

Lecture Notes in Networks and Systems 384

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Klender Aimer Cortez Alejandro ·
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Digital Era and Fuzzy Applications in Management and Economy

 Springer

Lecture Notes in Networks and Systems

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Preface

In the face of information technology, digitization, and uncertainty, organizations confront new opportunities and challenges. To take advantage of these opportunities and overcome current and future challenges, it is needed to understand the evolution of these phenomenon. This book “Digital Era and Fuzzy Applications in Management and Economy” convened by the International Association for Fuzzy-Set Management and Economy (SIGEF) jointly with the Universidad Autonoma de Nuevo Leon (Mexico) aims to contribute to the discussion about the implications of fuzzy logic, neural networks, and other intelligent techniques applied to public and private organizations in the current digital era.

Recently, new developments based on socioeconomic and computational changes have shed light on the importance of fuzzy applications in social sciences. The purpose of this publication is to disclose the applications of fuzzy logics and new quantitative methodologies to management and economics in the context of the digital era. This book will be very useful for researchers, practitioners, and graduate students aiming to introduce themselves to the field of quantitative techniques for overcoming digital uncertain environments and developing models to make decisions. It is important to mention that all the chapters were selected from a peer-reviewed process. In this regard, we want to thank all the authors of the chapters, the SIGEF scientific committee, as well as the invaluable contribution of the invited reviewers from different universities who supported the review and selection of the papers received.

This book provides solutions to the organizations problems faced by the lack of information in some cases and the large amount of information. To understand the recent economic and financial behavior, the introduction of the book was carefully written by Dr. Jaime Gil-Aluja. After the 2008 financial crisis, the need for a fast world economic recovery with billions of people connected by mobile devices using the new disrupting technologies, the expansion of internet, and the artificial intelligence was imminent; however, the system was interrupted by a serious external shock: the COVID-19 pandemic, and as Dr. Gil-Aluja mentioned in this chapter “opening up new horizons to which the existing structures need to adapt.”

In this scenario, the “Economic humanism self-induced incidences in the circular economy” was introduced.

Then, the following chapters were grouped into four topics of specialized knowledge: finance and economy; management and accounting; methodological issues, and technology and business innovation to provide a scientific approach that contributes to improving the decision-making process in the organizations.

The first part of the book corresponds to the financial and economic analysis. Due to the importance of short-term investing decision, the initial chapter examines the long memory properties in high frequency time series of eight important cryptocurrencies; the results show that high frequency returns exhibit a trend toward a more efficient behavior; on the other hand, high frequency volatility reflects a strong persistence in volatility. Subsequently, in the following chapter, the economic and agronomy risks are studied with a fuzzy decoupled net present value as an improve to the traditional valuation techniques for agricultural commodities. The proposed method allows a more realistic investment estimation in an uncertain environment. As a result of changes in the energy policies in emerging countries, in the next chapter, the performance of energy prices through an elasticity analysis is presented. A quadratic almost demand system estimation indicates that the Mexican demand for energy is inelastic, that is, when prices increase, households do not tend to change their consumption; furthermore, changes in prices have a greater impact on low-income household well-being compared to high-income households.

The second part of the book contemplates the topic of management and accounting. Due to the recently pandemic and the interaction between nurses and patients within an uncertain environment, the need of serious research in the health sector is important. In this logic, the first chapter of this section proposed the use of fuzzy qualitative comparative analysis as an effective method for understanding the cognitive heuristic decision-making in the emergency department of a private–public hospital in Naples; the authors also proposed some practical implications to improve the triage process. On the other hand, the next chapters are oriented to assess accounting issues. To analyzes whether ESG risk information disclosures impact on earnings per share to confirm accounting conservatism in Mexico, a multifactor fuzzy regression is proposed. The results suggest the presence of accounting conservatism in the Mexican capital market in 2020 due to the negative disclosures of ESG risks since the “bad socially responsible news” increases the impact of the market reaction to financial performance. Finally, since companies need to evolve toward the new digital era as a result of the technological advances in the government taxation mechanisms, a research to assess the effect of the digital taxation mechanisms in Mexico is presented. The results show that the implementation of digital taxation directly benefits income tax collection.

