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DOMENICO CEGLIA

AN ANALYSIS OF INSTITUTIONAL DYNAMIC FOR INDUSTRIAL SYMBIOSIS IN THE UNITED KINGDOM

FORTALEZA

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Dissertação submetida ao Programa de Pós-Graduação em Administração e Controladoria na Universidade Federal do Ceará para o conseguimento do titulo de Mestre em Administração e Controladoria.

Orientadora: Profa. Dra. Mônica Cavalcanti Sá de Abreu

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"Live as if you were to die tomorrow. Learn as if you were to live forever" by Ghandi

RESUMO

A simbiose industrial é um conceito industrial que aponta à troca de recursos entre empresas. Entre vários casos ao redor do mundo como Kalundborg, TEDA e Styria nenhum desses teve um programa em nível nacional fomentado pelo governo. No Reino Unido a simbiose industrial foi financiada pelo governo desde 2005 até 2014. Em 2000 nasceu o Programa Nacional de Simbiose Industrial (NISP) pela International Synergies Ltd. Desde 2000, o NISP teve excelentes resultados na área econômica, ambiental e social. O ambiente institucional britânico é altamente competitivo e sempre mais dependente de outros em continua mudanças, portanto esse trabalho visa responder de que forma as dinâmicas institucionais no Reino Unido suportam ou impedem o desenvolvimento da simbiose industrial? Com base nessa pergunta de pesquisa o estudo seguiu o objetivo geral de entender o desenvolvimento da simbiose industrial no Reino Unido ao longo dos anos influenciado pelo contexto institucional. O estudo foi desenvolvido como estudo de caso da simbiose industrial no Reino Unido utilizando uma serie de entrevistas semiabertas com os atores envolvidos. Mediante uma analise de conteúdo foram individuadas as categorias chaves e os conceitos ligados a elas que resultaram na construção de um framework conceptual de simbiose industrial do Reino Unido. O contexto institucional incentivou a criação do NISP que promoveu com resultados satisfatórios o desenvolvimento da simbiose industrial participando do desenvolvimento das capacidades institucionais entre as organizações envolvidas, embora com algumas dificuldades na atração de novas firmas no processo. A simbiose industrial no Reino Unido está tendo dificuldade de avançar, pois o governo não esta mais financiando o NISP e uma visão em curto prazo das empresas tornou esse processo descontinuo e provavelmente destinado a uma revisão dos mecanismos de desenvolvimento. Esse estudo aponta para um fortalecimento da colaboração entre o governo e empresa acompanhada de uma mudança cultural do gerenciamento do resíduo como fonte de oportunidade para as empresas, portanto um processo educacional que promovesse isso é fundamental para o futuro da simbiose industrial no Reino Unido. Por fim, esse estudo aponta para a continuação do financiamento por parte do governo e a divulgação e compartilhamento dos resultados e praticas em nível nacional para que a simbiose industrial possa se institucionalizar.

Palavras-chave: Simbiose industriale, dinâmicas institucionais, Teoria Institucional.

ABSTRACT

Industrial symbiosis is an industrial concept that points to the exchange of resources between companies. Among several cases around the world as Kalundborg, TEDA and Styria none of these had a program on a national level encouraged by the government. In the United Kingdom the concept was funding from 2005 to 2014. The National Industrial Symbiosis Programme (NISP) born in 2000 by International Synergies Ltd and has excellent results in economic, environmental and social space. The British institutional context has become highly competitive and ever more dependent on others in a continue changing, so this work aims to understand if institutional dynamics in the UK support or impede the development of industrial symbiosis? Based on this research question the study followed the general objective of understanding the development of industrial symbiosis in the UK overtime influenced by institutional context. The study was conducted as a case study of industrial symbiosis in the UK using a series of open-end interviews with the actors involved. Through a content analysis were individuated key categories and concepts related to them which resulted in the construction of a conceptual framework for UK industrial symbiosis. The UK institutional context encouraged the creation of NISP which produces with satisfactory results the development of industrial symbiosis participating in the development of institutional capacities between organizations involved, although they were not completely fomented. Industrial symbiosis in the UK is struggling to move forward because the government is not financing the NISP and a short-term view of the companies made this batch process and probably for a review of development mechanisms. This study has appointed to a strengthening of cooperation between government and company accompanied by cultural change of the waste management as source of opportunity for companies, so an educational process that promotes this is fundamental to the future of industrial symbiosis in the UK. Finally, this study has appointed to the continuation of funding by government and the dissemination and sharing of results and practices at the national level for the institutionalization of industrial symbiosis.

Keywords: Industrial symbiosis, institutional dynamics, Institutional Theory

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1. INTRODUCTION

Industrial Ecology was conceived upon an analogy with natural ecological systems because the last operates through a network of connections in which organisms

survive with the *waste* of the others (FROSCH, 1992). The *waste* is conceived as something that contain available energy or useful material that, otherwise, could be lost if the organisms do not consume it (FROSCH, 1992). The European Court of Justice Judgments summarizes some waste definitions from Jointed Cases as Vessoso and Zanetti (1990) among others. The Court said: "The concept of waste […] is not to be understood as excluding substances and objects with are capable of economic re-utilization. The concept does not presume that the holder disposing of a substance or object intends to exclude all economic re-utilization of the substance or object by other" (LAVRYSEN, 2005).

The Industrial Ecology (hereafter, IE) works as facility or firm level through design for environment, pollution prevention and "green" accounting. Moreover, it can work between firms within an eco-industrial park through industrial symbiosis and at regional/global level as well (CHERTOW, 2000).

The industrial symbiosis uses this term to explicate the "flows and the cycling of materials, nutrients and energy as a potential model for relationships between facilities and firm" (AYRES; AYRES, 2002, p. 4). In 1976 in a conference at the United Nations Economic Commission for Europe (ECE) through a paper titled "zero waste technology and production" the industrial symbiosis (hereafter, IS) concept was conceived (ERKMAN, 1997).

The IS consists of place-based exchanges among different entities working together to promote greater benefits than the sum of individual ones. It can emerge in several forms, such as through waste exchange between companies geographically distant and within a facility through a closed loop. Moreover, IS can emerge among firms based in an eco-industrial park where the geographic proximity influence the process development or through a virtual eco-industrial parks (CHERTOW, 1999).

A shared learning process and a strategic vision between different actors fomented by presence of an enabling context, which may be defined in terms of policies, regulations, and other institutions are relevant for IS development (BOONS; SPEKKINK, 2012).

The actors involved depend on complex of institutional dynamics because these entail with institutional change in the rules and/or enforcement of activities by them (BURNS; CARSON, 2002; POWELL; DIMAGGIO, 1991). Institutional dynamics are all the changes due to new policies and laws, mobilization of actors, and key actors that try to

fulfil gaps in their domain through new rules or norms (BURNS; CARSON, 2002). The institutional reproduction is not fixed because of the power and depth forces into the field (DELBRIDGE; EDWARDS, 2007)

A study conducted by Abreu e Barlow (2013) upon the United Kingdom (UK) showed that the institutional dynamic context influenced the Corporate Social Responsibility (CSR). British companies deal with a more transparent rule-based governance environment, strict environmental laws, inquisitive media and a set of entrenched ethical values that support and shape CSR development.

The Institutional Theory conceives the social dynamics as a closed loop between social institution and actors/organizations. The last are pressured by mechanisms as coercive, normative and mimetic from external of organization as government as well as from internal as practices (ZUCKER, 1987). Social institutions impose restriction by legal norms, moral and cultural boundaries (SCOTT, 2014) regulating actions by defining social positions agents influencing its occupations and behaviours which are associated with these positions (FLEETWOOD, 2008). An institution “comprise regulative, normative and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning of social life” (Scott, 2014, Chapter 3, Section 1, para. 5) and as defined by Dr. Hughes “There is an order of social phenomena in which the feature of establishment and of collective behaviour meet in a particular way; namely, so that the very form taken by collective behaviour is something established” (ANGELL, 1936, p. 191).

Consequently, the actors/organizations acting among them create new practices, rules and norms shaping the social institutions as Scott (2014) argue, thus these interactions are influenced by capacity that each one has to influence each other under a common policy (ELSTER, 2013; INNES; BOOHER, 2003). These interactions deploy under three different forms: 1) relational capacity; 2) knowledge capacity; 3) mobilizational capacity (HEALEY et al., 2003b, p. 65).

According to Miller (2012) social institutions are complex forms that reproduce themselves over time as governments, the family, universities, business corporations, and legal systems. The social institutions are organized within the state boundaries influenced by four key national institutional frameworks as political system, financial system, skill development and control system and trust and authority system that compound the National Business Systems (NBS) (WHITLEY, 1999).

The NBS differs over time and shape the social actors through the coercive, normative and cultural forces (MATTEN; MOON, 2008). Within the NBS, these forces form a continuum moving “from the conscious to the unconscious, from the legally enforced to the taken for granted” (Hoffman, 2001, p. 36). Coercive forces are based on sanctions whereas the organizations are obligated to accomplish with them. Normative forces are designed to be morally obligated and encompassed in the recommendation and cultural forces are taken-for-grounded and the actors act unconscientiously (SCOTT, 2014). A study conducted in the United Kingdom showed that NBS shapes the organizational field improving the governance at state and firm level (ABREU; CUNHA; BARLOW, 2014).

In the United Kingdom (UK) the industrial symbiosis was approached through the National Industrial Symbiosis Program (NISP) that became operative since 2000. The NISP was funded by Peter Laybourn after a working experience with the By-Product Synergy (BPS) in the Gulf of Mexico region by the U.S. Business Council for Sustainable Development (BCSD). He wanted to replicate that model in the United Kingdom, but he needed to find sources of funding. In 2003, the umbrella idea of NISP was put into place by funding from the Veolia Environmental Trust with a contribution from Advantage West Midlands, followed by a sub-regional programme and two regional programme (LOMBARDI; LAYBOURN, 2007a).

According to Lombardi and Laybourn (2007) and Mirata (2004), NISP was able to expand from its regional base to national one in April 2005 through funding of 6 millions of pounds from UK government through a landfill tax. The NISP had strong regional governance developing advisory groups that are business-led. The NISP service was free for memberships so that in that time it approached 4000 small, medium and big companies.

1.1. Research question

The institutional context and capacity influence the development of industrial symbiosis?

1.2. General objective

The general objective of this study is to investigate how the industrial symbiosis was developed in the United Kingdom over time through an institutional context.

1.3. Specific objectives

1) To explore the institutional context needed to run the industrial symbiosis process;

2) To investigate the institutional capacity for industrial symbiosis;

3) To analyse how the institutional context and capacity influence the antecedents, mechanisms and outcomes of industrial symbiosis;

4) To explore institutional pressures and responses by organizations involved into industrial symbiosis process.

1.4. Justification

There are some cases of industrial symbiosis around the world; the Kalundborg in Denmark is most successful because it represents a voluntary approach developed overtime since 1959 when the Asnaes power station established there. In Kalundborg was developed a complex of contract and alliances that have arisen with little or no institutional intervention (ASHEIM; DUNFORD, 1997; EHRENFELD; GERTLER, 1997). In Kalundborg an atmosphere of trust exist due to their long history and geography proximity and it is important in establishing alliances or contracts among participants (GULATI; SYTCH, 2008; JACOBSEN, 2006).

In China, there is an example of an successful industrial symbiosis development within the Tianjin Economic-Technological Development Area (TEDA) influenced by Environmental Protection Bureau (EPB) created in 1990 creating a strong environmental institution where the organizations needed to accomplish with it (ASHEIM; DUNFORD, 1997; SHI; CHERTOW; SONG, 2010). Around the China the industrial symbiosis development addresses institutional barriers due to weak regulatory controls (MATHEWS; TAN, 2011). On the one hand, in China the informal social networks due to a cultural aspect based on reciprocity and mutual obligations impede a governance rule-based (LI, 2013). On the other hand, into TEDA the EPB created a positive governance on companies that spontaneously share information (YU; DE JONG; DIJKEMA, 2014).

