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Article

Functional analysis of industial zones in the Greater Tunis area

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ABSTRACT
In this paper, we aim to discover in depth the functionality of industrial zones in the Greater Tunis area. We have seen a lack of publication, book,articles dealing withthis issue.
Therefore, we propose this contribution to understand and master the complexity of the functionality of these zones. It comes with a new approach using the functionnal analysis tool which adapted from the APTE. This appraoach help us to identify and describe how the industrial zone works, in terms of functions.

Keywords
industrial zone, function analysis,urban planning, industrial location.

INTRODUCTION

Researchs in the industrial localization in Tunisia indicates that Functional Analysis was never used in such researchs. In examining this situation in the tunisian industrial zones, the research described in this paper aimed to answer to the following question: How appropriate is Functional Analysis as the basis of measuring tunisian industrial zones functionality?

The lack of use of Functionnal Analysis in Tunisia is mostly attributable to the lack of knowledge of this method ingeneral and the difficulties of carrying it out in practice. Functionnal Analysis is a relatively new concept in Tunisia and this, together withthe inherent difficulties in grasping theconcept and lack of guidance, contributes to the lack of knowledge of Functional Analysis.

AN OVER VIEW OF GREATER TUNIS INDUSTRIAL ZONES

The Greater Tunis is the largest industrial city in Tunisia and its industrial zones are the foci of this article.It has a 44 industrial zones covering about 1768 hectares which represent an average of 40 hectares per zone.Figure 1

shows the distribution industrial zones at 2011 with respective size of land use.

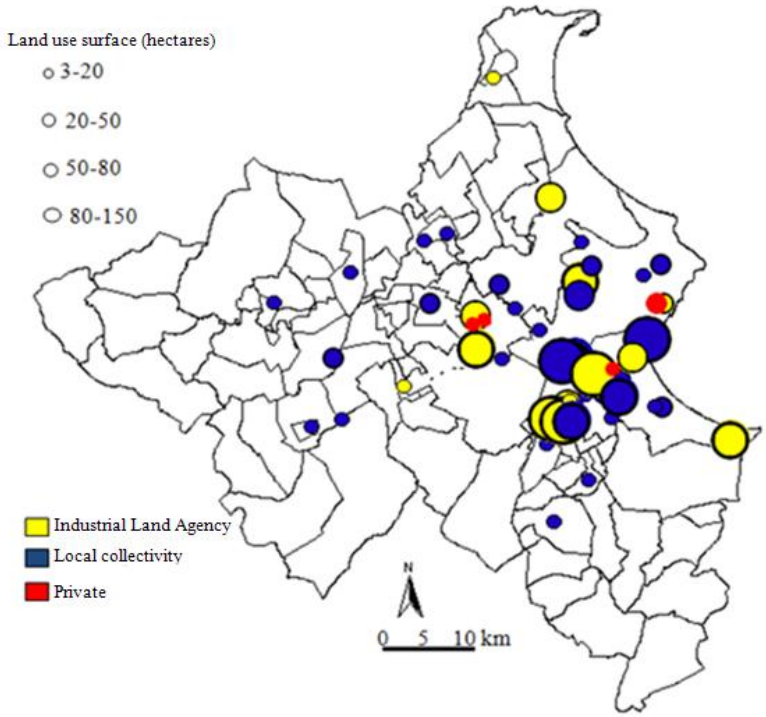


Figure 1. *Map of industrial zones in Greater Tunis*

The Greater Tunis concentrates the third of the total number of the industrial zones in the hole country. Since 1973, date of creation of the Tunisian Industrial Land Agency, the rhythm of creation of industrial zones has significantly increased. Before this date, territorial collectivities (municipalities and regional council) were the main public actors dealing with industrial zonesplanning. Recently some private planers become interested by this issue due to the incentivies and encouragement of the government in the field.