The third block of manuscripts is related to methodological issues in order to analyzes uncertain environments. First, a methodological proposal is presented to analyze the poverty through educational lag from a complex network and optimization approach. Then, using a spatial analysis, the following chapter explores the existence or lack of a process of convergence among the economic production of Mexican firms in different cities; the results show that the geographic location

determines the successful of the firms. A final method in this section is proposed to asset the cryptocurrencies investment industry. The on-chain data that uses metrics from the blockchain of the underlying asset and technical analysis is applied to predict investor sentiment for the cryptocurrency markets.

Finally, settled on the Fourth Industrial Revolution, three chapters are presented in the technology and business innovation section of the book. The first chapter provides some insight into designing a visual graph-shaped frontend for two flagship deep learning software platforms. The proposed frontend, called Visual Keras&Autokeras, is attempting to visually emulate all the APIs related to Keras Functional model and AutoKeras AutoModel in a codeless environment at any level of complexity. On the other hand, as price optimization is an important research topic for business and economy, the next paper proposes a novel approach based on two major components: the predictive component using parametric and non-parametric machine learning techniques, and the forecast component processed into an optimization model to analyze cross price elasticities in order to maximize the revenue for a retailer while keeping control of traffic and assortment at the stores. Finance is not the exception in these digital changes; in this sense, a fintech analysis is presented at the end of the book. The objective of the final chapter is to compare an investment portfolio that utilizes similar strategies to those of an Robo Advisor against an investment portfolio that makes decisions through a consensus of valuation analysts. To compare both portfolios, a Fuzzy Jensen's alpha is estimated. The results indicate that both strategies succeeded in surpassing the benchmark, but the analysts' portfolio has accelerated its growth since 2018 against the Robo Advisor portfolio. However, the Robo Advisors' portfolio has a higher possibility of obtaining abnormal or unexpected returns than the analyst's value investing portfolio, given the systematic risk involved.

As we have mentioned, the treatment of uncertainty in the economic and business analysis is fundamental and requires methods compatible with the uncertain environment in the recent digital era since most of the traditional models have been overtaken by this reality when trying to make decisions with uncertain information in a big data word. In this sense, fuzzy logic, optimization approaches, complexity science, economic process modeling under uncertainty and geographic context, fintech analysis, deep learning and other artificial intelligent techniques applied to different organizations can be powerful tools in the decision-making process. The selected and peer-reviewed chapters in this book invite to delve into these issues with real applications that can undoubtedly be of great utility to both researchers and practitioners.

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Organization

The International Association for Fuzzy-Set Management and Economy (SIGEF) joint with reserachers in the Universidad Autónoma de Nuevo León (UANL) prepared the blind arbitration process for the Springer book series with the title “Digital Era and Fuzzy Applications in Management and Economy” and book series on “Advances in Intelligence Systems and Computing.”

Academic comittee is working to arrange the publication of the best papers and chapters. Manuscripts will be selected for potential publication in special issues or Springer book. Twenty-nine researches have been submitted, and 13 chapters were selected for publishing in Springer book considerng the arbitraje doble blind. The book has the participation of various colleagues from different countries all over the world, such as Argentina, Croatia, Spain, Italy, Perú, and México.

Guest Editors

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Contents

Economic Humanism Self-induced Incidences in the Circular Economy	1
Jaime Gil Aluja	
Finance and Economy	
Wavelet Entropy and Complexity Analysis of Cryptocurrencies Dynamics	25
Victoria Vampa, María T. Martín, Lucila Calderón, and Aurelio F. Bariviera	
The Use of Fuzzy Decoupled Net Present Value in Pepper Production ...	36
José M. Brotons-Martínez, Amparo Galvez, Ruben Chavez-Rivera, and Josefa Lopez-Marín	
The Effect of Energy Prices on Mexican Households' Consumption ...	47
María Guadalupe García Garza, Jeyle Ortiz Rodríguez, and Esteban Picazzo Palencia	
Management and Accounting	
How to Cope with Complexity in Decision-Making: An Application of Fuzzy Qualitative Comparative Analysis in the Triage Process	59
Lorella Cannavacciuolo, Cristina Ponsiglione, Simonetta Primario, Ivana Quinto, Maria Teresa Iannuzzo, and Giovanna Pentella	
ESG Risk Disclosure and Earning Timelines in the Mexican Capital Market Using Fuzzy Logic Regression	73
Martha del Pilar Rodríguez García	
The Digital Taxation Adoption and Its Impact on Income Tax in Mexico (2010–2020)	82
Fabiola Denisse Flores-Guajardo, Juan Paura-García, and Daniel Oswaldo Flores-Silva	