Based on previously discussion, the UK industrial symbiosis shows to be a middle approach because it is a type of public-private partnership where companies and local/regional government are engaged in a IS development (AGARWAL, 2011). In the UK, for example, the cultural context is far different from Denmark as argued Djursaa

(1994), the business companies are more resistant to economic changes than those located in Denmark.

Thus the UK institutional mechanisms such as brokers or planning agencies can supplement this resistance to change in industrial symbiosis development (EHRENFELD; GERTLER, 1997). The IS could be development by a coordinator that provide information and facilitation assistance to companies that are seeking both technical and economical viable solutions (COSTA; MASSARD; AGARWAL, 2010).

This position is further reinforced by Christensen, ex-promoter of the industrial symbiosis in Kalundborg, when he argued that the political impetus is needed to go beyond a certain level of symbiosis (GERTLER, 1995). The political impetus in the UK was established since 1990, when was established the *Environmental Protection Act*, which introduced the definition of waste and the duty for producers and operators for the collection, treatment and disposal of waste and in 1995 it was updated outlining the need for a national waste strategy, the need for enhanced legal and institutional setting for waste management (UNITED KINGDOM ACT OF PARLIAMENT, 1995). In 2007 was established the *Waste Strategy for England* that define the UK's waste policy. It proposed instruments and targets to reduce impacts of waste generation and management (DEFRA, 2007).

As previously argued different institutional dynamics have developed the industrial symbiosis in these three cases, but only in the UK an institutional normative force fomented by International Synergies Ltd pushed the government to implement a Landfill Tax to finance partly (the first two year) the NISP in the country (COSTA; MASSARD; AGARWAL, 2010; MIRATA, 2004). Moreover, the NISP was established at national level instead of at industrial park level as TEDA and Kalundborg, more actors are involved around the industrial symbiosis development than other cases. This arises the complexity of institutional dynamics that lead to field creation and how it evolves over time to make sense of interactions emerged (WOOTEN; HOFFMAN, 2008). The arena of industrial symbiosis development involves the interactions among actors within a relational space influenced by both institutional pressure and response (FROSCH; GALLOPOULOS, 1989a; OLIVER, 1991; SCOTT, 2014; WOOTEN; HOFFMAN, 2008).

1.5. Structure

In order to understand how the research is orchestrated, this paper firstly realizes a whole theoretical underpinning to understand how the Industrial Ecology was developed over time. Industrial symbiosis cases around the world are presented with particular attention at the NISP development over time.

Secondly, the methodology is presented with an overview of the philosophical elements which support the research method and design appropriateness. This part follows with a research framework section evidencing the main categories and concepts of investigation based on the conceptual framework that support this study. It shows the actors involved in industrial symbiosis development in the United Kingdom over time with a sample of questionnaire utilized during the interviews. It shows as open coding was realized during the process of building of categories and concepts and a resume about the amount of nodes extracted by paragraphs in the text.

Thirdly, the results section is divided in four sections; each section is focused on one part of the research framework: the first focus on institutional context and how EU influence this context for industrial symbiosis development; the second on UK organizational dynamic and its interaction for industrial symbiosis process; the third on institutional capacity which influence the industrial symbiosis and the fourth on responses to institutional pressure by companies.

Fourth, the discussion of results previously emerged divided in six sections revisiting previously works and summarizing the results. Refining the implications with mapping the link with literature was necessary to understand the whole study. Lesson learned section is added to show particular suggestions to better support and limit the end of industrial symbiosis with a succinct explication why this social phenomenon was not institutionalized. The study crafts a conceptual framework for industrial symbiosis in the UK.

Fifth, the conclusion of the study showed the relationship between objectives and results achieved showing the scientific contributions. Limitations were presented as contribution for future research under institutional context.

2. THEORETICAL UNDERPINNING

2.1. Fragments of industrial ecology concept

According to Frosh and Gallopoulos (1989a), the innovations create new forms of improvements inside and outside organizations. However, these innovations not always have create positive benefits to human life, for example the industrialization have caused irremediable effects to whole societies and the environment through a linear economy where the waste is disposed into landfills.

The linear economy turns complex and thus new forms of economy emerged as engineering system based on industrial ecology studies where the human activity could cohabit with the natural system (ALLENBY, 1998). Allenby (1992, p. 57) pointed out that:

> "Industrial ecology may be defined as the means by which a state of sustainability development is approached and maintained. It consists of a systems view of human economic activity and its interrelationship with fundamental biological, chemical, and physical systems with the goal of establishing and maintaining the human species at levels that can be sustained indefinitely – given continued economic, cultural, and technological evolution."

According to Lowe and Evans (1995), industrial ecology implies several distinctive principles: 1) All industrial operations functions within the constraints of their local ecosystems; 2) The dynamics and principles of ecosystems offer a source of guidance in the management of industrial systems; 3) High energy and materials efficiency in production, use, recycling and service will generate economic benefits; 4) The ultimate source of economic value is the long-term viability of the.

The essential of industrial ecology is to design an industrial ecosystem to address sustainability performance under the limitations imposed by nature. Industrial ecosystem are a web of interaction among companies that exchange waste between them (FROSCH; GALLOPOULOS, 1989a; LOWE; EVANS, 1995).

Fig. 1 shows different ecosystems proposed by Ayres and Ayres (2002):

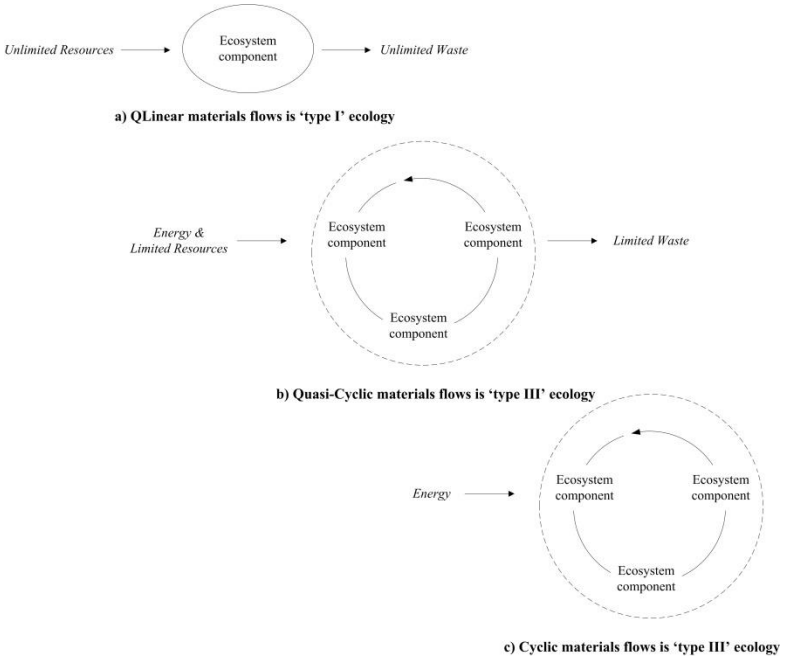

Figure 1- Different ecosystems in the environment

Source: (AYRES; AYRES, 2002)

In the first phase, the ecosystem works in a linear logic where unlimited waste is generated from unlimited resources as the actual economy runs. The second phase is a quasi-cyclic logic where limited waste is generated by energy and limited resources. The third phase called of ideal is based on eco-industrial parks spread around the world where no waste is generated by energy input because the ecosystem is be able to transform all the waste in input resource. The waste is not understood as useless or worthless material, but as "residues" and "experienced resources" with value to be used for others (GRAEDEL; ALLENBY, 2011).

The manufacturing processes in an industrial ecosystem transform materials that are circulating among organizations in other materials decreasing the materials used as input (FROSCH; GALLOPOULOS, 1989a). According to Frosch (1992), the industrial ecosystem transforms end-of-pipe production into a cradle-to-cradle based on technology that turns it less complex. The technology helps this transformation designing the products with less input resources and to low the cost of optimization process turn them more competitive.

As depicted by Chertow (2000) IE operates on three levels as following Figure 2:

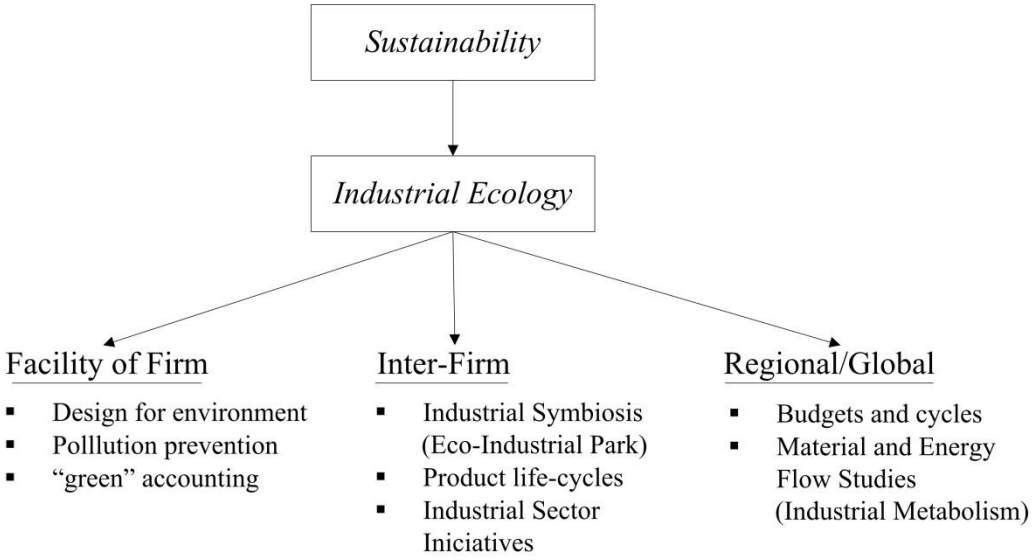

Figure 2 - Three levels of Industrial Ecology

Source: (CHERTOW, 2000)

The industrial symbiosis process is encompassed in the eco-industrial park or not. The symbiosis process terminology come from relationship in biology (DOUGLAS, 1994). This relationship happens between at least two otherwise unrelated species that exchange materials, energy, or information in a mutually beneficial manner (MILLER, 2009).

Industrial symbiosis produces various benefits as argued Cotê and Hall (1995): 1) Reductions in the input of materials and energy; 2) Reduction in the overall output of waste; 3) Reduction in financial, ecological and health costs; 4) Increased awareness about the integration of environment and economy; 5) The identification of new products and businesses making use of waste materials. The symbiosis do not need to occur within the strict boundaries of a "park," despite Eco-Industrial Park term is now depicted to describe organizations engaging in residual exchanges (CHERTOW, 2000).

2.1. Cases of Industrial symbiosis initiatives

2.1.1. Kalundborg eco-industrial park

Kalundborg eco-industrial park is located approximately 100km from Copenhagen in Denmark (see Fig. 3 and 4).

Figure 3- Denmark geographic map

Source: (“Kalundborg”, 2014)

Figure 4- Kalundborg eco-industrial park

Source: (VAN RENSSEN, 2012)

The first model around the world with a long history of industrial symbiosis come from an industrial park placed in Kalundborg, Denmark. The strength of the Kalundborg approach is that the business leaders voluntary have done the “right thing” for the environment guided by rational business interests (EHRENFELD; GERTLER, 1997). Joergen Christensen, the initiator of the Kalundborg EIP, underlined that the project was viable due to the economic advantages previously shared and accepted by the members (WALLNER, 1999).

Kalundborg EIP is based on a complex of relationships between partners not supported by institutional intervention, this could have occurred because the cultural context in Scandinavian countries is a backdrop of environmental awareness (EHRENFELD; GERTLER, 1997). These relationships are trust based and as argued

Gulati (EHRENFELD; GERTLER, 1997) they are important in establishing alliances and new possible social institutions can emerge to support them (LOWE; EVANS, 1995). As argued Gibbs and Deutz (2005) trust and cooperation are drivers to support the relationship between the actors involved into industrial symbiosis process.

