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THE ROLE OF INDUSTRIAL ENGINEERING IN PUBLIC SERVICE DELIVERY

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ABSTRACT

Government institutions exercise public administration and the delivery of public services takes place at all three spheres of government. Section 195 of the Constitution of the Republic of South Africa, 1996, requires that government service delivery must comply with certain democratic values and principles in order to be effective and efficient. This article attempts to describe what public administration and public service delivery encompass, as well as how Industrial Engineering can be part of and enhance these. The contribution of this article is twofold. Firstly, to reflect how Industrial Engineering can benefit the public sector. Secondly, to explain various untapped opportunities that are available to Industrial Engineers to apply and implement their skills to the advantage of the public sector.

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1. INTRODUCTION

Section 195 of the Constitution of the Republic of South Africa, 1996, requires that government service delivery must comply with certain democratic values and principles in order to be effective and efficient [10]. Section 195 also states that this requirement applies to public administration performed by every sphere of government, organs of state and public enterprises.

Chapter 2 of the Constitution, 1996, contains the Bill of Rights with a list of basic (fundamental) rights, which must be respected, protected and upheld by all persons and all organs of state (section 7). Section 8 states that the Bill of Rights obliges all three spheres of government and parastatals of the government, when performing public administration, to respect, protect, promote and fulfil the rights set out in the Bill of Rights. This implies that public services must be rendered in a professional manner, responsibly, with integrity and fairly in order to comply with the requirements of the Constitution, 1996.

Despite the mentioned constitutional obligation to deliver public services in a particular and an acceptable manner, government does in fact experience difficulties to deliver many public services due to the lack of professional artisans in many facets. The failure to deliver public services is just as unacceptable as the delivery of deficient public services. This situation results in dissatisfaction amongst the public and leads to protests against poor public service delivery. It appears that government is often reluctant to involve the private sector to ensure actual delivery and improve the delivery of public services. In particular circumstances private companies often have to be involved to assist with the delivery of certain services, such as with the waste removal in Tshwane.

There may be many benefits from involving the private sector to apply their specialised knowledge in especially major development initiatives of government. This article accordingly attempts to describe what public administration and public service delivery encompass, as well as how Industrial Engineering can be part of and enhance these. The contribution of this article is twofold. Firstly, to reflect how Industrial Engineering can benefit the public sector. Secondly, to explain various untapped opportunities that are available to Industrial Engineers to apply and implement their skills to the advantage of the public sector.

2. GOVERNMENT STRUCTURES

The Constitution, 1996, governs the manner in which the public administration of the state must be exercised, so as to provide for a well established relationship between the people and all the government authorities. A further description of the public administration is provided next.

2.1 Public administration

The Constitution, 1996, states how the public administration must be performed in all public institutions and the manner in which functionaries must act in executing their functions to ensure that their actions and decisions are governed by the democratic and ethical values and principles enshrined in the Constitution.

Section 195(1) of the Constitution, 1996, spells out the values and principles that govern public administration. Subsection (2) states that these principles apply to public administration in every sphere of government and to public enterprises. A few of these principles are:

(a) the promotion and maintenance of a high standard of professional ethics;
(b) the promotion of efficient, economic and effective use of resources;
(c) a responsiveness to people's needs and the encouragement of the public to participate in policy-making;
(d) the fostering of transparency by providing the public with timely, accessible and accurate information.

A vital aspect is that section 195 of the Constitution, 1996, requires that the delivery of public services should satisfy the broad and complex variety of needs of the people. Section 195(1) also reflects the democratic values and principles that govern public activities and services and that these should include effectiveness, efficiency, transparency, responsiveness, accountability, integrity and interest. Section 195(1) therefore creates a duty for every sphere of government and public enterprises to achieve and uphold an accountable, open, transparent, fair and honest administration which serves the interests of the general public. This furthermore requires co-operation between all institutions involved.

2.2 Co-operative governance

The governing function in South Africa and the delivery of public services are performed at different levels. South Africa has three spheres or levels of government and section 40(1) of the Constitution, 1996, makes provision for "co-operative governance" when it states that in the Republic, government is constituted as national, provincial and local spheres of government which are distinctive, interdependent and interrelated. Section 40(2) states that these spheres of government must conduct their activities within the parameters of the Constitution. This implies that although each sphere of government has its own distinctive characteristics and operates on a different level, it is dependent on the other spheres and interrelated to them in terms of the relationship created in section 40.