Obviously, industrial zones are extremely important for the Tunisian economy and the urban revenue of the cities where they are implemented. They are created as a designate area for manufacturing facilities and a base of performing projects for investors.

However, the invesors that chose to locate factories in this zone face a lack of adequate utilities infrastructure and management. Furthermore, there are significant functionnal problems connected with maintenance of infrastructure and services in most industrial zones. For that reason, there is a need to grasp the difficulties that face the industrial zones to develp a high level performance of functionality.

NEED ANALYSIS

The need analysis is the process of identifying and evaluating needs to create or to promote an industrial zone. It takes place in two steps: Identification and validation of the need.

Need identification

This step allows expressing the purpose and limits of the industrial zone. Therefore, it isnecessary to clarify the fundamental requirement that justifies the creation of an

industrial zone. Thus, to find the need, it is necessary to put three fundamental questions about the product design:

- Who takes advantage of the industrial zone?

- Who does the industrial zone act on?

- What is the industrial-zone's purpose?

These questions are the backbone of the "Honored Beast" method which express in Figure1

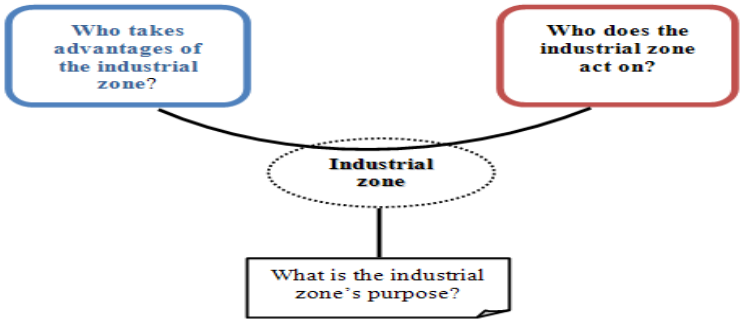


Figure 1.*"Horned beast"applied to a industrial zone*

Need validation

After the need identification that the industrial zone should answer to, it is necessary to validate this need by answering the following three questions:

- Why does this need exist?

- What could make it disappear?

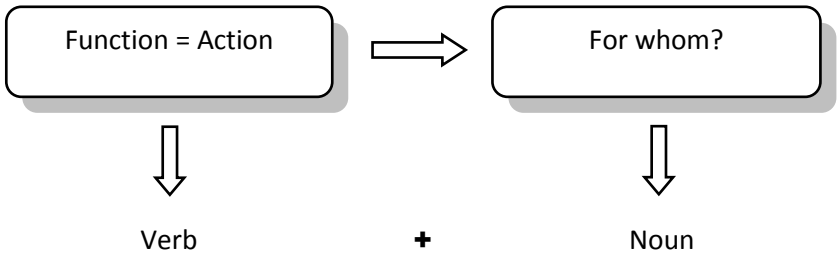
- Is there any risk the need disappears?

FUNCTIONAL ANALYSIS

The functional analysis is the fundamental step in industrial zone creation or improvement. It consists in finding, characterizing, prioritizing the functionsof the industrial zone expected by the investors seeking for land to implement their enterprises.

To define a function we use the French standard NFX 50-151 which stipulates that "*function is an action of the product or of one of its component expressed exclusively in terms of finality*".

The function can be formulated by using a verb that describes the action and a noun to define the object of that action.



This way to express a function seems to be easy but actually searching for the most descriptive verb and noun can be difficult and time consuming. For that reason, Functional Analysis is always undertaken by a team and not by one person operating individually.

The functional analysis is performed in several steps:

Function identification

In this stage the functional analysis aimed at the formulation of functions and describe them. In fact, the industrial zone has to fulfill several functions in order to reach the goal and satisfy the fundamental need of future investors.