Methodological Issues

Analysis of Poverty Through Educational Lag Using the Maximum Clique into the Complex 97

Israel Santiago-Rubio, Román Mora-Gutiérrez, Edwin Montes Orozco, Eric Alfredo Rincón García, Sergio Gerardo de los Cobos Silva, Pedro Lara Velazquez, and Miguel Ángel Gutiérrez Andrade

Spatial Effects on Economic Convergence Among Mexican Firms 109

Esteban Picazzo Palencia, Jeyle Ortiz Rodríguez, and Elias Alvarado Lagunas

On-Chain Metrics and Technical Analysis in Cryptocurrency Markets 122

Angel Roberto Nava-Solis and Eduardo Javier Treviño-Saldívar

Technology and Business Innovation

Some Insight into Designing a Visual Graph-Shaped Frontend for Keras and AutoKeras, to Foster Deep Learning Mass Adoption 133

Vasile Georgescu and Ioana-Andreea Gîfu

Elasticities on a Mixed Integer Programming Model for Revenue Optimization 153

Jesus Lopez-Perez

Robo Advisors vs. Value Investing Strategies: A Fuzzy Jensen’s Alpha Assessment 178

Rodrigo Caballero-Fernández, Klender Cortez, and David Ceballos-Hornero

Author Index 195



Economic Humanism Self-induced Incidences in the Circular Economy

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Abstract. The Circular Economy has proven to be one of the main advances in trying to solve the serious problem of environmental degradation. In this work we present an algorithm, based on the reticular theory, to detect the incidence of actions (incident elements) linked to the circular economy on products (incident elements). For this we establish both the direct incidents, which are easier to determine by the experts, and the self-induced incidents whose determination is not so simple. Starting from these incidents, the semi-accumulated flows are established at different stages of the algorithm, until the final accumulated flows are obtained. These contain all possible incidents, both direct and indirect, obtaining a network of incidents that will allow determining the best policies to obtain the desired result. We present the application to a specific case, although the significant contribution is the methodological proposal that we understand in accordance with human thought and that allows those incidents that are not direct and therefore difficult to detect by the human mind to appear.

Keywords: Circular economy · Reticular theory · Incidences algorithm

1 External Impacts in an Evaluative System

Information, realities, actions, reactions, strategies, but basically and sometimes as protective umbrellas: politics. A subtle word, so often prostituted, so often maltreated. And a waste collecting recipient: the economy.

Not so long ago, in 2008, a serious internal crisis was generated and exploded as a result of the financial “imbalances” that invaded practically every area of the economic systems.

Some short-term measures were taken to repair the damage caused and some medium and long-term ones outlines to adapt to the new realities of our world, which had been shaken up as much by internal impacts on the economic system as external ones, caused by the “toxic” activities of the leaders of life in society (public, institutional, and business managers and, of course, economic units of consumption and investment).

Having overcome the financial crisis, the outlook for recovery and economic expansion was looking increasingly bright and imminent when the system was interrupted by a serious external shock in the form of the Covid-19 pandemic which, driven by the confusion into which the health, political, and economic organization had been thrust,

changed the existing “normality” with its accepted routines, opening up new horizons to which the existing structures need to adapt.

It is not an easy task. The human mind is slow to account for changes that occur, but at least the economic structures appear not to have suffered any internal damage. Recovery is happening fast.

The fact is that nowadays, the events that have varying degrees of impact on economic activity happen sporadically, but continuously. The shocks suffered by the economic system are no longer separated by 10-year gaps, but by just a few months, with the subsequent need for repair and adaptation to the new scenarios.

Just a few short weeks ago, a new Palestinian-Israeli conflict broke out, with missiles, death, and devastation. At the time of writing these words, sorrowful scenes of minors trying to reach Spain from Morocco via Ceuta are being played out in basic seafaring craft, swimming and scaling fences, sometimes straight to their death. We are the stunned observers of painful and emotive scenes of “illegal” children being embraced by Spanish soldiers.

The speed with which these changes are happening leads us to a first conclusion: any adaptations must be flexible so that they can be swiftly modified, and without involving huge costs and the need for great effort.