As concerns the manner in which public powers and functions must be exercised, section 41(1)(g) and (h) of the Constitution, 1996, provides that all three spheres of government and all "organs of state" must exercise their powers in a manner that does not encroach on the functions of other spheres, co-operate with one another and assist one another on matters of common interest.

2.3 Organs of state

It is noteworthy that the Constitution, 1996, mentions "organs of state" in section 41(1). Section 239 of the Constitution, 1996, defines an "organ of state" as a department of state in the national, provincial or local sphere of government or any other functionary or institution performing a public power or public function in terms of the Constitution or in terms of any legislation. This implies that the functions of public institutions can be exercised by an entity that is not, strictly speaking, part of the three spheres of government and that normally functions outside of these usual spheres and also in the private sector. This, accordingly, includes a person or institution, such as a statutory council, ESKOM and the CSIR, which exercises a public power or a public function in terms of legislation.

The intention of section 239 of the Constitution, 1996, is that the use of a private sector entity is needed to enhance the performance of the public sector. In this regard, co-operative governance and intergovernmental relations should contain measures and mechanisms to encourage a co-operative spirit and relationship between the spheres of government in order to increase government efficiency. This situation should include recognition of interdependency as the public sector cannot function in isolation and needs the expertise, co-operation, co-ordination, joint planning and the sharing of resources of the private sector. In the next paragraph, the role of local government is explained.

2.4 Local government

As concerns local government, section 155 of the Constitution, 1996, arranges the "establishment of municipalities" and section 156 arranges the "powers and functions of municipalities". From these sections, as well as section 151, it appears that the role of local government is to govern the local government affairs of its community and to cooperate with national and provincial government to strengthen the capability of local government. In terms of sections 153 and 154, provision is made in national and provincial legislation for particular functional areas to be allocated to local government, for example local roads and transport. Although local government functions as an autonomous and self-governing sphere of government, it is not independent and cannot function in isolation.

In terms of sections 152 and 153 of the Constitution, 1996, local government must deliver public services and oversee the application of these services. This means that a local authority works and delivers services within broader provincial and national frameworks and in conjunction with other "organs of state". This co-operation may relate to the provision of public services in the local area by entering into an agreement between the municipality and, for example, the Rand Water Board or Eskom or the CSIR, for the provision of particular services. Section 154(2) of the Constitution, 1996, requires that persons and institutions outside of government be involved in local government affairs to ensure expertise and quality of service. Government is also involved with parastatals and this aspect is now discussed.

2.5 State-owned parastatals

Since 1995, government has developed a privatisation programme so as to involve selected equity partners in certain enterprises in the telecommunication and airways sectors. Labour unions were excluded from the original policy decision-making process and with the threat of job losses, the unions resisted the decision by government and expressed this by means of various protests. Although government proceeded with its privatisation programme, it did not, for example, enter into any Public-Private Partnership agreements with any institutions during the 2013/14 financial year [3].

The government currently has a large number of state-owned parastatals that function in capacities such as commissions, corporations, institutes, for example Eskom, the South African Post Office and the CSIR. All such parastatals are involved in the economy in fields such as transport, construction, agriculture, water, electricity, and others. The involvement of the parastatals in the different fields means that not only are government departments responsible for the delivery of public services in South Africa, but parastatals are in fact also involved in the delivery of services on the national, provincial and local spheres. Whereas similar government departments on the different spheres often deliver similar services, a state-owned-parastatal is allocated a particular service with a full or partial monopoly over that particular service. The result is that the parastatal dominates the market in respect of that particular service and does not allow any other entity, institution or person to perform a similar service [1].

As mentioned above, section 41 of the Constitution, 1996, requires co-operation between all institutions and organs of state involved in the delivery of public services. This includes the requirement to source alternative modes of assistance.

2.6 Alternative modes of service delivery

All spheres of government have the obligation, in terms of sections 152, 153 and 195 of the Constitution, 1996, to monitor the effectiveness and efficiency of their respective public service delivery programmes. It may occur that a certain mode of service delivery fails or is not as effective as expected. In such a case, the relevant government department is compelled to source an alternative mode of service delivery. This is because the department must still comply with the constitutional prescriptions and fulfil its mandate of ensuring that public services are delivered to meet the expectations of consumers. Stacey [16] argues that the necessity to search for alternative modes of service delivery can be attributed to the existence of factors such as low productivity, poor financial management, inadequate risk management, and soft budget constraints on the part of government.