According to Schwarz and Steininger (1997), the total investment in Kalundborg between partners in 1994 was US$60 million, with returns of approximately US$ 120 million. In 1995 into Kalundborg network was improved the internal and external communication between the actors. The network spread learning and innovation process based on flexibility and stability to share concepts and experiences among actors contributing to sustainable development (ROOME, 2001).

The organizations which participated are: an oil refinery, a power station, a gypsum board facility, a pharmaceutical plant, and the municipality of Kalundborg. They literally shared ground water, surface water and wastewater, steam and electricity, and also exchange a variety of residues that become feedstock in other processes as Fig. 5 shows:

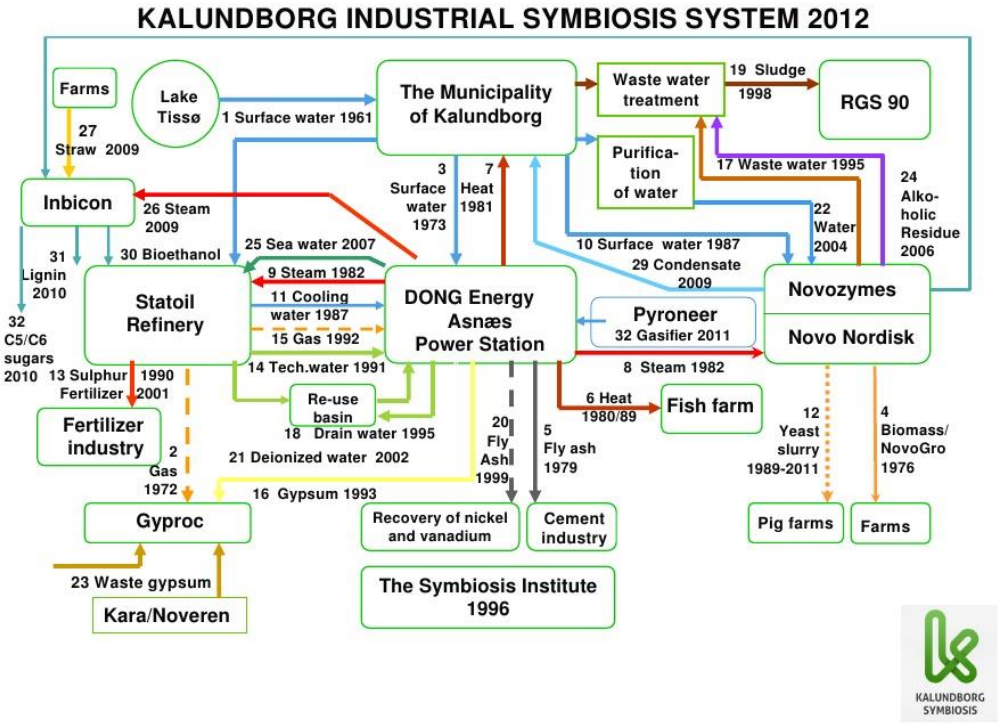

Figure 5- Kalundborg eco-industrial park

Source: (“Cases | Symbiosis Center”, 2015)

According to Ehrenfeld & Gertler (1997), the project began around 1970s and only in 1980s the community and organizations could identify economic, social and

environmental benefits with the reduction of 25% of the waste and 5000 household received heat produced by some organizations within the EIP. The EIP is compound of Asnaes Power Station a coal fired power plant that produces 1,500-megawatts, an oil refinery operated by Statoil, Novo Nordisk, a producer of pharmaceuticals and enzymes and Gyproc, a plasterboard manufacturer.

According to Ehrenfeld and Gertler (1997), the EIP Kalundborg engine is Asnaes Power because it reduced waste at 80% suppling the households and other firms around it with heat. This creates a new small revolutionary economic system, called “block economy”, based on the principle of self-help and self-determination and thus promoting sustainable development (WALLNER, 1999).

2.1.2. Teda

According to Yu et al. (2014), an EPI successful project is Tianjin Economic-technological Development Area (TEDA) located in China. It was founded in 1984 as one of the earliest initiative under China National EIP Program. TEDA is located at 45 kilometers east of Tianjin downtown and 130 kilometers southeast of Beijing city with a coastal area of 33 km2. The industries within the TEDA include Bohai Bay, electronics, automobile & machinery, biotechnology & pharmaceutical, and food and beverage.

Yu et al. (2014) argued that TEDA is compound of four coal-fired that produce steam for industrial, commercial and residential uses. In the 1990 was created the Environmental Protection Bureau (EPB), his role is to monitor environmental management capacity and to install new environmental programs such as Environmental Impact Assessment (SHI; CHERTOW; SONG, 2010).

The TEDA is managed by an Administrative Committee (AC) accredited by Tianjin municipal government. This AC prioritizes projects for closed-loop industrial chains involving the industries within the TEDA (YU; DE JONG; DIJKEMA, 2014).

2.1.3. Brazil

In Brazil, the Natura S/A has developed an industrial ecosystem calls Benevides (BIE); it is a social institution resulting from decisions, actions and attitudes of Natura business managers taken from 1999 to 2007. The Benevides industrial ecosystem was developed due to its location, nearby suppliers of socio-biodiversity products, at the Amazon Rainforest (CAVALCANTE, 2010). According to Cavalcante (2010), the

farm workers cooperatives in the region of Amazon received social benefits through financial, technological and educational resources.

The Industrial Federation of Minas Gerais State (FIEMG) in 2009 has become a regional program of industrial symbiosis (PMSI) under lessons learned by UK International Synergies Ltd. The FIEMG has adopted the same methodology of NISP; UK industrial symbiosis, based on workshop to foment institutional capacity building ("FIEMG-SOBRE O PMSI", 2015). The resulted achieved up 2012 by PMSI are 317 firms engaged, 139,793 tonnes of waste far from landfills, 194,815 tonnes of raw material reduction, 87,476 tonnes of CO_2 reduction, 13,650,000 m3 of water reuse, 8,768,683 of cost reduction ("FIEMG-RESULTADOS", 2015).

According to Elabras, Veiga and Magrini (2009), an project of industrial symbiosis was realized by Rio de Janeiro State in 2002 with a decree 31,399 setting up the Sustainable Eco-Industrial Development Program – Rio ECOPOLO (EIP) in partnership with Rio de Janeiro Environmental Protection Agency (FEEMA), Rio de Janeiro Federal University (UFRJ) and the Rio de Janeiro Industrial Federation (FIRJAN). According to authors, the goal was to strength the sustainable development in that area through the Economic and Social Development Fund (FUNDES) to incentive the industries to engage in the EIP program.

2.1.4. National Industrial Symbiosis Programme

Costa et al. (2010) claimed that a supra-level institution as EU is placed better position to set objectives to waste reduction and that national level could better implement economic and regulatory instrument to achieve these objective such as tax and ban.

The last Directive introduced the "polluter pays principle" and the "extended producer responsibility" positing two new recycling and recovery targets of 50% to be achieved by 2020 (EC-EUROPEAN COMMISSION, 2008).

The Directive 2008/98/EC on waste or Waste Framework Directive was updated from Directive 2006/12/EC and this in turn from Directive 75/442/EEC on waste. The last Directive was updated considering the *Thematic Strategy* on the prevention and recycling of waste ("Waste Framework Directive - Environment - European Commission", 2015).

In the UK Costa and Ferrão (2010) argued that the UK government introduced a mix of economic, regulatory and voluntary instruments as the Landfill Tax and the Waste Protocols Project to reduce waste production according to European targets.

Since 1975, the UK was obligated to introduce key legislative documents as Environmental Protection Act in 1990 and in 1995 it was updated focusing on a where a national waste strategy to improve legal and institutional setting for waste management (COSTA; MASSARD; AGARWAL, 2010).

According to Business Council for Sustainable Development (2014), in 1997 born a by-product synergy (BPS) programme in Tampico, Mexico endorsed by itself to find valuable synergies among companies. Successively, according to Business Council Sustainable Development in the UK (2004), it inspired by BPS to promote the first effort of industrial symbiosis in UK in the Humber region in the summer 2000.

In order to develop the industrial symbiosis on national level, the BCSD-UK promoted the National Industrial Symbiosis Programme (MIRATA, 2004). The programme was supported financially by The Onxy Environmental Trust. This independent company and registered charity aimed to award grants to categories projects identified by Landfill Tax Regulations ("Memorandum by The Onyx Environmental Trust (LT 79)", 02/021999).

According to Mirata (2004, p. 970) "having the right institutional setting in a region is among the most important elements for IS programmes and is an area where coordination bodies can make a contribution […]. The scope of such actions should not be limited to companies and other parties within a region, and should be expanded to include communication and feedback channels reaching out to regulatory bodies, other policy makers and financiers, who can help overcome regulatory or financial hurdles, or can facilitate the development of necessary incentives."

The NISP is a middle-out approach because, as argued Costa and Ferrão (2010), the UK Government promoted an private-public partnership with a consultancy to involve the firms to participate to programme. When the firms participates to programme, they provides an amount of data pertaining their production and industrial waste (JENSEN et al., 2011).

The NISP works with public sector organizations through capacity building support and tools for economic development. Moreover, it works with private sector

through NISP network, synergy facilitation service, resource management platform, feedstock analysis and training (“About International Synergies”, 2015).

The NISP between 2005 and 2013 provided successful results such as diverted 47 million tonnes of industrial waste from landfill, generated £1 billion in new sales, reduced carbon emissions by 42 million tonnes, cat costs by £1 billion by reducing disposal, storage, transport & purchasing costs; reused 1.8 million tonnes of hazardous waste; created and safeguarded over 10,000 jobs, saved 60 million tonnes of virgin material and saved 73 million tonnes of industrial water (“National Industrial Symbiosis Programme (NISP)”, 2015).

The Fig. 6 shows the first industrial symbiosis programme in UK, they are West Midlands, Humberside and Mersey Banks.

Figure 6- Location of West Midlands, Humberside and Mersey Banks

Source: (MIRATA, 2004)

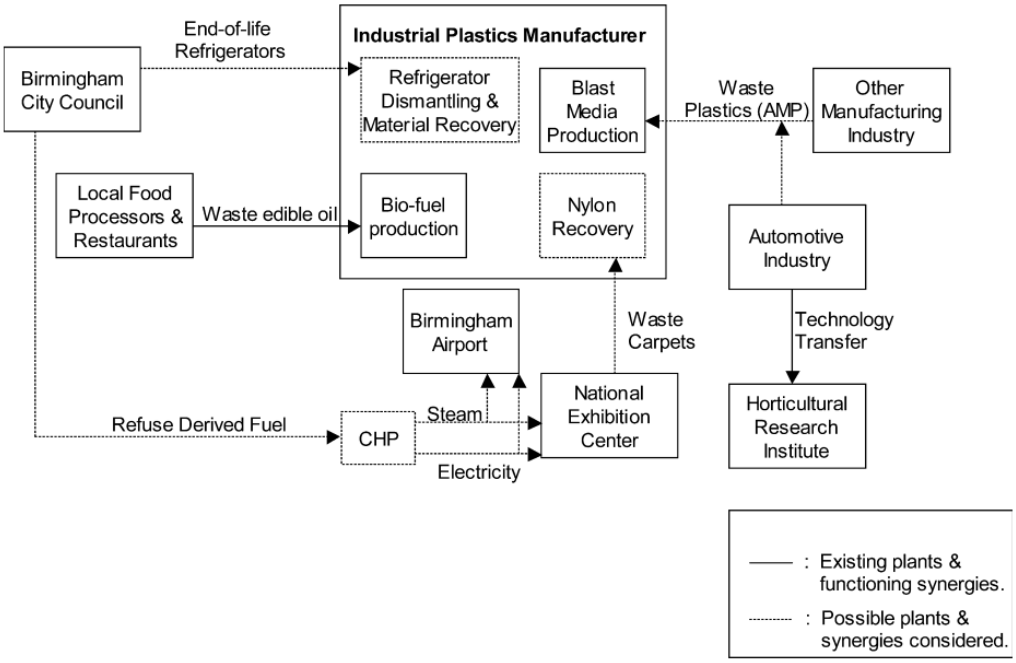

Figure 7 - West Midlands Industrial Symbiosis Programme

Source: (MIRATA, 2004)

The West Midlands region is located at 200 km Northwest of London and covers the areas around Birmingham; it was the first of those regions showed in Fig.6. The region is compounded by automotive, aircraft components, power systems, metal production and fabrication, plastics and rubber, agriculture and food processing, ceramics and glass, and logistics and service industries (see Fig. 7) (MIRATA, 2004). The regional coordinator of the programme is Midlands Environmental Business Communications (MEBC). It engaged with NISP program after detailed information was provided about Humberside Industrial Symbiosis Program (HISP) by BCSD-UK. The MEBC role was fundamental to involve the participants to exchange information about its waste and to build an information management tool internet-based to accelerate the data gathering process (MIRATA, 2004).

