to the market or to rural producers. It is a core business to the company because without this process, agricultural technology would still remain in the domain of a few researchers and would not be available to the ones who need to use it. Production engineers play an important role on making this interface between research and market because they understand the market and its behavior, as well as have some strong background on technology and innovation development.

In the field of innovation in the public sector, Lee et al. study the open innovation process in the public sector in USA, Canada, Denmark and other countries [26]. In these countries, innovation in the public sector is fully linked to the integration between public, government and other stakeholders and, according to Linna et al., when developing and implementing performance measurement systems in the public sector, the starting point and key should be stakeholders' needs and expectations [29].

A good example of engineer's role in innovation topics occurred in China. Li et al. introduce the idea of National Innovation Platform (NIP), which is now being developed in China. Briefly, NIP could be described as a public policy strategy which aims at improving innovative capability of specific industries [27]. It has strong similarity with the concept of National Innovation System (NIS). The broader difference relies on infrasctructure issues associated with the concept of platform. This way, a platform will support innovation enhancing, while a system is more linked to the environment in which innovation will occur. Modelling these platforms for each industry is, at least, a good job that can be conducted by engineers and that is strictly linked to the public sector and to the integration of this public policies with other sectors like universities, industries, entrepreneurs, NGOs and citizens.

Wescott presents the case of Bangladesh, in which the engineering and infrastructure department is recognized as an 'island of excellence" in the Government. It is due to the use of typical engineering tools: risk management system and performance targets [42].

Another example is driven directly to production engineers. Manica et al. study some engineering careers and suggest the creation of a new career: the Knowledge Engineer [31]. According to authors, the competencies and tasks associated to this new career should be:

- understand and appropriately address the organizational context as a critical success factor for knowledge systems and other measures of knowledge management;
- identify bottlenecks and opportunities of knowledge in an organization, based on analysis of their processes, knowledge-intensive tasks, those responsible for such tasks and the nature of its knowledge;
- address the economic, technical and feasibility design solutions as knowledge systems;
  • understand and decide on the organizational impact and the need for changes when new solutions based on knowledge systems are introduced in the organization;
- integrate knowledge-oriented organizations, workplace and task analysis to analysis of information;
- plan the architecture technology (ICT) in order to make it useful to the organization's strategic goals and to support knowledge systems.

Manica et al. taught about this new career facing it with IT professional tasks. But if one look carefully to what is

expected of the new professional, it can be clearly seen that the Knowledge Engineer already exists: all of these responsibilities and points of view are now done by Production Engineers.

About the same topic, and inside the public sector, Buhl and Löffler points out some difficulties faced by IT engineers in public sector. Some of them are also difficulties for production engineers:

"Governments face a complex environment, where conditions and requirements are in parts totally different compared to private enterprises. Numerous interest groups need to be satisfied and the project progress is critically followed by the population and the respective opposition. After all it is the taxpayers' money that is used for the realization of these projects. The project results need to be considerably more transparent since they are under critical observation of the press and the public interest." [9]

"The general conditions for and objectives of projects are often subject to dynamic changes. New political emphasis and legislation need to be integrated into running projects." [9]

"The lack of IT-experts in the public sector is even more striking than in private enterprise." [9]

But there's another point in Buhl and Löffler that people should look more carefully. They say that experienced (major) project managers are rare – in particular in public administration and that lacking qualification and expertise in project management results in methodical weaknesses of project planning and realization. This example is a good one for us to emphasize the matter of production engineers in public sector. Public sector needs some professionals to manage its projects. Usually, when these professionals are available, they have studied Business / Administration or IT. But the question is: what is the right professional to work as project managers in public sector? Production Engineers must assume this role. Business professionals may not have technical expertise to dialogue with people involved directly with the technological aspects of the system. On the other hand, IT professionals, or other mostly technical career, should not have ability of managing aspects of the project that are not directly involved with the technological activity developed by project team. So, Production Engineers rise as the right professional to make this interface between technical and management aspects, and to carry on the project management.