In terms of the White Paper on Local Government, 1998 (section F, paragraph 2) [2], municipalities have to consider new approaches to service delivery from a range of delivery options to enhance service provision. They need to strategically assess and plan the most appropriate forms of service delivery for their areas. The choices about delivery options should be guided by criteria such as coverage, cost, quality and the socio-economic objectives of the municipality. The modes of service delivery that a municipality can consider (section F, paragraph 2.2) include the following:

- Building on existing capacity;
- Corporatisation;
- Public-public partnerships;
- Partnerships with community-based organisations and non-governmental organisations;
- Contracting out;
- Leases and concessions (public-private partnerships); and
- Transfer of ownership (privatisation).

When a municipality assesses the appropriateness of different modes of service delivery, the real issue facing each municipality is to find an appropriate combination of options which most effectively achieves its policy objectives (section F, paragraph 2.3).

3. MAJOR DEVELOPMENT INITIATIVES

In view of the fact that government institutions as well as parastatals are involved in the delivery of public services, a few of government's major development initiatives are discussed.

3.1 The National Development Plan

To improve the country's economic growth and competitiveness, government introduced the National Development Plan in 2011 [12]. Among the six priorities in this plan, there are three to take note of in particular:

- Bringing about faster economic growth, higher investment and greater labour absorption.
- Focusing on key capabilities of people and the state. Building a capable and developmental state.
- Encouraging strong leadership throughout society to work together to solve problems.

Government has struggled to bring about these priorities. Higher economic growth from higher investment necessitates appropriate implementation strategies that include the resources to implement these. To this

extent, a capable and developmental state is required, but this does not mean that the state should attempt to do everything alone. In fact, the strategic use of expert knowledge in both parastatals and the private sector should be encouraged. Strong leadership would guide this strategic partnership and ultimately problems should be approached in a holistic manner, which includes public sector, private sector, and public participation.

Among the critical actions in the NDP, a few should be highlighted again. *Action 3* calls for the state to professionalise the public service. To achieve this, requires advanced training in various fields, which very often derives from parastatals or the private sector. *Action 7* calls for an increase in public infrastructure investment, especially through public-private partnerships and with a focus on transport, energy and water. *Action 9* calls for the densification of cities, transport improvements, and better job location. These actions require appropriate and focused research programmes so as to develop sustainable solutions.

3.2 The National Infrastructure Plan

Government subsequently developed the National Infrastructure Plan [13]. Through the Presidential Infrastructure Coordinating Committee (PICC), 18 Strategic Integrated Projects (SIPs) were developed to invest more than R1-trillion in infrastructure across the country. The developments include, among other, logistics corridor development, enhancement of import and export facilities, aerotropolis developments, road and water infrastructure investment, densification of transport corridors, upgrades and optimal placement of social facilities, higher education infrastructure and expansion of communication networks. All these programmes require proper project management and monitoring and evaluation to ensure the on-time and within-budget realisation thereof.

3.3 The 9 Point Plan

In a further attempt by Government to accelerate growth, the 9 Point Plan was developed in 2016 [14]. Initiatives include the revitalisation of agriculture value chains, the encouragement of private sector investment, and boosting the role of state-owned companies and infrastructure. To adequately realise this plan, requires proper value chain mapping, business process re-engineering, programme management and infrastructure investment prioritisation.

3.4 Planning Processes for Infrastructure Investment

At municipal level, Capital Investment Frameworks (CIF) are used to implement or realise projects as part of a spatial strategy. This strategy normally stems from the Provincial Spatial Development Framework, which informs the Regional Spatial Development Framework and culminates in a Metropolitan Spatial Development Framework (MSDF). Capital Expenditure (CAPEX) is allocated to infrastructure investment projects and capital investment prioritisation is normally a tough task as budgets decrease while requirements and needs increase. There is a great need to determine how to use limited budgets optimally, colloquially known as “getting the best bang for your buck”, while the implementation of these strategies require the participation of highly skilled professionals.

The Division of Revenue Act, 1 of 2015 [11], requires Municipalities to prepare a Built Environment Performance Plan (BEPP) [7] in which they are to report the intended use of infrastructure grants. The BEPP therefore responds to principles set out in the Spatial Planning and Land Use Management Act, 16 of 2013 [15]. It is informed by the Built Environment Value Chain [7], as depicted in Figure 1, with the aim of aligning financial resource allocation to development objectives.