2.2. Uncovering industrial symbiosis drivers and barriers

2.2.1. Drivers

Most of modern networks are very often based on existing personal relationships between entrepreneurs and, thus, they are more casually distributed than systemically developed (WALLNER, 1999). What happens among organizations that want to get in contact with each other is fundamentally important under the IS context. Who

influences whom and how it occurs, based on cohesiveness and communication have an important role in it. The cohesiveness occurs when an organization is attracted by others and communication occurs when one interacts with another verbally.

The development of trust based on common vision, a successful past experience of cooperation, time and frequency of contact and relationships where personal and emotional attributes play fundamental role (DOMÉNECH; DAVIES, 2011; GOLEV; CORDER; GIURCO, 2014; TUDOR; ADAM; BATES, 2007). An atmosphere of trust in Kalundborg existed even in the absence of specific experience among firms. In the United States, where there is a strong tradition of company privacy, such natural communication is much more difficult to find. The absence of a cultural context for exchange can be mitigated through institutional mechanisms such as brokers or planning agencies (EHRENFELD; GERTLER, 1997).

Desrochers (2002) argued that geographic proximity in Kalundborg helped them to exchange some products which are difficult and costly to transport outside the park such as bio sludge, flare gas, sulphuric acid, and steam. In Kalundborg, the high degree of awareness about waste value among the actors helped them to create new engineering solutions to viable the exchange process (TUDOR; ADAM; BATES, 2007).

Schlarb (2001) pointed out who finances the industrial symbiosis initiatives. Potential sources of funding could come from mainstream investment companies, local commercial banks, pension funds, and insurance companies. Beers (2007) sustained that the financial support by Commonwealth and state government was basic for industrial symbiosis development in Kwinana, Australia. The industrial symbiosis supporters could doubt about the success of by-product exchange among companies because of connections breaking (LOWE, 1997).

Roberts (2004) and Tudor *et al.* (2007) pointed out that the state and local government have been critical to the success of the industrial symbiosis development whereby businesses are located according to its performance rathen than their activity. Most of states and local governments have policies and procedures to place in order to reduce the volume of waste and encouraging the recycling. They embark upon a process to educate and encourage communities to invest in the project.

Beers (2007) and Tudor *et al.* (2007) argued that operational costs and revenue function are important synergy drivers for industrial development. Moreover, the raw material cost influences the decision making about waste exchange (ASHTON, 2008).

Informational availability about local industry, staff mobility, and detailed qualitative and quantitative data on waste stream are the starting point for the development of industrial symbiosis (BEERS et al., 2007; GOLEV; CORDER; GIURCO, 2014).

Boons *et al.* (2011a) pointed out institutional capacity building as mechanism of industrial symbiosis development distinctive in three forms: 1) knowledge resources; 2) relational resources and 3) mobilization capacity. Healey *et al.* (2003b) argued that knowledge resources encompasses as tacit well as explicit ones of involved participants and how these are shared to learn new ideas. The relational resources involve the stakeholders and their connexions under a power game among them. The mobilization capacity creates an institutional arena where the two early resources play an important role of power among the stakeholder involved.

These institutional capacities are appointed by Boons and Spekkink (2012) how a force which is continually emergent and interplays the conditions for industrial symbiosis to occur; they are: 1) the need for a learning process and a strategic vision; 2) diversity of actors involved; 3) trust; 4) anchor tenant or coordinating bodies and the roles they can play in providing information; and 5) policies, regulations, and other institutions (BOONS; SPEKKINK, 2012).

2.2.2. Barriers

There are many barriers to develop the industrial symbiosis as argued Deutz and Gibbs (2008) such as technical, informational, economic, regulatory and motivational obstacles. The technical barriers concern with the absence of availability of partners to fit together. The informational ones are regarded to the impossibility to find new uses for waste by products. The economic ones promote the use of waste because they are not available into the market. The regulatory ones may limit the network system. The motivational ones are regarded to the willingness to co-operate. Furthermore, unlike uncovered and/or intentionally planned IS networks, government intervention and/or coordination such as flexible regulation in waste management with strong economic/regulatory instruments are necessary for IS development and stakeholder expectations (COSTA; MASSARD; AGARWAL, 2010; POSCH; AGARWAL; STRACHAN, 2011).

According to Kelting-Büttner (SCHWARZ; STEININGER, 1997, p. 52) “the most common cause for the failure of negotiations for cooperation or existing cooperation

are problems in human relations". Therefore, these difficulties could be overcome if frankness and mutual trust were encouraged by personal contacts among cooperating companies and informal contacts are placed among employees of cooperating companies (SCHWARZ; STEININGER, 1997). For example, informational and organizational relations are easier to develop in smaller regions where the responsible people of many companies know each other in person (SCHWARZ; STEININGER, 1997).

Desrochers (2004) pointed out that the planning agencies have not sufficient appreciation about market economy elements. These elements incentive the private firms to cover the costs of by-product disposal than to find new markets for them. One of the most important role by planning agencies might be to promote policies to remove obstacle to industrial resource recovery as price-distorting subsides that discourage recycling. The United States legislation discourages possible waste exchange differently by Danish regulations (GERTLER, 1995).

Beers (2007) and Golev *et al.* (2014) sustained that regulation can difficult the waste exchange although some synergies appear technically and economically feasible and have positive sustainability impact. The legislative framework in Australia creates uncertainties in particular with regard to the final responsibility for reuse.

Tudor *et al.* (2007) argued that industrial symbiosis needs time to be proven, the current sites borne 10 or 15 years ago, whilst Kalundborg borne 30 years ago.

2.3. Towards an institutional dynamics framework

2.3.1. Institutional Theory and Institutional Forces

The organizations become more institutionalized through the infusion of values beyond the technical requirements to self-maintenance to symbolize with the community's aspirations reaching a sense of identity. These values may reach the organization through a conscious or unconscious way e when it begins to more aware of dependence internal as well as external, its conception can change at whatever level inside it, so that the organization gains the stability as a mean of support losing the flexibility (SELZNICK, 2011).

The institutions and organizations are mutually interdependent and reflexively intertwined with one another. The organizations are "rule-makers" and "rule-tacker" at the same time because they produce rules and act within the boundary imposed by rules itself (JACKSON, 2010). Giddens (2013) calls this as "duality of structure" because the rules

guide the human activity within social system itself created by them, it is structuring and thus reproducing the social systems.

The Institutional Theory serves as a conceptual framework to address provocative questions upon the changing process inside the organizations; for example, how the organizations of the same type located in widely scattered located so closely are resembled one another, what are the specific types of institutions associated with the rise of organizations, how we can regard the behaviour in organizational settings, why the individuals and organizations conform to institution and how control systems function only when they are associated with incentives – rewards and punishments (Introduction, Section 1, para. 2 SCOTT, 2014).

The process of institutionalization can be understood from bottom (micro level) to up (macro level) and vice versa. The societal institutions may shape the organizations and actors through constitutive activities, diffusion, translation, socialization, imposition, authorization, inducement and imprinting. These means may enter inside an organizational field and actor environment though coercive, normative and cognitive-cultural elements (institutional forces). Coercive elements restricts the behaviours based on punishment action for no compliance with them, rule imposed by state is one example. Normative elements recommend a particular behaviour, but no punishment actions are given for no compliance with them, the standards recommendation from supra-organizational state is a valuable example. Cultural-cognitive elements are shared values unconsciously acquired for those who keep in contact with a different social context, shared schemas among workers is one example. All these elements are called symbolic systems embodied in activities as monitoring for coercive elements, habits for normative elements and scripts for cultural-cognitive elements (SCOTT, 2014).

Organizational filed represents organizations having enduring relationships among them, as between a company and their customers and suppliers and the regulatory public body in that locality (DIMAGGIO; POWELL, 1983). This is defined by an institutional environment defining the range of the organizational reality bounded by rules, norms, and belief of the organizational field (HOFFMAN, 2001). The actors included in organizational fields are those that create both mental and social structures as a public-private partnership because it represents new ways of working for public body importing external skill into the field. Thus an organizational field changes their structure when the number and importance of organizations whose principal function is to oversee, steer, and

mediate the transactions among the primary players. Moreover, in order to be a social system and thus an open one, the boundaries are delimited by actors, activities, relations and cultural markers (e.g. cultural beliefs) (SCOTT, 2014). The organizations and actors as companies, public regulatory bodies, trade associations, unions, professional associations and NGOs inside it are governed by a relations system supported by regimes created by mutual agreement, by legitimate hierarchical authority or by non-legitimate coercive means. Thus, “Each organization field is characterized by a somewhat distinctive governance system composed of a combination of public and private actors employing a combination of regulatory and normative controls over activities and actors within the field” (Chapter 8, Section 4, para. 2 SCOTT, 2014).

The organizations in the organization field might respond through either an individual or a collective response to the institutional pressures. An individual response compounds the acquiescence, compromise, avoidance, defiance and manipulation (OLIVER, 1991). Collective responses have the potential to shape the nature of the demands and even to redefine the rules and logics operating within the field, for example the case of Big Six tobacco companies in the United States to the Surgeon general’s report about the relationship between smoking and cancer (SCOTT, 2014).

These pressures on organizational field and actors may create a similarity in the organizational conduct among the organizations or actors; this is called isomorphic behaviour under coercive, normative and mimetic pressure. The coercive isomorphism results from both formal and informal pressure exerted on organizations by other organizations upon with they are dependent and by cultural expectations in the society within they works. The existence of common environmental legislation is a one example where all organizations are similar to accomplish it. The diffusion of technological innovation among the organizations exert a mimetic process avoid the risk to lose market share or to cease their activities. Normative isomorphism stems primarily from professionalization; it is a collective of people that work to define the conditions and methods of their work (POWELL; DIMAGGIO, 1991). Although not all identical institutional forces create an isomorphism process because varying carriers whose characteristics or mode of transmission alters the message, competing models being combined into varying hybrid forms and strategic responses by networks or associations of organizations may diverge in different way (SCOTT, 2014).

The actors represented by individuals, associations of individuals, population of individuals, organizations, associations of organizations and populations of organizations may change the structure of organizational field as previously argued by normative and cultural elements, but not by coercive elements if the actors differ from public body. From a bottom-up view (micro level), the actors, collective actors and organizations may encourage to change the societal institutional by invention, innovation, interpretation, innovation and error. These responses are produced by some strategies as acquiesce, the organizations obey to rule and accept the norms; compromise, the organizations negotiate with institutional stakeholders; avoid, they changing goals, activities, or domains; defy, the rules are contested; manipulate, the organizations and actors shape values and criteria (OLIVER, 1991).

2.3.2. European Union and National Business System: macro-level

Integrating European countries started after the Second World War to avoid whatever conflicts among them. Integrating followed the supranationalism approach, institutions and policies supersede the power of their members for some issues and intergovernmentalism one, collaboration between national government for others (STAAB, 2013).

The candidate members to European Union need accept rights and duties imposed by European Parliament thorough the legislation. The European Commission proposes the legislation to European Parliament about key issues such as agriculture and rural development, competition, environment and others. The European Commission has the power to carry out the EU policies through national authorities (STAAB, 2013).