Meanwhile, the economic studies and research undertaken to underplay the negative incidence of economic cycles and to highlight the opportunities their emergence always offers, continue to be produced with the support of principles, techniques, and operators of the strictest mechanical philosophy. Nonetheless, economic science has not changed since its birth. Its models, methods, and calculation procedures are little effective or entirely ineffective when dealing with the complex problems and uncertainties of our current realities.

It is true that from time to time some new concepts, processes, or techniques that could potentially open new paths come to the attention of economic research teams. This is the case of the appearance of the “Fuzzy Sets” work of Lofti Zadeh [1], which we proudly contributed to.

While different in terms of its potential and originality, the concept of the “Circular Economy” is another such example. In essence, it consists in reintroducing an old method of economic management adopted during and after the Spanish Civil War, reborn now at odds with the waste involved in the consumption and production of goods and the investment that a large part of our societies take part in in an UNSHARED prosperity.

And what is more, this distinct lack of sharing not only occurs between territories but is also often missing in the heart of a territory.

The recent images of undernourished and hungry children roaming around Ceuta, and the sadly recurrent images of young and old alike sleeping outdoors in the cold of winter and rummaging in our city’s rubbish bins looking for what others have thrown away to fill their stomachs must prompt consciences to not remain indifferent to such serious imbalances. It is now appropriate to pose the following question:

What attitude must we take in the face of this desolate scenario?

It is not the investigative sector’s responsibility to carry out activities that belong in the political or legal realm, but it is their responsibility to work to supply these sectors

with the elements of rigor and effectiveness to underpin any valid decisions they make based on legality and ethics.

We have been doing it this way up till now and our proposal is to do it the same way in the future.

And not only have we done it this way, but we offer our findings with no compensation whatsoever and with total freedom of use.

2 A Road to the Humanist Economy

From an operative point of view, we must highlight the construction of humanist algorithms designed to find effective solutions to serious and complex problems.

Among the latest humanist algorithms created, published, and offered we can find the “Portugal Algorithm” [2] designed to enhance cohesion between the countries and zones of the Iberian Peninsula.

The “Algorithm for allocating immigrants” [3], which seeks compatibility between immigrants’ possibilities and aspirations and the desires and needs of the welcome companies and institutions, is another of them.

The purpose of a variant of this algorithm is to solve the enormous problem of the MENAS (non-accompanied minors) to better allocate immigrant minors to welcome families, taking into account the human, social and educational characteristics of the first and the desires and possibilities of the second. We believe we do not have to spell out the high degree of subjectivity involved in some of the criteria set out to guide this allocation.

Nowadays, with the serious situation in Ceuta, the “Algorithm to allocate non-accompanied minors” fits perfectly with the problem that has now emerged. And even though political agreements are periodically made, we are seriously concerned that this problem will persist for many years to come. We reiterate our willingness to help resolve the situation.

The “Algorithm for inter-generational harmony” [4]. This main aim of this algorithm, which is generalizable to harmony in all aspects of life in society, is to make compatible the tasks involved in a workplace such that that they complement the work destined for various generations of humans.

As we speak, we are working with Dr Jean-Jacques Askenasy, Professor of Neurology of Tel-Aviv University on an algorithm for the early detection of neurological disorders.

These and other works have a humanism that impregnates as much the tools used to resolve the problems in hand as the problem itself.

The general aim to some degree is to find a way to prevent problems from happening before they do and to make sure they do not appear later, manifesting themselves in all their harshness.

The creation of these and other algorithms marks the end of our venture into humanist economics in which, in addition to the rational components, subjectivity and emotional aspects explicitly intervene in the formalization of human decisions.

Looking back over our research, we realized that in a some of our works we obtained acceptable results without the need to lead the way with numbers, in the sense that we could evade the operators belonging to arithmetic.

Therefore, the sum could be substituted by an addition, the difference by a distance, the derivatives to optimize by the maximization of minimums, and so on. We had already created a humble but solid body of doctrine, ranging from the principles to techniques for its immediate application.

Four concepts with their operators were sufficient to find suitable solutions for any economic problem in a context of uncertainty: relation, consolidation, allocation and ordering [5]. In 1999, I published a work in Kluwer [5], which covered my research work developed from the four theories we formalized.

“Numerical mathematics” of uncertainty and “non-numerical mathematics” alone already provided a body of technical knowledge capable of dealing with economic phenomenology with humanist tools.