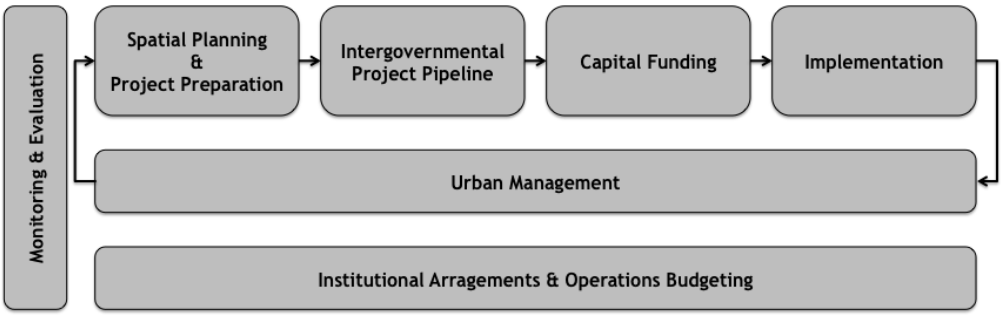

Figure 1: The Built Environment Value Chain

The Department of Planning, Monitoring and Evaluation (DPME) has the mandate to monitor and evaluate the performance of national, provincial, and municipal governments. To adequately do so, requires the collection of the most appropriate data, business analytics, and the creation of proper Key Performance Indicators (KPIs).

4. AN OVERVIEW OF INDUSTRIAL ENGINEERING

Before reflecting a connection between the needs of the public sector and the skills of Industrial Engineers (IEs), an overview of the field of Industrial Engineering is provided. Industrial Engineers are notorious for their capability to take a holistic and systems view of problems, to be able to learn a new environment quickly and to be the interface between multiple domains. Furthermore, IEs have the capability to translate a real world scenario into a model that represents the reality to be used for simulation and optimisation purposes.

4.1 Methodologies used

Industrial Engineers use and apply different methodologies when being involved in the various environments. These are described next.

4.1.1 The Engineering Methodology

The Engineering Methodology (based on and adapted from Ertas and Jones [21]), as is shown in Figure 2, is a very useful process to follow when encountering a problem in practice or academia. It normally commences with a problem definition or a research question, which sets the tone for the study at hand. Literature is then consulted to obtain useful tools and methodologies already in existance with which to approach the problem. The problem is then analysed further to ascertain the exact requirements of the client/solution/product. Once the requirements are captured, a solution methodology is designed, which in essence is a set of steps to follow to be able to deal with the problem at hand. This step is informed by the literature review and the requirements specification. A model is normally developed to represent reality with which one can test various interventions and scenarios so as to identify improvement opportunities and likely outcomes. The model is tested and verified to ensure accuracy so as to build trust in the model and normally sensitivity analyses are done to ensure robustness of the model. Results could be communicated through reports, dashboards, analytics and other visual means.

Figure 2: The Engineering Methodology

While the Engineering Methodology is useful, it also allows for modification and adaptation. Various other methodologies are also used in practice and many of the steps are evident in all these methodologies.

4.1.2 Define, Measure, Analyse, Improve, Control

The *Define, Measure, Analyse, Improve, Control* (DMAIC) [4] procedure is a Six Sigma methodology that is often used for process improvement. It starts with a problem definition or an opportunity for improvement as well as the sought after goal. Thereafter, process performance is measured and root causes of variation are determined. The process performance is improved and controlled by eliminating the root causes of variation.

4.1.3 PRINCE2©

The *Projects in Controlled Environments* (PRINCE2©) methodology is a project management methodology, which consists of seven themes that are essentially principles to be applied to a project at the commencement of the project, and then monitored throughout the project. The seven themes for project management include the following:

- A *Business Case* in which the business justification is provided; it provides the evidence to show that a project is worthwhile pursuing.
- *Organisation* relates to how roles and responsibilities are determined.
- *Quality* is related to quality assurance and quality management principles.
- *Plans* define targets, how these will be attained, project costing, and associated benefits.
- *Risk* provides an overview of the threats and opportunities that could manifest themselves.
- *Change* includes changes in the project as well as issues that may occur.
- *Progress* includes the monitoring and evaluation of the project.

4.1.4 Plan-Do-Study-Act

The Plan-Do-Study-Act (PDSA) cycle [18] is commonly used to gain insight for the purposes of continuous improvement. The *Plan* step involves identifying a goal or purpose, the definition of metrics, and the design of a plan of action. Next, the plan is executed in the *Do* step. The *Study* step essentially involves where success, progress and validity are monitored. The cycle is closed through the *Act* step, which makes use of the results in the *Study* step to set a new goal and repeat the process.