The European Union uses three financial means: the European Regional Development Fund (ERDF), the European Social Fund (ESF), and the Cohesion Fund. The ERDF reduces differences among regions by supporting research, innovation, environmental protection, and risk prevention. The ESF focus on human skills and the Cohesion Fund is only for poorer member state with a GDP less than 90 percent of the EU average (STAAB, 2013).

The funds support among others the environmental issues, such as climate change and global warming, natural habitat, wildlife, and biodiversity, environment and health, and natural resources and waste management. The European Union might strict the

environment law to force organizations to invest even further in environmental technologies (STAAB, 2013).

The European norms, namely directives, follow two-stage process of law making: the enactment of the directive itself specifying a target result by Member State within a certain timeframe; and the transposition of that directive into national law by national legislative with own form and methods. What is intended to become part of the national law is not the EU norm itself, but rather the national measure designed to achieve that target result (DICKSON, 2011).

There are 73 members of the European Parliament from the UK. In the Council of the EU, national ministers meet regularly to adopt EU laws and coordinate policies. The EU budget doesn't aim to redistribute wealth, but rather to focus on the needs of all Europeans as a whole. In 2014, the total EU spending in the UK was € 6.308 billion. The money paid into the EU budget by the UK helps fund programmes and projects in all EU countries - like building roads, subsidizing researchers and protecting the environment. Around 80% of the EU budget is managed by national governments or regional managing authorities. Each EU country is responsible for publishing data on the beneficiaries of the funds it administers ("EUROPA - United Kingdom in the EU", 2015).

The UK "national business system (NBS) institutionalize economic rules of the game that shape the strategies, structures and competitiveness of firms" (MORGAN, 2007a, p. 128). The emphasis is on social compromise between labour and capital, therefore the economic rules emerged by laws of contract and corporate personality, the collective organization of employers and employee, skill and training institutions, the organization of state and its relationship to economic actors (MORGAN, 2007a; WHITLEY, 1999).

The State commits to coordinate economic development and willingness to share investment risks with private economic interests. It can encourage the development of corporatists forms of intra- and inter-sectorial organization, moreover it can regulate the formal market through licence and appropriate skill certificates (WHITLEY, 1999).

The financial system deals as the funds are available for organizations, capital market or credit base. The capital market push the organizations in a short term financial return on investment realized by operators, differently the credit base requires a long term return enabling. These two forms influence the institutional context of business systems (WHITLEY, 1999).

The skill development based on education and training system and how this is sold into the market represent the third pillar of NBS. The trade union in associations or not with the State and industrial federation can develop this skill letting a bargain power centralized (WHITLEY, 1999).

The norms governing trust and authority relations are crucial because they arrangement exchange relationships between organizations and between employers and employees. The extant of trust affects the level of inter-firm cooperation and tendency to delegate control over resources. The formal and paternalistic political culture influence the social and moral distance between employers and employee. The authority relation rely on contractual and communal form. The former attains to narrow agreements and the latter to high level of mutual trust and commitment (WHITLEY, 1999).

2.3.3. Institutional capacity: meso-level

Healey et al. (2003a) claimed that the ability of communities to deal with collective problems depends upon the extent to which they build up institutional capacity. This is supported by an array of practices performed by various stakeholders with different interests which establish a dialogue addressing a common concern policy (INNES; BOOHER, 1999b). Boons *et al.* (BOONS; SPEKKINK; MOUZAKITIS, 2011b) pointed out three requirements for building the institutional capacity for industrial symbiosis. They are knowledge and relational resources, and mobilization capacity.

Healey *et al.* (HEALEY et al., 2003a) argued that knowledge resources can be tacit as well as explicit, involving participants in sharing and learning new symbiotic solutions. Frosch (1989b) pointed out that absence of knowledge resources delay technology investments and thus industrial ecosystem development.

The relational resource appointed by Healey et al. (2003) references to an integration of a range of stakeholders involved to find common solution based on power game among them. Velenturf and Jersen (2015) argued that IS development need of proximity to promote the trust between actors involved in the process. Trust is a pivotal resource appointed by various industrial ecologist because the firms need to invest money to change their technology to make the IS possible (CHERTOW, 2007; GOLEV; CORDER; GIURCO, 2013; LOMBARDI; LAYBOURN, 2007b).

Healey et al. (2013) also argued that mobilization capacity deals with the presence of promoter to create an institutional arena where knowledge and relation

resources are combined among companies and stakeholders involved. In the IS development, to mobilize these resources is a step forward to success because without information, relationship and trust among others the promoter could be imped to create a space to promote resource exchange (ASHTON, 2009; BOONS; SPEKKINK; JIAO, 2014; BOONS; LÜDEKE-FREUND, 2012; LOMBARDI; LAYBOURN, 2012).

2.3.4. Organizational Dynamic Field for IS: bottom-level

Organizational dynamic field represent an arena where organizations produces similar products, services, suppliers, resource and product consumers, regulatory agencies, and others (DIMAGGIO; POWELL, 1983). These actors interact among them guided by institutions: cultural-cognitive, normative, and regulative structure providing stability and collective meaning to social behaviour (SCOTT, 2014). Institutions exist only they are powerful, if they influence the actors' behaviour, beliefs and opportunities of individuals, groups, organizations and societies creating patterns of practices. The departure from patterns are counteracted by sanctions and rewards (LAWRENCE, 2008). Institutions turns institutionalized when the social processes, obligations, or actualities come to take on a rule-like status in social thought and action (MEYER; ROWAN, 1977). So, for example, the extraction reduction of raw material could institutionalize if the State could obligate it with rules or if a moral norm to preserve the environment will become an organizational behaviour generally accepted for all the organizations.

According to Fligstein (2012), the organizations operate within an unorganized social space where overtime they create new relationships and meanings. As organizations incorporates common institutional elements, they became homogenous in structure, culture, and output (DIMAGGIO; POWELL, 1983). The State influences the organizations through legal/regulatory environment and they respond to them uniforming their form or structure (WOOTEN; HOFFMAN, 2008).

As organizations interact among them, organization field became dynamic and capable of moving beyond isomorphism sphere letting the entry and exit of particular organization (HOFFMAN, 1999). The boundaries of strategic action field are not fixed but they change depending on the definition of the situation and the issues as stake (Fligstein, 2012).

The dynamics within organizational field arise the notion of institutional entrepreneurship, the activities of actors who have particular interest within field and

leverage resources-financial, material and cultural; create a collective action frame to problem solving and involve inter-actor relations to bring about change existing structure or create new ones (HARDY; MAGUIRE, 2008).

Organizations depends on resources to produce products and services for others, thus the fields overlap among them. The proximity of the fields creates dependence among them and thus the stability is a function of others. The stability depends on exogenous shocks, such as resource scarcity or environmental regulation. This offers challengers opportunities to better their positions and even change the rules of the game (FLIGSTEIN, 2012).

Opportunities to change turn a survival necessity when raw materials are scarce. Industrial symbiosis offers the opportunity to replace old practices with new ones because it aims to reduce raw materials substituting them with availability output from other organizations (CHERTOW, 2000).

Location and business specific features, authorities, and associations are antecedents elements placed in different organizational fields. Incumbents and challengers with different power have the control over them in different space and time (Fligstein, 2012). These elements push the mechanisms at society level and regional industrial level to industrial symbiosis development (Boons et al., 2011).

Societal Level deals with means of diffusion; they are coercion, imitation, private interest from the government, demonstration projects, training and professionalization and altering boundary conditions (BOONS; SPEKKINK; MOUZAKITIS, 2011a). For example, China adopted a law requiring a circular economy, new industrial park as TEDA needs to reuse all resources disposed by production processes. In UK differently, NISP promoted an industrial symbiosis development by government interest.

Regional industrial level represents the arena where the actors need to achieve a consensus to promote the industrial symbiosis development. The consensus building is “an array of practices in which stakeholders, selected to represent different interests, come together for face-to-face, long-term dialogue to address a policy issue of common concern” (INNES; BOOHER, 1999a, p. 402). The consensus building produces tangible and intangible results, the former are projects and the latter are professional relationships and built up trust, which lets genuine communication and problem solving. The stakeholders share knowledge and mutual understanding to achieve an agreement. This led to build

political capital working outside the consensus building process to influence public action (INNES; BOOHER, 1999a).

These three forms of intangible results represents what Healey et al. (2003b) call for institutional capital when internal evolution and external forces act. The external forces represented by NBS influence the organizations spread between different organizational fields (SPEKKINK, 2013).

When organizations meets together to solve a common problem such as resource scarcity or waste disposal reduction, a new organizational field emerge with its strength and weakness because opportunities and uncertainties emerge (FLIGSTEIN, 2012). The institutional capacities acts under these new conditions, thus internal evolution can move forward or back as organizational factors emerge (HEALEY et al., 2003b; SCOTT, 2014).

The industrial symbiosis process produces outcomes split in economic, social and environmental. Economic outcomes attain to cost reduction due to viable alternative for waste diverted from landfill. Social results represent job creation and environmental ones virgin material reduction (HARRIS; VAN BERKEL; KURUP, 2008).

Level	**Theoretical linking**
Institutional context	• *WHITLEY, 1999;* • *MORGAN, 2007;* • *DICKSON, 2011;* • *STAAB, 2013;*
Institutional capacity	• *INNES; BOOHER, 1999;* • *ASHTON, 2009;* • *BOONS; SPEKKINK; JIAO, 2014;* • *BOONS; LÜDEKE-FREUND, 2012;* • *LOMBARDI; LAYBOURN, 2012.*
Organizational dynamic field for Industrial symbiosis	• *DIMAGGIO; POWELL, 1983;* • *SCOTT, 2014;* • *INNES; BOOHER, 1999;* • *FLIGSTEIN, 2012;* • *HARDY; MAGUIRE, 2008;*

3. METHODOLOGY

Gray (2004) suggests that an interrelationship exists between the theoretical stance adopted by the researcher, the methodology and method used, and the researcher's view of the epistemology. Thus, in Figure 8 I present how these interrelationships were approached for this study:

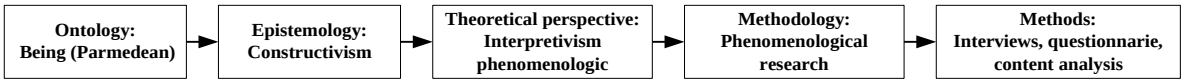

Figure 8 - Relationships between research constructs

Source: (Adapted from GRAY, 2004)

The study considers industrial symbiosis as a social phenomenon: it includes all behaviour which influences or is influenced by organisms sufficiently alive to respond to one another (MARKEY, 2014). All behaviours involve by industrial symbiosis development are acted by actors and organizations interacting in a social system that overtime become habituated into reciprocal roles. When these roles are acted by others as well, the reciprocal interaction emerged are institutionalized. Therefore, the reality is said to be socially constructed (BERGER; LUCKMANN, 1966). This is the ontological approach of the study. Whereas the firms interact among them following a unique objective: to reduce disposal cost through the waste exchange according to an objectivist epistemology, it quite complex to understand as the reality is socially constructed by different actors and organizations involved in this process. Therefore, this inquiry is the study's focus.

The study has approached this phenomenon under a constructivist epistemology; in other words behind technical or economic reason, the actors and organizations need to build a social context to support industrial symbiosis "constructing own meaning in different ways, even in relation to the same phenomenon" (GRAY, 2004, p. 17). The logic of this study is inductive because it tries to create a link between the social context and the industrial symbiosis development according to a multi-faced view. The teleology of this study is to understand how this social phenomenon can be replicated in different social context (MAYKUT; MOREHOUSE, 1994).

This study approaches the research question according to interpretative phenomenology analysis (IPA) because: 1) It explores the *understanding* and *experiences* of actors and organizations involved on industrial symbiosis development; 2) It interprets the *speech* of the actors into industrial symbiosis context and this is interpreted into the

discourse of the actors according to double hermeneutic circle and 3) It inquiries in detail the *particular* event for industrial symbiosis development to understand how it might replicate the social phenomenon due to the accumulated experience (SMITH; FLOWERS; LARKIN, 2012).