There are several types of methods which may be used to identify all functions such as the intuitive method, RESAU[1] Method, etc. The approach we used to enumerate, with accuracy the functions industrial zones have to fulfill, is based on the "octopus diagram" (figure 2). This approach consists in listing the elements, which the industrial zone will have to coexist with, and identifying functions that it will have to accomplish. During this step, we draw a diagram in which the industrial zone is surrounded with its elements, functions being represented like relations between these various elements.

This diagram defines main and constraint functions of an industrial zone: we call "main functions" the interactions between the industrial zone and two elements and "constraintfunctions" connections between the industrial zone and one element of its environment.

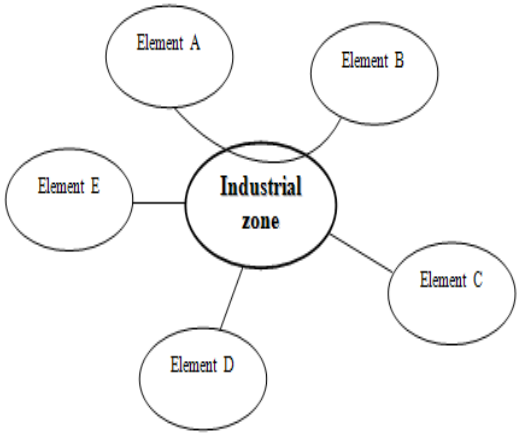


Figure 2. "*Octopus Diagram" related to the industrial zone's accessibility phase*

Functions characterization

Once the functions are identified, it is necessary to obtain more specific analysis in the next step we called as characterization the functions. For that, it is necessary to carry out:

-Criteria expression: each function should present one or more criteria associated to the verb of the function. The criterion is a mean

[1] RESEAU stands in french to these steps : "***R****echerche intuitive ;* ***E****tude du cycle de vie et de l'environnement ;* ***S****equential analysis of functional elements ;* ***E****xamen des efforts et des mouvements ;* ***A****nalyse d'un produit de référence ;* ***U****tilisation des normes et des règlements*". They can be translate respectiveley to : Intuitive Research, environement and life Cycle Study , Sequential analysis of functional elements, Motions and efforts examination, Reference product analysis, Regulation and standards use.

for measuring and verifying function importance.

-Define a level for each criterion: the level of a criterion is a mean to provide details about the criterion.

-Flexibility: it consists in defining if the levels of criteria should be respected or may be negotiated.

The levels of flexibility can be classified as follows: **F0**: Imperative level (no flexibility); **F1**: slightly negotiable level; **F2**: Negotiable level; **F3**: Very negotiable level.

Functions hierarchy

This phase allows quantifying the relative importance of the functions. To perform this, an importance scale coefficient was adopted as follows: K=1: " Useful", K = 2: " slightly important", K=3: "important", K=4 : "very important", K=5, : "vital".

Results

In a workgroup session of some experts, we identified, specified and summarized the results in one table.

The functions was adapted to the industrial zones through three lifecycle phases: planning, accessibility and use.

The table obtained is called "Functionnal table" (Table1)

Table 1. *Functional Table of an industrial zone*

Function	Designation	K	Criterion	Level	F	Type
1	Comply with requirements	5	Obligations respect	Conformity number	0	Planning
2	Ensure a successful planning	5	Technical features	International standards	0	Planning
3	Connect to public networks	5	Service	Connection and adduction state	1	Planning
4	Ensure a suitable design to the enterprises	5	Parcels surfaces	Number of m2 per activity	1	Planning
5	Respect entreprises needs	5	Layout	Survey	0	Planning
6	Reserve space for bus stations	5	Bus station	1	0	Planning
7	Offer sufficient space	2	Surface	Survey	1	Planning
8	Ensure organization to fit to the different activities	5	Layout	Survey	0	Planning
9	Ensure attraction	4	Zone filling	Time	2	Planning
10	Resist to bad weather	2	Resistance	Simulation	3	Planning
11	Fight against fire	4	Fire fighting system	1	0	Planning
12	Ensure an aesthetic landscape	1	Architecture and landscape treatment	Improvement of Visual Appearance	3	Planning
13	Respect land market rules	1	commercialization	Square meter price	3	Planning
14	Integrate into environment	1	Natural features	Buffer space	3	Planning
15	Preserve pre-existent features which value the zone	1	Natural features	Value estimation	3	Planning