4.2 Industrial Engineering Training and Competencies

Industrial Engineers are known to work in a variety of industries, ranging from the finance industry to a typical production environment. To be able to unpack the skills that Industrial Engineers can bring to the table, the curricula of 4 Universities in South Africa, that offer studies in Industrial Engineering, were investigated. These include the following:

- University of Pretoria (UP) [20]
- University of Stellenbosch (USB) [17]
- North West University (NWU) [9]
- University of Johannesburg (UJ) [19]

Table 1 illustrates a subset of the various modules offered by these institutions.

Table 1: Typical Industrial Engineering modules in curricula at UP, USB, NWU, UJ

Business Law	*Engineering Activity & Group Work*	*Business Engineering/Enterprise Design*	*Manufacturing Systems*	*Labour Relations*
Information Systems Design	Control Systems	*Systems Engineering*	*Facilities Planning*	*Quality Assurance*
Industrial Logistics	*Electrical Drive Systems*	*Engineering Professionalism*	*Operational Research*	*Ergonomics*
Operational Management	*Engineering Statistics*	*Engineering Economics*	*Mathematics*	*Supply chain management*
Practical Training	*Philosophy and Ethics*	*Management Accounting*	*Programming*	*Industrial Analysis*
Simulation Modelling	*Production Managements*	*Environmental Engineering*	*Ergonomics*	*Industrial*
Financial Management	*Electronics*	*Manufacturing Systems*	*Systems Dynamics*	*Project Management*

It is evident that a degree in Industrial Engineering includes a variety of modules of different domains to equip an Industrial Engineer with tools and techniques to use in a variety of industries.

5. TAKING UP STEWARDSHIP THROUGH UNTAPPED OPPORTUNITIES

As stated previously, section 195(1) of the Constitution, 1996, contains the values and principles that govern public administration. To illustrate the role that Industrial Engineers can fulfil to assist in the successful execution of these principles, some of the principles are now listed and specific words are placed in italics for emphasis. The selected principles of section 195(1) are:

(b) the promotion of *efficient, economic and effective use of resources*;
(e) a *responsiveness to people's needs* and the encouragement of the public to participate in policy-making;
(g) the fostering of transparency by providing the public with *timely, accessible and accurate information*;

5.1 Matching the need with the supply

Efficiency, efficacy, optimality, responsiveness, timeliness, and accuracy are all principles that could be achieved through the utilisation of Industrial Engineering tools and techniques. To this end, Table 2 provides a summary of some governmental needs, matched with what Industrial Engineers can offer.

Table 2: Matching governmental needs with Industrial Engineering supply

Governmental Need	IE Supply	IE Tools & Techniques & Methodologies
Bulk infrastructure investment decision making	Decision support	Simulation modelling and analysis
Programme management	Project management, monitoring and evaluation	PMP, PRINCE2©, DMAIC, PDSA, analytics, systems thinking
Optimal placement of social facilities	Optimisation	Operations research
Risk management	Risk mitigation and minimisation	Monte Carlo methods, modelling, operations research, risk analysis
Professionalise the public service	Skills transfer and training	Multiple
Densification of cities	Modelling and decision support	Transport modelling, urban growth modelling, geospatial analysis
Transport improvements	Modelling and decision support	Transport modelling, operations research
Better job location	Optimisation	Operations research
Logistics corridor improvements	Supply chain management and logistics	Supply chain analysis, gap analyses
Revitalisation of value chains	Value chain improvement	Business process re-engineering, value chain mapping,
Optimal use of budgets	Optimisation, prioritisation	Financial management, operations research
Monitoring and evaluation	Monitoring and evaluation	Requirements analysis and specification, database design, data collection and maintenance, Key performance indicator development, business analytics, quality assurance

5.2 Taking up stewardship

Stewardship stems from the word *steward*, which encapsulates the notions of serving and taking care of others as well as managing the supply and distribution of goods. In the business environment, the concept has been established that -

"as a steward, you try to leave the company in better shape for your successor than it was handed over to you by your predecessor." [5]

While Industrial Engineers have been playing a big role in the private sector to improve operations and the functioning of the sector, there remain many untapped opportunities in the public sector that could help to improve the country's economic competitiveness. To realise all the plans in the public sector requires that the public sector reaches out to the private sector to assist with the technical execution of many tasks, but also to train and transfer skills to officials to enable them to undertake similar tasks in future. It is therefore a collaborative approach, to make sure that the country is left in a better shape for the generations to come, through the responsible planning, use, and management of the country's resources.

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