3.1. Research Method and Design Appropriateness

Based on these epistemological and theoretical perspectives, this study follows an exploratory design because I want to understand the institutional dynamics which incentive the industrial symbiosis development in UK (BABBIE, 2007) and to identify and to discover important categories of meanings (MARSHALL; ROSSMAN, 1999). The study is qualitative because it is particularly suited to understanding the dynamics operating in single setting (EISENHARDT, 1989).

The research design of study follows a multiple-face perspective analysis because it wants to understand *how* the social phenomenon emerged and evolved within an UK context (YIN, 2008). The case study chosen was corroborated by the three main conditions depicted by Yin (2008); 1) “How” or “Why” as form of question research; 2) It does not require a control on behaviour and 3) It has the focus on contemporary events.

3.2. Research Framework

Based on previous literature review, this study proposes a research conceptual framework to investigate the institutional dynamics for industrial symbiosis in the UK as Figure 9 depicts. This research framework is a “network of interlinked categories that together has guided to a comprehensive understanding of industrial symbiosis phenomenon under Institutional Theory” (JABAREEN, 2009, p. 51).

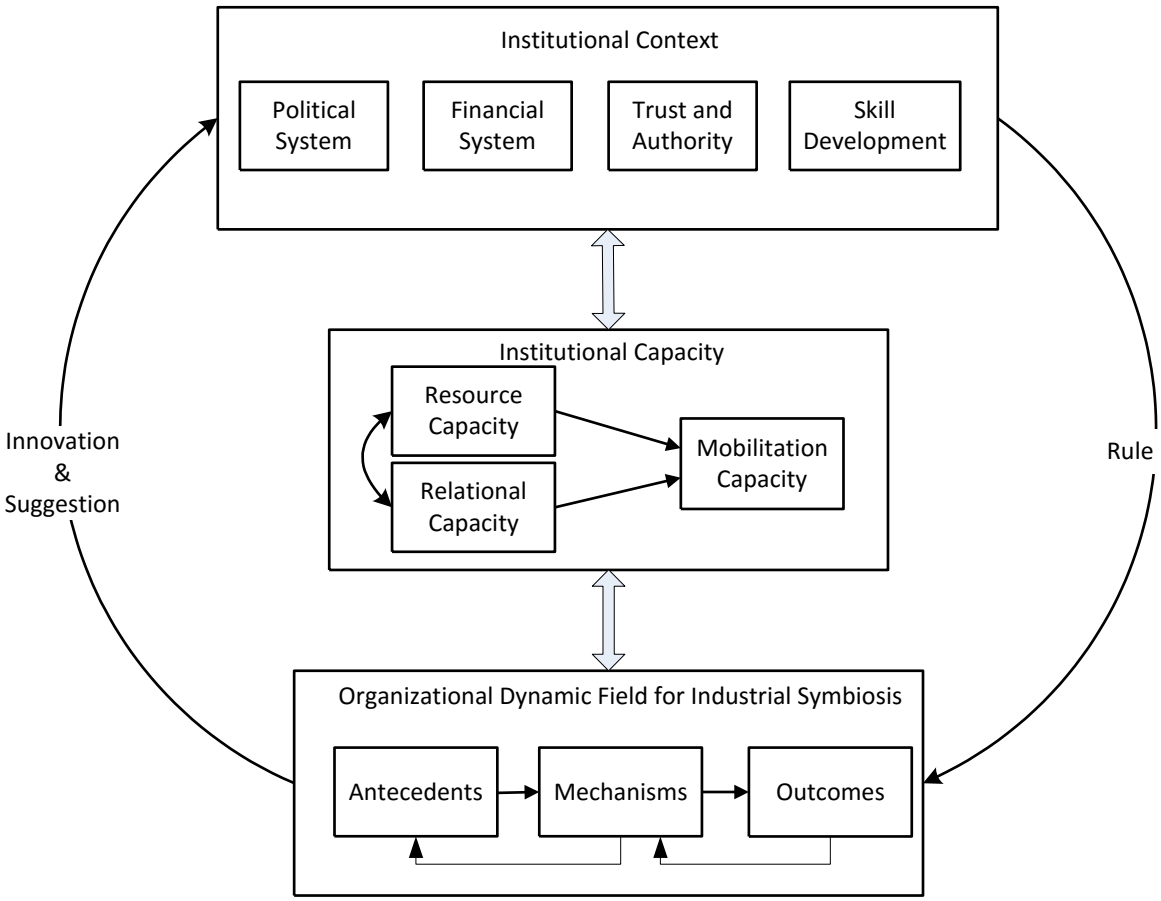

Figure 9 - Research framework for industrial symbiosis in the UK

European Union regulates key issues across member States and funds key projects to facilitate a sustainable growth (STAAB, 2013). Political and financial system concepts were studied within the European Union category. Moreover how these concepts are influenced by Directives and how the UK NBS response to them by compliance. Institutional context represents crucial arrangements because they guide, incentive and constrain the nature of ownership relations, inter-firm connections, and employment relations to access critical resources (WHITLEY, 1999). European Union and the UK institutional context providing coercive, normative and culture pressure to actors involved in to industrial symbiosis development within and outside the organization dynamic field (WHITLEY, 1999).

Political, financial, skill development and control system and trust and authority relations were studied within the UK NBS category. Moreover how they influence the organization field through coercive, normative and culture-cognitive forces;

Organizational Dynamic field constitutes the arena where organizations such as government, public agency, firms, non-governmental organizations, media, consultancy

interact between them to establish enduring meaning of social life (FLIGSTEIN, 2012). Antecedents, mechanisms and outcomes concepts were studied within the organizational field category and how the organizations within the field responses to these forces by acceptance or not;

Institutional capacity deals with a set of elements feasible to put forward the industrial symbiosis development through its constituent roots, they are resource and knowledge capacity to influence the mobilization capacity (INNES; BOOHER, 2003).

Institutional Theory is suitable to understand how organizations might be institutionalized by institutional pressures and how these can create a dynamism inside institutional settings in a given national boundary (SCOTT, 2014);

3.3. Data collection and instrument

Organizations groups are been chosen because they represent a multi-perspectival, it helps to develop a more detailed and multifaceted understanding of industrial symbiosis development (SMITH; FLOWERS; LARKIN, 2012).

The research draws on in-depth interviews face-to-face with some organizations involved in the industrial symbiosis development in the UK, such as the International Synergies Ltd, a UK company-based promoter around the world as well as shows Table 1. The choice to study the industrial symbiosis development in UK under a multi-faced aspect was relevant to capture highly knowledgeable informants who viewed the focal phenomena form diverse perspectives and different hierarchical levels. It is unlikely that these varied informants will engage in convergent retrospective sense making and/or impression management (EISENHARDT; GRAEBNER, 2007).

We chose to interview the companies because they could explain all the details about the process of engagement and how the workshops run. The study needed to understand the mechanisms of industrial symbiosis; how the institutional capacity was built overtime and how the International Synergies Ltd fomented it; the outcomes achieved and which were the antecedents. Moreover, the study needed to understand the reasons for organizations participation or not into industrial symbiosis and what kind of institutional responses they provided under institutional pressures.

The interview with the International Synergies Ltd was relevant because they could explain in details how fomented the institutional capacity during and after the workshops. It was important to know the main barriers and drivers for companies'

engagement into the industrial symbiosis process. In general the study needed to know how the industrial symbiosis ran under his management. The interviewees with the academics in industrial symbiosis were particular useful to understand the main strengths and weakness; the academic participation into industrial symbiosis development and how they envisage the future about it.

Media and NGOs helped to understand if the stakeholder's pressure was present into industrial symbiosis development and how they envisage the future about it. As the resulted achieved by industrial symbiosis should be spread to community, how it happened. The local government and Innovate UK were important to investigate at what extent they fomented the industrial symbiosis and how the NBS worked to promote it, in particular the relationship between them and industries. Innovate UK is a public body that works with industries to implement eco-innovation solutions.

The WRAP' interview was extremely useful because it is the executive body by DEFRA and it financed the NISP and worked in strict collaboration with International Synergies Ltd and industries. It helped the study to understand how the industrial symbiosis has ran and how it was supported by government and why now it is not funded. The Table 1 shows the organizations' names involved directly and indirectly in the United Kingdom industrial symbiosis.

During the interview, the interviewer and interviewee were engaged in a dialogue whereby the initial question was modified according to participants' response, in order to investigate multi-faced aspects does not emerged during the literature review (SMITH; FLOWERS; LARKIN, 2012).

Table 1 - Characteristics of actors and organizational role

Characteristic	**Actors**	**Interviewee position**	**Organizational area**	**Quest.**
Company	Lower Reule Bioenergy Ltd	Managing Director	Senior Executive Management	A
	Ab Connect	Co-Products Technical Development Manager	Production Engineering	
	GNK Aerospace	Sustainability Manager	Sustainability Department	
	Veolia UK	CEO	Executive committee	
	Arla foods	Sustainability manager	Sustainability Department	
Consultancy	International	International Manager	International Project	B

	Synergies Ltd		Development	
University	Linköping University	Professor	Institute for Industrial Productivity	C
	UCL	Researcher	Industrial Ecology	
Media	Financial Times	Financial Time and Economist Group contributor	Environmental Department	D
NGO	Green Alliance	Associate	Sustainability Department	E
	Forum for the Future	Senior Sustainability Advisor	Innovation	
Government	Birmingham City Council	Sustainability and Science City Manager	Climate Change and Environmental Team	F
Not for Profit Company	WRAP	Head of Collaborative Programmes at WRAP	Innovation Department	
Executive non-departmental public body	Innovative UK	Knowledge Transfer Manager – Materials Security and the Circular Economy	Sustainability Innovation	

The study was relied initially on secondary data to set the institutional context for industrial symbiosis development in the United Kingdom to reflect on historical evolution of the political, financial, skill development and control and trust and authority relations. I was supplemented this secondary data with primary one research involving relevant organizations and actors.

To achieve this, face-to-face detailed in-depth interviews were conducted with organizations and actors based on six perspectives which are directly or indirectly involved in industrial symbiosis issues, such as companies, NGO, governmental body, media, consultancy and university. As seen in Table 1, this diversified sample composition will be necessary to capture differences in perceptions and interpretations of NBS and relevant institutional pressure across various actors in the British context. An open-ended questionnaire will be used to collect the information through a semi-structured interview guided from six sections developed for each organization and actors.

In Appendix A, the study presents the two whole questionnaires, the first was used for International Synergies Ltd (NISP promoter) and the second was used for Lower Reule Energy Company. Table 2 provides a sample about some questions realized in the UK. In

the first section *NISP Concept*, organizations were asked to outline the key triggers for NISP participation and the company role during the NISP participation. Within *strengthens and weakness of industrial symbiosis* section, interviewees were asked to explain the main drivers and barriers for its development and how they were overcome over time. In the third section *regulatory and financial system*, organizations were asked to define the main influences and support by environmental agency and financial institutions to industrial symbiosis development. In the four one *relationship among firms*, companies were asked how they share information, increase trust and mutual understand and mobilize other companies to joint in the network. Within the *CSR, outcome, organizational and cultural environmental* section, the interviewees were asked to explain the main social, environmental and economic results and if industrial symbiosis improved the CSR practices. Moreover, if an organizational and cultural environmental context were supported for IS development. Finally, the last section *lesson learned and future of IS in the UK*, interviewees were asked to envisage the future of IS in the UK based on their learned lesson from it.

Interviews will be conducted during September of 2014 in the UK. Each interview was lasted between 40 and 120 minutes and was fully recorded and transcribed. Preliminary research using websites, news clippings and other information will be conducted for each organization in advance of the interviews to understand the dynamic process of a multi-faced view by them about IS development. This was used initially to focus the interviews on insightful questions tailored to the individual organizations and later to validate evidence and avoid personal bias and poor recall by interviewees.