In its widest sense, this has only been possible by anticipating what society will be like wherein human relations with other humans will take place. We had made previous attempts to do this in view of the advances in transhumanism and dataism, along with the risks and important advantages and opportunities these lend, and to which we were among the first to contribute [6].

During times of profound and rapid change, and on the difficult-to-predict courses on which the world is nowadays set, we need some rays of sunshine to avoid the pitfalls of delirium, disorientation, and disillusion, the vitamin supplements for dehumanization.

To confront these dangers, there is also a serious need to strengthen cooperation in all areas of our shared existence, but particularly in the field of scientific investigation. To weaken solidarity is to erode humanism. To convert solidarity into selfishness is to reduce it to a mechanism: using machines to serve humankind is a battle we can win.

We continue to be committed to placing all the effort we are capable of at the service of idea of a human future, generator and driver if the mechanical at its service.

2.1 Circular Economy: From a Past Inheritance to a Future Opportunity

Meanwhile, these and other actions, from thousands of millions of individual acts to the consolidated habits of companies, corporations, and institutions, are causing further deterioration of the planet. Slowing this down at the very least, and if possible changing the trend, requires the tenacity of everybody, so that the sum of many “not much in the way of positives” can be converted into an interesting collaborative cooperation.

At this point, we would ask your permission to leave aside the air of formality for a moment to examine some of the small realities of our past and present.

Some years ago, in the last decades of the XX century, and like with other facts and phenomena, concepts and processes, an attractive name was coined to designate a way to carry out economic activity: circular economy.

This term somehow managed to encompass activities in the form in which they took place in our country in times of shortage, and are still taking place nowadays in economically deprived communities. What do realities like the second-hand market, re-used textbooks, second-hand bike sales, and hand-me-down clothes say to us, and especially to us older members of society?

Words that used to have no pejorative connotations at all, like junk dealer, rag and bone man (the typical French “chiffonnier”), and scrap dealer, have also stuck in our

memory. Does anybody remember going to buy food and drink in glass bottles or containers and taking them back once they were empty? Well, today's circular economy has something of all this in it, but back then it was physically dispersed and formally unconnected. Its only reason to be was survival.

And then low cost, easily manipulable and transformable products and raw materials appeared, and the "throwaway society" was born. Some jobs disappeared and others appeared: a simple fact of life.

But lands and seas have filled up with rubbish, pollution in our villages and cities has increased, and we are now suffering the consequences of the warming of our planet.

Actions with varying degrees of effectiveness and efficiency seek to halt this destructive process, implementing measures designed not only to limit the existing accelerated squandering but also slow down the soiling of both our planet and the part of the Cosmos nearest to us.

We may think ourselves and our humble occupations more important than they really are in terms of this crusade to safeguard our future. But what is intolerable is sitting back and watching how we are jeopardizing the progress of future generations.

To this effect, we simply claim that it is within our scope to help improve the structures and functioning of the circular economy.

And the way we think we can do this is by completing its conceptualization, specifying its operation, and providing it with operational techniques using artificial intelligence.

In studies related to the circular economy, the lifecycle of a product is usually described as a series of stages that start with raw materials entering a process of production, manufacture, and use, representing the end of the product's first life, and its eventual utilization (with or without transformation), thus closing the circle with a new use.

We can of course imagine all the variants. However, for our purposes, this simple but interesting description is enough to understand that this process can be expressed through a flow in a network, which can be as simple or as complex as required.

This way, we can largely take advantage of the schemes and operators of the reticular theory, which we have so often used to resolve other problems [7], although to do so it is recommendable to somehow define some aspects that represent the circulation of the flows in the networks. This is what we are now going to do.

However, what cannot be forgotten is the fact that there are other circuits that are just as important and without which we cannot talk about the circular economy. We are talking about the ones that come to rest where the flows in the circle start.

We will try to fill this potential gap with what we believe will help open up a new path to taking good decisions.

3 Incorporating the Notion of Incidence into the Circular Economy

To do so, let us go back to the notion of incidence. Incidence is usually associated somehow with a relationship, in the same way as is causality (cause and effect relationship). The "causes", incident elements, come together and jointly intervene to some degree or level in the "effects", another set of elements impacted on.