1	Allow easy accessibility	5	accessibility	Survey	2	Accessibility
2	Ensure an external marking	3	Visual access	Survey	3	Accessibility
3	Provide information for visitors	3	Visual information (sign, map,..)	Survey	2	Accessibility
4	Facilitate accessibility for logisticians	5	Circulation map	1	1	Accessibility
5	Allow entreprises visibility	2	Signs	Survey	3	Accessibility
6	Ensure easy identification	3	Aspect	Survey	3	Accessibility
7	Ensure proximity to the city center	3	Access time	20 min	1	Accessibility
8	Ensure proximity to freeway	4	Distance to the way	500m	2	Accessibility
9	Ensure proximity to the port	3	Access time	30min	1	Accessibility
10	Ensure proximity to the airport	4	Access time	10 min		Accessibility
11	Ensure visibility	2	situation	No obstacles limiting visibility	3	Accessibility
1	Allow easy enterprises implementation	5	Number of enterprises	Implementation rate	2	Use
2	Attract Foreign investments	3	FDI	Survey	3	Use
3	Provide employment	5	Created jobs	Number of jobs	3	Use
4	Contribute to public finances	2	TCL Taxes	Rate according to regulation	0	Use
5	Ensure anchorage of enterprises	1	Delocalization	Survey	3	Use

6	Give enterprises opportunities for extension	4	Extensions undertaken	Survey	3	Use
7	Respect the zone vocation	1	Types of implemented projects	Survey	2	Use
8	Respect environmental standards	1	Waste disposal	Volume	1	Use
9	Ensure a non encumbered buildings	1	Density	Survey	2	Use
10	Provide enterprises with proximity services	4	Creation of service center in the zone	1 premises	2	Use
11	Resist to speculation	1	Protection	Survey	3	Use
12	Resist to diversion attempts	2	Protection	Survey	3	Use
13	Resist to malevolence	1	Protection	Survey	3	Use
14	Ensure vicinity's security	5	Protection	Survey	3	Use

Acording to this table, we obtained three octopus diagrams corresponding to the three phases of the industrial zone life cycle and which can be represented as follows:

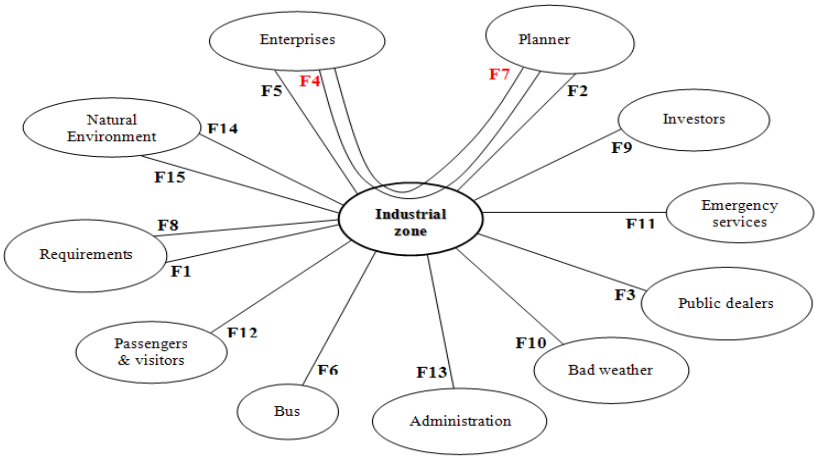


Figure 1. *Octopus Diagram related to the industrial zone's planning phase*

This diagram shows that the two functions F4 (Ensure a suitable design to the enterprises) and F7 (Offer sufficient space) are the main functions among the 15 functions relating to the planning phase.