3.4. Open coding

A direct content analysis was used because the study aimed to validate and extend conceptually a theoretical framework presented in Fig. 12. To investigate the social construct emerged by phenomenon investigated, NVIVO® 10 software package was used because it permits a systematic and objective description of the texts through indicators (quantitative and not) to infer the relative knowledge as inferred variables of the message (BARDIN, 2011).

The interview's transcriptions were coded, in other words, each expression that can be represented in a word, a phrase or paragraph will be transformed into a node (SALDAÑA, 2009). The study used the *double hermeneutic* coined by Giddens (2013) to

interpret how the actors understood social meanings of industrial symbiosis and their changes over time. So, for example, the question about *lesson learned in industrial symbiosis* aimed to understand what the changes in actors' behaviours were after this fashion or unfashion experience. After it, the study used the metalanguages provided by industrial symbiosis literature such as *resources* because it can have various significates, but according to actors speech it could mean *time* or *waste* and so the study needed to interpret it under a social science point of view related to industrial symbiosis phenomenon.

The study used an open coding technique to corroborate the concepts according to Figure 9 in a continuous dialogue with empirical data. All the sources were coded two times to improve their meanings. The codes were merged together and split where possible to get more meaning about the phenomenon (JULIET M. CORBIN; STRAUSS, 2014).

In Table 2, an example of open coding was presented on transcription realized from interviews. In the first column there are two sources and related questions. The first question aimed to understand the development of industrial symbiosis. In the third column the interviewee's response and fourth column shows the paragraph coded under *economic* concept because the interviewee talked about the advantages that could obtain the companies when they talked between them, thus this is a category *driver*. The second question aimed to understand if financial support was necessary to development of technology for industrial symbiosis. The third column shows the paragraph coded under *business as usual* concept because the interviewee talked about the company inertia with or without financial incentive, thus this is a category *barrier*.

In the last two columns, the study showed as the concepts emerged previously were reliability by secondary data. Among the secondary data, these two (European Environmental Agency and Industrial Symbiosis in Action) showed that *economic* concept is a driver and *business as usual* concept is a barrier for industrial symbiosis development as emerged by coding on primary data.

Table 2- Extract of an open coding on two sources

Source	**Question**	**Paragraph**	**Concept**
Ab Connect	Is it hard to develop this	There is willingness by industry	***economic*** factor as

	concept of industrial symbiosis?	to get involved and once you've got a small number engaged, businesses talk to each other, ***so they soon proliferate.*** Two companies have success, they'll go and talk to another two companies and they'll talk to another two companies and they'll say how wonderful it is and how much ***money*** they're saving their business, etc.	driver for IS development
Wrap	Is financial development one part here for companies to develop technology?	Well, this is it. We can provide evidence and some companies will change their business practice without any financial incentives. However, most of the time, even if you show them that there is a different way, an alternative way, of doing business, there is inertia; '***business as usual'***.	***business as usual*** as barrier for IS

The data was collected from various actors involved directly and indirectly in the process of industrial symbiosis development. The study followed three types of validity approach pointed by Maxwell (1996) such as the whole industrial symbiosis phenomenon was described through the transcriptions of interviews and secondary data as videos and pictures among other were used to corroborate the former; the questions formulated were open-ended leaving the interviewees free to answer. The framework in Fig. 12 guided the interviews, but without force the interviewees to talk about some categories previous emerged by literature reviews. This led the opportunity to learn about new categories never emerged before by literature and the data collected were analysed by academics in industrial symbiosis expertise. It was realized a comparison with data collected by other study in industrial symbiosis in Brazil as well, thus whereas some discrepancies emerged they were corrected previously at this publication.

4. RESULTS

4.1. Institutional Context

The WRAP interviewee explained that several strategies were developed in order to implement the EU environmental policies including: the UK waste strategy plan and the landfill tax. However, costs involving the EU waste reduction targets were considered as a critical factor for companies. The concept of a national industrial symbiosis programme seems to be partial solution for this waste problem disposal.

All interviewees have confirmed that the landfill tax escalator has been a strong driver to divert waste from landfill as international synergies and Ab Agri. Table 3 and 4 capture the key quotes by respondents. They emphasize a structured approach established at institutional context level for industrial symbiosis. The WRAP and International Synergy aims to engage with companies about waste management requirements and proposes operational changes that companies can make to resolve problems. This behavior is incentivized through working with NISP, and particularly by obtaining industry input in advance of changes to regulations and mechanisms of waste exchange.

In the UK, the government influenced by EU waste strategy, set a waste strategy policy, however it is still focus on disposal right instead of industrial waste flows. The waste strategy is grounded on strict recycling target without coordination by government and thus limiting the effectiveness of it.

Table 3 – Main quotes from interviewees about Institutional Context

Dimension	Characteristic	Main Quotes from Interviews
Political system	Landfill Tax	– *Policy and environmental legislation can be a driver. Now it's at £80 a tonne and it hurts. [International Synergies]* – *The government has made it clear that that's (landfill tax) going up and up and up. There is an economic driver for doing something other than putting waste into landfill. [Wrap]* – *Every year the landfill tax would go up. That was very much a driver that kick started the economy. [Ab Agri]*
	UK Waste Strategy	– *There're only a few rules related to understanding industrial waste flows and it's still, waste policy is still very focused on getting the disposal right. [Green Alliance]* – *We need a setter, set a new target for the next ten years cycle, and the government came back with a very, very hard target, stupidly high target, so we work together to gather the evidence and to propose a new target, stretching, but sensible.[Arla Food]* – *I think in waste management less. So, I don't think that strategy is coordinated. They need to be looking at the original bigger areas. […], and you end at one area prioritizing incineration, and then one say "no, I'm gonna stick with landfill a bit longer"[Lower Reule Energy]*
Financial	Limited	– *The government have got incentives, so if you burn biomass, you*

system	European Union funds	*get an incentive for that or if you put liquid waste through digestion then you get an incentive for that because you've producing those green energy tariffs.[Ab Agri]* – *I think that's an opportunity, definitely, to stand industrial symbioses programs. In fact there's quite a few initiate in Europe. [University College of London]* – *Funding is very limited and certainty what get impression it is hard to find ways of making use of new types of waste. [Birmingham Council City]*

Table 4 - Main quotes from interviewees about Institutional Context

Trust and authority relations	Carrot and Stick approach	– *You must need an incentive, or if you don't want to, you know, give the carrot and you use the stick and you put it into a regulation, but what business is doing is more regulation. So, I think that's best to incentive people than say "you must to do this". [Birmingham Council City]* – *Sure, to be clear the UK government policy isn't to develop a circular economy but is to help business transition so it is very much supporting businesses to develop circular economy for themselves.[Innovate UK]* – *I buy a gas which we burn for the electricity, and it goes out the grid. And the UK government pays us a tariff for producing renewable electricity from a renewable technology.[Lower Reule Energy]*
Skill development and control system	Conservative	– *Culture is that we do not risk money early on where there is no visibility. The culture change needed is for the government to fund the initial investigation instead of businesses.[GSK Aerospace]* – *It's a big political issue around...because people don't want pay, and also about collect people rubbish they starts get very , you know, "why changing it?[Birmingham Council City]* – *I mean, by the time we started develop the industrial symbiosis in England; people did not really understand what we was going to do. In some of the regions the examples that were using and communicating to people was not. [IEI]* – *I mean, once you have that economic incentive and you try that could work, that finding outlets of finding synergies with other companies could be a good way to actually make something of your waste. Then, it's when, maybe perhaps starts to change the culture of the company. [University College of London]*

For example, Lower Reule Bioenergy interviewee said that the UK government had banned liquid and food waste from landfill. There is also a strong concern about energy scarcity and fossil fuel overseas dependence. These led the UK government to incentive to turn food waste in to an energy source instead of recycling it.

Arlafood interviewee also claimed that the government set high recycling target to be accomplished by companies. Veolia interviewee sustained that the green agenda developed by the UK government have allowed recycle valuable materials and established lower tax for product extracted by recycled materials. Interviewees recognized that the UK government stresses the difficult to set a strategy for all environmental issues.

Birmingham city council interviewee pointed out that they set out plans to "exploit opportunities for industrial symbiosis" in the Tyseley Environmental Enterprise District in order to harness the area's true potential and become an exemplar for sustainable economic development. The City Council commissioned International Synergies to undertake a resource mapping exercise of the area to identify its potential for industrial symbiosis. The Innovate UK interviewee also recognized the UK Government efforts in helping the companies to address IS issues.

Related to the financial system, Ab Agri interviewee pointed out that the UK government incentive the industrial symbiosis instead of to develop new waste technologies to treat hazard waste and generates. The electricity generation technology is backed by government. The researcher from University College of London argued the industrial symbiosis was backed by European fund. However, GSK Aerospace interviewee complained that such funds are limited.

GNK Aerospace interviewee claimed that the UK companies are risk averse to find new solution because they have no time and money to lose, thus the government should to start to demonstrate the viability of industrial symbiosis. The Birmingham council city interviewee pointed out that companies do not want to pay for green solution but citizens expected that the government continue developing a green agenda. However, the Green Alliance interviewee complained that the general public opinion is still concern about forest and nature conservation instead of waste disposal.

Interviewees from "Financial Time" and "Forum for the Future" added that the UK government need to incentive companies to address sustainability issues and spread environmental knowledge. The Green Alliance interviewee claimed that the government has not been a central position to tackle the waste problem in the UK. In this sense, landfill sites are the main destination of the waste and waste recycling.

According to NGO and media interviewees, general public do not understand what does industrial symbiosis means. There are some environmental educational programs aims to educate and to raise awareness about waste reduction. Innovation culture

and strong knowledge of legislation are desirable to find new alternative for waste disposal. The *business as usual* is the predominant mind set among the organizations and where the CEOs are engaged, waste turns a key theme to address. There were mobilization in public opinion on waste issues and especially when they have to pay to help the environment.

4.2. Institutional Capacity for Industrial Symbiosis

At the beginning it was much more difficult to approach NISP for companies because they didn't know the program, but once they realize that the program was working actually that there was a lot of companies started to become interested and spoken with each other. The most of companies know each other, and they started to say "well, this is a quite interesting initiative, it doesn't cost anything, and they can go on saving possibility to do something with the waste and reduce cost".

As well-known the companies became for others easier was for them to build the trust because they already have the resources to exchange in the right way. Table 5, 6 and 7 capture the key quotes by respondents. This was the beginning to create the trust between the companies, but once they established the right resources to exchange then, it started to become easier.