By way of illustrating our proposal, we are going to introduce a formal process that starts with establishing two sets of reference A and B, comprised of the incident elements a_i , $i = 1, 2, \dots, n$, and the elements impacted on b_j , $j = 1, 2, \dots, m$.

As an example, and only an example, potentially included among the incident elements are government measures, press articles and releases, waste collection points in cities, intermediary companies such as Vinted, Wallapop, and Poshmark, home collection services, recovery solidarity organizations such as Humana, Arrels, Caritas, the Red Cross, etc., and commercial second-hand companies such as Tuvalum, Thingeer, and Percentil, etc.

Again, just as a reference, other incident elements could include the inventories of products and goods in storage for their re-incorporation in the circular economy: individual transport vehicles such as bicycles and skates, etc., furniture and other household items, clothing and accessories, glass containers, books and school equipment, and food leftovers.

Once the elements that make up the incident sets $A = \{a_1, a_2, \dots, a_i, \dots, a_n\}$ and $B = \{b_1, b_2, \dots, b_j, \dots, b_m\}$, the basic concepts are established and the operators required for their later use are chosen.

We propose the following, produced for the research work we presented at the 6th International Conference: “Economics Scientific Research. Theoretical, Empirical and Practical Approaches” on 10–11 October 2019 in Bucharest [8]:

1. Channels of incidence: arcs of the networks and subnets through which the incidence flows.
2. Incidence flow: the level of flow through the channels. It is evaluated in the interval $[0; 1]$
3. Incidence deposits: arc peaks in a network where the incidence flow can reach or leave
4. Channel confluence: the peaks of a network can be deposited where the incidences that arrive from two or more channels flow.
5. Incidence distribution center: peaks of a network where two or more channels exit.
6. Dilution of incidence flows: a phenomenon that occurs in an incidence deposit when the arrival flow is less or greater than that generated by the deposit itself. The deposited flow is reduced to the lower of the two.
7. Incidence Flow Evaporation Threshold: The degree or level below which the incidence flow stops in a reservoir and stops passing through the next channel or channels.

By establishing these concepts, we can present the most important aspects we propose to achieve the following two objectives:

- I. Obtain the total number of incidences from the incident entities to the affected entities, and detect the incidents that act as the most important intermediaries.
- II. Establish the level or degree of incidence flows that reach the final deposits.

Within the framework of a conference of the type that would be interested in accepting this research work, we believe it is necessary to insist that the incidence evaluations take place using the endecadarian system in the confidence interval $[0, 1]$.

Despite this, and to provide a solid basis for our previous explanation, we are now going to replicate the basic principles of the theory of incidences:

- a. The natural quality of the human being doesn't allow the use of just the two positions of the binary system: the incidence exists or it doesn't exist. Let's introduce nuance by appealing to multivalent logic and, mathematically, to fuzzy sets.
- b. Incidences propagate with a chain of relations through a network. To formalize this, we use the image of a flow of incidences with a degree or level of intensity that flow through the connected channels with a capacity degree or level.
- c. Incidence is a notion with a highly subjective content which, consequently, cannot be generally treated through the operators with which determinism, certainty and hazard are concerned, as it is not the object of quantification (objective numerical assignment) but of an assessment (subjective numerical assignment). Determinism is not a good bet for human adventure. Everything evolves, and adaptability has become essential.
- d. If, in Boolean algebra, values are taken from the set $\{0; 1\}$, in multivalence we establish that these are included in the interval $[0, 1]$. In this regard, we propose an endecadarian numerical-semantical correspondence as an indication (we can use another one too) [8].

4 Direct and Self Induced Incidences

Having set out the most essential concepts and basic principles for developing our work, we are now in a position to start the stages needed to incorporate the theoretical and technical elements of the self-induced incidences into the study of the circular economy.

First, we will proceed in obtaining the direct incidences, or in other words those that represent the "degree" or "level" of incidence of all $a_i/i = 1, 2, \dots, n$, on all $b_j/j = 1, 2, \dots, m$, without incidences that act as intermediaries.

For greater clarity, we will represent the grade or level of incidence of all $a_i/i = 1, 2, \dots, n$ on all $b_j/j = 1, 2, \dots, m$, by means of $(x_i, y_j)/i = 1, 2, \dots, n; j = 1, 2, \dots, m$. The entire valuation $(x_i, y_j)/i = 1, 2, \dots, n; j = 1, 2, \dots, m$ is included in $[0, 1]$.