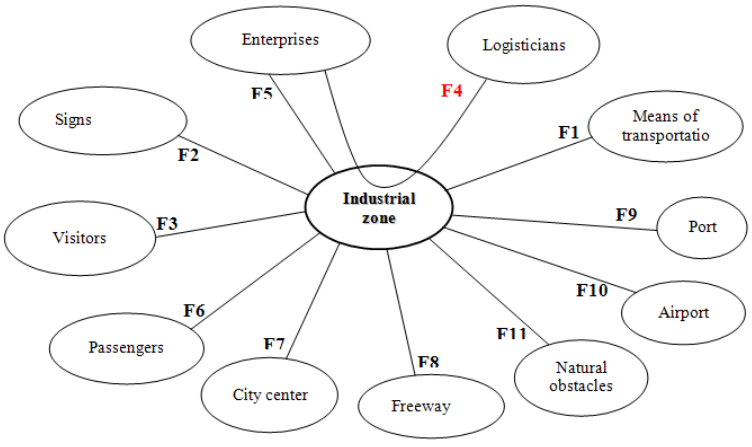


Figure 2. *Octopus Diagram related to the industrial zone's accessibility phase*

This diagram shows that the function F4 (Facilitate accessibility for logisticians) is the only main function among the 11 functions relating to the accessibility phase.

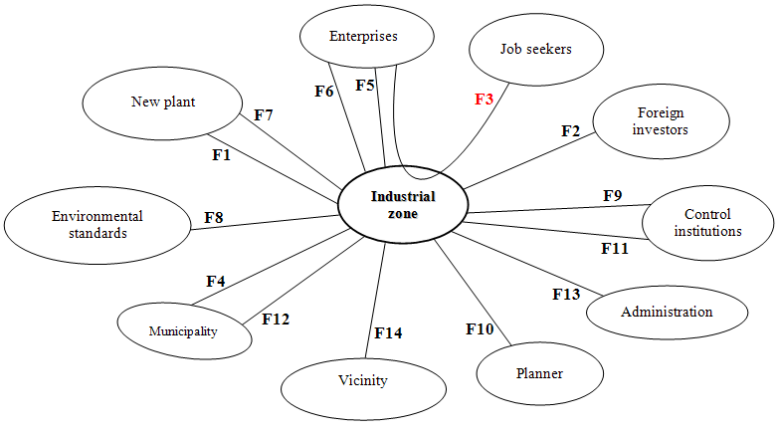


Figure 5. *Octopus Diagram related to the industrial zone's use phase*

This diagram shows that the function F3 (Provide employment) is the only main function among the 14 functions relating to the use phase.

EVALUATION OF INDUSTRIAL ZONES FONCTIONALITY

The evaluation of industrial zone functionality was carried out according to a multi-creteria table witch gather functions, their importance and their criteria. This table was filled in by comparing criteria one by one, with a note attribution according to a "0-3 scale": V= 0: if the criterion is not feasable; V= 1: if it is slightly feasable; V= 2: if the criterion shows a medium level of feasibility andV= 3: if the criterion is totally and perfectly feasable.

Each function was estimated according to a weight "K" (weight percentage) corresponding to functions hierarchy. The calculation of the product KV allows us to classify the functionality of the industrial zones in the Greater area of Tunis. The more KV is important the better the functionality of the industrial zone is (table 2)