3.3 Integration and holistic approach

"A new class of engineers and engineering managers is emerging who will pioneer the new engineering and science framework necessary for global innovation. These people are not only engineers or managers or marketers: they also have a combination of skills, knowledge and education that go beyond traditional engineering and science training." [30]

It is important to note that these professionals described by Lynn and Salzman ARE engineers. We are all the time talking about engineers who learned other skills, not about people of other careers that have learned engineering issues.

Duderstadt affirms that engineers play a crucial role in a world that is changing each way faster. As the world is changing towards a technological-driven approach, these professionals will be mostly involved with processes that improve the competitiveness of their country [14].

Duderstadt says that the changing world demands a changing professional [14]. So, engineering should be transformed in education, research and exercise of profession towards a more holistic approach, to enable engineers to play their roles in an innovation-driven world. It is particularly important when in a research conducted in the Brazilian State of Paraná, Igreja concluded that engineers are generally more analytical than holistic [23].

Some holistic characteristics are related with the complex nature of government. Stiglitz understands the political democratic processes should be central to government decision making, as the domain of government processes has plenty of cases with asymmetric information, multiplicity of interests and social and economic conflicts [41]. Acevedo et al. put some effort on developing these skills and competencies to make engineers prepared to assume positions on public sector [3]. This argument is reinforced by Apelian who says: "There are very few good systems engineers, but many well-trained engineers with a narrow focus who know how to do the basic stuff. Engineers who are taught to be systems oriented are going to have a big leg up on everybody else." [6]

It can be noted that these skills might be not so common in many of engineering careers. However, production engineers have good skills in managing complex situations and to think out the technical box.

Ramos and Sette say that production engineer is a versatile professional, prepared to work in virtually any industry, since it has expertise in management methods, implementation of computerized systems, methods for improving efficiency and quality, use of control systems procurement processes, strategic planning, production control, logistics, supply chain, etc [40].

As it can be seen, production engineering is the best engineering to deal with complex systems that mix economic, social and environmental issues, as governmental ones.

4 CONCLUSION

Engineers, and specially production engineers, has been becoming increasingly important in the State. There are some strategic roles that these professionals can hold. These roles include participation on making and developing public policies, and, in some cases, structuring them on a project mould.

Technological and innovation affairs are extremely relevant and production engineers have a lot to do in this matter. Due to its sociotechnical approach, production engineers can hold some innovation projects and act on developing and promoting innovation systems or platforms. Innovation has becoming a crucial element to strength municipalities, regions and countries and to improve their competitiveness. Thus, it can be said production engineers play an important role on these strengthening and improving.

The holistic and systemic approach production engineers have make their work a kind of an interface between some technical tasks conducted by other engineers and management questions conducted by gov ernors and public administrative staff. Integration has always been an important issue for production engineers, so working on teams and considering the stakeholders needs and claims to decide or support decision is also a good contribution production engineers can give government.

At last, it can be noted many government structures still work without production engineers, in cases when it would be strongly recommended. Sometimes it can occur by ignorance of employers and governors. Ramos and Sette show us that the level of ignorance related to production engineering tasks and competencies can reach 80 % in

some Brazilian localities [40]. They also put some light on the question of professional differences between Production Engineering and Business. In their research place, the ignorance among employers about these differences reaches incredible 70 %.

Ramos and Sette study the marketing strategies that are used to increase the knowledge about Production Engineer in a given region [40]. Authors use Public Relationship professionals as a key-actor to show entrepreneurs and companies owners what are the competencies and main tasks of Production Engineers. This can be perceived as a good strategy because the career is still new to very of these entrepreneurs / owners and it sometimes remains as an interrogation to these agents.

It is important to note that this marketing strategy could be used not only for private sector, but also for government institutions. There are many lacks to fill about the matter, and a scientific approach is also a good way to share these ideas about production engineers working for the State. This work shows that, although studies have walked very long in the promotion of production engineer tasks and competencies, that is a lot more to be done.

Thus, as suggestion for future researches, new studies could be done exploring production engineering work in government institutions in three main sides: case studies, studies collecting the perception of public engineers working for the government and ones that identify new sectors of acting that this work could not reach.

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