The set of valuations in $[0, 1]$ of the direct incidences of $a_i/i = 1, 2, \dots, n$ on $b_j/j = 1, 2, \dots, m$, can be represented by a fuzzy matrix $\left[\underset{\sim}{M} \right]$ like the following one (Fig. 1).

Where the valuations of all the pairs (a_i, b_j) , or in other words (x_i, y_j) , $i = 1, 2, \dots, n; j = 1, 2, \dots, m$, are included in $[0, 1]$.

$$\forall (a_i, b_j) \in \left[\underset{\sim}{M} \right] \quad (1)$$

$$(x_i, y_j) \in [0, 1] \quad (2)$$

$$[M_{\sim}] =$$

	B			
A		b_1	b_2	b_m
a_1		(x_1, y_1)	(x_1, y_2)	(x_1, y_m)
a_2		(x_2, y_1)	(x_2, y_2)	(x_2, y_m)
a_n		(x_n, y_1)	(x_n, y_2)	(x_n, y_m)

Fig. 1. Direct incidences matrix.

The matrix $[M_{\sim}]$ therefore expresses the direct incidences of all the elements $a_i/i = 1, 2, \dots, n$, the set of incidences of the set A, on all the elements of $b_j/j = 1, 2, \dots, m$, the set of affected elements of the set B.

We will now formally express the self-induction of incidences, although it may be pertinent to first clarify that what is understood as self-induction of incidences are the relations of incidences that take place among elements in the same set, or in other words, among the elements in A and, likewise, among the elements in B, and including the incidence of an element with itself.

To this effect, it is considered that, given a referential A of incident elements on the referential B of affected elements, there are also some incidences of $a_i/i = 1, 2, \dots, n$, on $a_h, h = 1, 2, \dots, n$, whose corresponding valuations $(x_i, x_h) \in [0, 1], i, h = 1, 2, \dots, n$, form a fuzzy matrix $[A_{\sim}]$, which is square and reflexive (Fig. 2).

$$[A_{\sim}] =$$

	A			
A		a_1	a_2	a_n
a_1		(x_1, x_1)	(x_1, x_2)	(x_1, x_n)
a_2		(x_2, x_1)	(x_2, x_2)	(x_2, x_n)
a_n		(x_n, x_1)	(x_n, x_2)	(x_n, x_n)

Fig. 2. Self-induced incidences matrix of incident elements.

where $(x_i, x_i), i = 1, 2, \dots, n$, are equal to the unit.

Similarly, given a referential of affected elements, B, of another referential of incidences A, these are also incidences of their own elements. Therefore, there are some incidences of $b_j/j = 1, 2, \dots, m$, on $b_k/k = 1, 2, \dots, m$, and their valuations.

$(y_j, y_k) \in [0, 1], j, k = 1, 2 \dots m$ form a square and reflexive matrix, $[\tilde{B}]$ (Fig. 3).

In the language of flows in networks we have defined, we can say that between two sets, one made up of primarily incident elements, A, and the other made up primarily of affected elements, B, there is also a flow of incidences of A to B, whose direct degree or level, the volume, is represented by a fuzzy matrix $[\tilde{M}]$, and two other flows of incidences that take place from the elements in A on the elements in A, and including the incidences of an element on itself and other flows of incidences from the elements in B on the elements in B, also including the incidences of an element on itself.

The fuzzy matrices $[\tilde{A}]$ and $[\tilde{B}]$, express the valuations of the self-induced incidences.

To this effect, we now have valuable information contained in the three incidence networks: the network of direct incidences and the two networks of self-induced incidences.

$[\tilde{B}] =$

	B	b_1	b_2	...	b_m
B		(y_1, y_1)	(y_1, y_2)	...	(y_1, y_m)
b_1			(y_2, y_1)	...	(y_2, y_m)
b_2				...	(y_m, y_m)
...					
b_m		(y_m, y_1)	(y_m, y_2)	...	(y_m, y_m)

Fig. 3. Self-induced incidences matrix of affected elements.

where $(y_j, y_j), j = 1, 2, \dots, m$, are equal to the unit.

4.1 Determining the Total Level of Flow of the Incidences

We have now reached a point in our work where we assume that the degree or level of the flows of direct incidences of set A of primary incidences on set B also of primary incidences, without considering the possible incidences through elements that act as intermediaries, are known.