Table 2. *FunctionalityEvaluation of Greater Tunis area's industrial zones*

Industrial zone	Product value (KV)
La Goulette SPLT	261
Ariana Aéroport	251
Ksar Said	246
Ksar Saïd SPRIC	246
Ksar Saïd SABI	246
Charguia 1	243
Ben Arous AFI	217
Radès Pétrole	206
Mégrine Z4	202
Sidi Rézig	201
Borj Cedria	198
Mégrine Riadh	197
Bir Kassaa1	197
Jbel Jelloud	196
Ben Arous Nord	194
M'Ghira1	193
Mghira 2	193
Mghira 3	193
Ben Arous Sud	190
Bir Kassaa 3	190
El Agba	190
Bir Kassaa2 Ben Arous	190
Bir Kassaa 2 Mourouj	188
Radès AFI	185
La Goulette AFI	185
Zl Zaanouni	185
Mégrine municipale	185
Cité Dispensaire	184
La Marsa	177
Radès Municipale	171
Chotranan AFI	158
Chotrana Sidi Salah	117
Ezzahra	117
Ibn Khaldoun	109
M'nihla	89
M'Hamdia	84
Sidi Thabet	81

Borj El Amri	81
Feja	81
Sidi Thabet Mbarka	79
Mornaguia	75
Jedeida	69
Kalaat Andalous	59
Tebourba	55

This table indicates the functionality degree of industrial zones in the Greater Tunis area. As it can be seen, we may distinguish three categories to characterise industrial zones:

-Industrial zones showing a coherent functionality with urban development. These zones follow, at the same rhythm, the urban progress of the Greater Tunis area and meet the needs of investors seeking for parcels to perform their enterprises. They constitute an efficient and competitive industrialinfrastructure. As such they provide the city in which they operates an industrial set-up which induce and encourage the growth and diversification of Greater Tunis area's urban base.However, the urban development has to be controlled to keep away industrial zones from saturation. These zones are the following: Ariana Aeroport, La Goulette SPLT, Ksar Said, Ksar Saïd SPRIC, Ksar Saïd SABI, Charguia 1, Ben Arous AFI, Rades Petrole, Megrine Z4, Sidi Rezig.

-Industrial zones which are not in a perfect coherence with the other elements of the urban environment. Despite their size andproximity to the city centre, the functionalpotential of these zones has not been fully realised. This isdue in part to the poor level of connection with thecity both spatially and functionally. Such zones have to co-exist in harmony in the city within legible system of primary, secondaryand tertiary streets and urban spaces that underpinthe creation of a coherent spatial order favourable to better performance of these zones. Concerned zones are the following:

Borj Cedria, Megrine Riadh, Bir Kassaa1, Jbel Jelloud , Ben Arous Nord, Mghira1, Mghira 2, Mghira 3, Ben Arous Sud, Bir Kassaa 3, El Agba, Bir Kassaa2, Ben Arous, Bir Kassaa 2, Mourouj, Rades AFI, La Goulette AFI, ZI Zaanouni, Megrine municipale, Cite Dispensaire, La Marsa, Rades Municipale, Chotranan AFI, Chotrana Sidi Salah, Ezzahra and Ibn Khaldoun.

- Industrial zones which are in acute shortage of suitable connections with the city so that the efficiency of industrial functions in the zone was seriouslyaffected. These zones suffer from many problems because they don't rhym with Greater Tunis agglomeration growth and they seem to operate in a closed and inwardlooking system.

As possible solution: it is argued that tightlyconnection between industrial zones and urban environment, as opposed to looselyconnection, can avoid these inconveniences.

The list of these zones includes: Mnihla, Mhamdi, Sidi Thabet, Borj El Amri, Feja, Sidi Thabet Mbarka, Mornaguia,Jedeida, Kalaat Andalous and Tebourba.

Finally, this article has examined the functionality of Greater Tunis industrial zones using the Function Analysis approach. We chose this great area owing to its role as a major industrial city, where important number of old and new industrial zones have been established. It finds that industrial zones have being undergoing a different degree of functionality and can be classified into three categories as mentioned above. Thus, an effort has to be undertaken by all the actors (public and private) in order to improve and boost the performance and competitiveness of the industrial zones not only in the Greater Tunis area but also in the hole country of Tunisia.

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