Table 5 – Main quotes from interviewees about Institutional Capacity

Dimension	Characteristic	Main Quotes from Interviews
Knowledge Capacity	Open	– *Most of the companies know each other, and they started to say "well, this is a quite interesting initiative, it doesn't cost anything, and they can go on saving possibility to do something with the waste and reduce cost" [University College of London]* – *We would use case studies; once we'd done some activity we would write a little story. You would say what the material was, how the facility came about and what the outputs were, so x many tons of material diverted from landfill or how many tons of carbon saved from doing something clever with the material.[Abi Agri]* – *You have to be very clear among the opportunities and the benefits. You have to share information very clearly with people. So, we've had event where we brought people to get this talking about a particular program that we're involved in.[Birmingham Council City]* – *We basically say to them, "Look, without this information we can't keep going on, because we don't know what we're doing. We don't know what we've achieved." [International Synergies Ltd]*
	Trust	– *So, I think it was a bit of snowballing that more you a kind of well-known you became for companies and easier for companies to trust them as well because you already have the resources, and they have been working with a members*

		of companies. So, I think, yes, in the sense of the beginning to create the trust between the companies.[University College of London] – *So, I think in the sense of the beginning to create the trust between the companies. And the coordination was more difficult, but once you have established yourself you have seen some resource then, it starts to become a bit easier. [Wrap]* – *The building of trust is very important. Again, we spend a lot of time on this. [International Synergies Ltd]*
	Know-how	– *Yeah. I think part that was done by International synergies, because they knew the business that work, and were able to tacking to that knowledge, and their experience, and their need and so on. So the part it was that. Just the fact that they knew the businesses at the area, that they were trusted by the businesses by the area [Birmingham Council City]*

Table 6- Main quotes from interviewees about Institutional Capacity

Relational Capacity	Collaboration	– *It's about actually bring people physically together as well, you know, rather than just e-mail it out. So, actually having events where you can bring people together, and potentially having incentives for people to do it as well.[Birmingham Council City]* – *We've been able to show them that the regulations that the European Commission are imposing on member states are going to have a big impact on them, and they can either wait, do nothing now and then when the regulations come along, they're going to have to make a massive change, or they can start changing now with our help and get ahead of the curve, if that makes sense. [Wrap]* – *I think the network was really, really powerful, but ultimately it was the relationship between the person who was working with them, so me and someone in industry, or one of my team and someone within industry, and that trust. [Ab Agri]* – *What's happening is that the concept, the network got a symbiosis and yes, it's building relationships; and you don't build relationships unless you have trust. So yes I have. I wouldn't say it built trust; I would say the trust would come because it builds relationships.[Arla Food]* – *It's my interest. If I didn't engage with them I would say "well will give my waste to landfill, or to another company that is interested in what I do".[Lower Reule Energy]*

Table 7- Main quotes from interviewees about Institutional Capacity

Mobilization Capacity	Active	– *Yeah. I think part that was done by International synergies, because they knew the business that work, and were able to tacking to that knowledge, and their experience, and their need and so on. So the part it was that. Just the fact that they knew the businesses at the area, that they were trusted by the businesses by the área. [Birmingham Council City]* – *We basically say to them, "Look, without this information we can't keep going on, because we don't know what we're doing. We don't know what we've achieved." [International Synergies Ltd]* – *We work very strongly to show that you can share information before you need to become competitive and keep the market to yourself, so it's creating a level of information that you don't feel threatened with, and this is why this voluntary action works quite well because you're all getting a benefit from it.[Wrap]* – *When I started working with NISP. I was working for part of the company that wasn't cooperative, but actually another thing. I think one of the most interesting things is that we change the people's perception, it changes people (I hate to use this word) trust. People were more open to the idea of talking to somebody, another company, or whatever.[Arla Food]*
	Promoter	– *We just went to the finance people and said, "Look, you could be saving money." Of course, there are very many businesses that don't like the idea of saving money, so they say, "Okay, well, show us how we can save money." We would show them some modelling. We would give them some modelling about wastage rates or something like that and they would say, "Well, okay, but that doesn't happen in our business." We would say, "Okay, well, come and do a trial with us and let's see if it happens in your business." We would often show that it would happen worse in their business than the model. [Wrap]* – *There is willingness by industry to get involved and once you've got a small number engaged, businesses talk to each other, so they soon proliferate. Two companies have success, they'll go and talk to another two companies and they'll talk to another two companies and they'll say how*

		wonderful it is and how much money they're saving their business, etc. I think it almost publicises itself. If you keep that network strong and growing and engaged, then business eventually, they do it themselves. [Ab Agri] – *And by the way, you started talking about what you're doing with NISP, because they can really help, they can actually put you in touch with people. Find to you what you're looking for. So keep in touch with NISP, they can probably help you. They have a large database, and they probably have someone with the same problem you've called. [Arla Food]*

The case studies showed during the workshops resumed some IS success. They companies can say what the material was used, how the facility came about and what the outputs were, so the amount of material diverted from landfill or the amount of tons of carbon saved from doing something clever with the material. They would talk about how engage, how it all came about, who was involved, and sometimes they would get the companies to stand up rather than hearing it from us they were running the program at the time.

So the NISP need to be very clear among the opportunities and the benefits. The companies need to share information very clearly between them. The NISP brought people to get this talking about a particular program that they were involved in. So, it is important to bring people physically together as well, rather than just e-mail it out. The main part is done by International Synergies because they knew the business that work, and was able to tacking to that knowledge, and their experience, and their need. The International Synergies approached with people that knew businesses personally and built a relationship with them through work, through other projects that they have been involved.

The International Synergies basically said to companies that without information sharing it can't keep going on, because it doesn't know what they are doing. They shared information because it isn't of any value to them any longer. They're already moving forward and they're already doing the next thing, so they're not sharing their innovation. They're just sharing what they see as good practice. For these people, good practice is actually best practice because they're not doing it. It's, again, de-risking information-sharing. The International Synergies worked very strongly to show that they can share information before they need to become competitive and keep the market to itself, so it's creating a level of information that they don't feel threatened with, and this is why this voluntary action works quite well because they're all getting a benefit from it.

The companies sign a NDA, non-disclosure agreement to protect certain element of intellectual propriety then by signing this declaration between two companies, they promise to not talk about the secret thing they've got. The NDA is an effectively legal document saying that they work together promising not to do something with somebody else at the same time, for example. And that gives a certain level of trust between two companies. Those documents are legally binding. If the companies break them, they can be taken to court. The cost taken is huge.

The network was really, really powerful, but ultimately it was the relationship between the people who was working with NISP. It was developing a culture of sharing, of trust and of development, and a mutual confidence in one another. If the NISP produced positive results, the people leave their place of work to come and see how it could be happen in their companies. The facilitators could go and see them on their site, have a look, understand and then they would develop that relationship. As everything, the longer is that relationship, the more touch points they have with people and companies, then the greater trust and mutual respect they have for one another so that it can develop. It didn't happen quickly, it developed over time.

The network developed a symbiosis because of relationships between people, but it was possible unless they built trust. The bigger thing is that the companies discovered something in this exchange of ideas to think outside the box, thus once they found a partner they can work with based on trust. It is interesting because they can't trust somebody until they get to know them, so they can't just trust a company and then get to know them. The under reason for meeting is transaction, the people involved with the IS projects were much more open to the idea that there was something, some other way of working. They have a bit more trust in engaging something that wasn't a transaction. When the companies are in the network and people offer that help or ideas, they build that trust confidence in them, and they have a trust in what they're doing. The building of trust is very important; the companies spend a lot of time on this because if they didn't engage between them they would know if their waste is useable for other. They only get to develop the opportunities through trust and the facilitators can help build that trust as well, because initially nobody knows others.

The NISP helps the companies to write good business plans to get money from the private sector based on his expertise and to save money taken away their waste from landfill. There is willingness by industry to get involved and once you've got a small

number engaged, businesses talk to each other, so they soon proliferate. Two companies have success, they'll go and talk to another two companies and they'll talk to another two companies and they'll say how wonderful it is and how much money they're saving their business.

The IS development publicises itself because of strong network and growing and engaging business where the companies switch waste to resource once the NISP influence their imagination to find new alternative solution. The NISP puts the companies in touch with others; it finds to them what they are looking for. So keep in touch with NISP, they can probably to find an alternative way to take away waste from landfill. The NISP have a large database, and they probably have someone with the same problem they have called.

They encourage people to find alternative solution and look for other companies in their database are not present. The NISP has not necessarily got the reciprocal person involved, they let's go and recruit that reciprocal company with a business opportunity. The NISP awakens the discussion between companies to find out new solution outside their working environment.

4.3. Organizational Dynamic Field for Industrial Symbiosis

In the organizational dynamic field, antecedents, mechanisms and outcomes categories play a key role to understand how industrial symbiosis develops. Concerns about waste disposal due to high landfill tax and resource scarcity in Europe triggered the actors in the UK to find new solutions. These are accompanied by information about waste owned by firms to process them through an industrial symbiosis development. The industrial symbiosis produces new mind set about waste because the last is conceived as value promoting sustainability results.

All interviewees pointed out that the UK Government supports efforts to reduce waste and avoid unnecessary cost. Table 8 and 9 capture the key quotes by respondents. Companies believe that a National Industrial Symbiosis Programme is necessary and that without Government support no progress will be made on IS. Based on coercive pressure, the UK Government imposed an escalating landfill tax pushing firms to find alternatives to waste disposal and introduce to firms the NISP. There is an economic driver for making use of as much waste as possible instead of spending money on the

landfill tax. In fact, the firms agreed to participate in NISP to solve an economic problem and because they have no time and resources to find solutions alone.

Table 8 – Main quotes from interviewees about Institutional Dynamic

Dimension	Characteristic	Main Quotes from Interviews
Antecedents	Waste Disposal	– *Another very important thing for NISP was the timing was very good because the waste was a very big problem in the UK, and the police was getting very strict.[IEI]* – *In England the landfill tax made landfilling very, very expensive, then it was actually it started to be a problem for the company to landfill all the waste. [University College of London]* – *At the moment the cost of disposal of the waste is high, we are not in a position to invest much money or spend time to find a solution alone, but we would contribute to a shared programme that would eventually reduce our cost of waste.[GKS Aerospace]* – *The NISP study starts to take shape. So, we handle 350,000 tons of waste in Tyseley area every year, we had a lot of waste, and the only recovery that happens there in terms of this low grade heats that comes out of it burning. [Birmingham City Council]* – *The people suddenly come running to us and said, "I can't stop producing my liquids. What can I do with them? Find me a home for these liquids please." [International Synergies Limited]*
	Resource Scarcity	– *Like, for example, some resource are located quite conflictive countries, and that requires for a lot of technological developments, and Europe is completely depending on those type of resources that come from outside. [University College of London]* – *We have parts of real problem that needs to be shouted is drinking water and to have security of energy supply because whatever the ones you use was in the supply chain the earth resources are in final, so you've got to start being very careful about how you use these resources, and how you're going to sustain them. [Veolia]* – *If you think in the future, 10 – 15 years like, resources scarcities is going to be so high that we don't have to value what they have around quite a lot, because it will be really expensive; the shipping process; the oil prices will be enormous. [Forum for the Future]*

	Landfill Tax	– *In the UK, symbiosis works very well because if you have waste, you have to pay to have it disposed to landfill. There is a landfill tax. There is an economic driver for doing something other than putting waste into landfill. [Wrap]* – *In the UK, the landfill tax escalator has really helped that having people push you away from landfill and having to look at other options. [Ab Agri]* – *We paid to take the food waste, because in the UK if you put it into a landfill you have to pay a tax, it's a very high tax. So, we offer to take the food waste, instead to going to landfill. [Lower Reule Energy]* – *Say it is £80 a tonne for landfill. I've got an alternative to landfill. I'm the only alternative, and I'm now cheaper than landfill. You suddenly think, "Well, look, there's an alternative. I will go to you." [International Synergies Limited]*

Table 9- Main quotes from interviewees about Institutional Dynamic

Mechanisms	Information	– *Having the information about different locations, and different regions. NISP was also able to identify the interregional synergies. So, these were the most important straights that we design the system. [IEI]* – *We would have some specific events with those sectors, but we would also run a number of cross-sector workshops, so we would invite anyone from any industry to come and sit down. [Abi Agri]*
	Network	– *Certain companies and certain regions has a history to be in contact with each other's, and may they're more open to the idea of working together, and in some other region, companies doesn't have this history. [IEI]* – *As everything, the longer you're in that relationship, the more touch points you have with people and companies, then the greater trust and mutual respect you have for one another so that it can develop. It didn't happen quickly, it developed over time. [Ab Agri]*
Outcomes	Culture	– *I think for the companies that were engaged in the program I think that was a learning experience for them and actually some of them changed the way they saw waste, and they also they realize that actually from waste they could actually do things even to, in some cases they manage to kind of make money out of waste, because they sold some parts of the waste.[University College of London]* – *Yes, and absolutely just thinking outside the box, having exposure to other people who were doing things and thinking about things differently gave people the appetite to do something.[Abi Agri]* – *Certainly it's giving me long standing business relationships that I've built. I have hold on to, even when the competition has come, the trust and confidence has grown, and grow, and I've manage to hold on to those relationships, even when three's more, and more plants, and this where symbioses took place. [Lower Reule Energy]*

	Sustainability	– *We are going to get environmental benefits but the company is also getting economic benefits by participating in this kind of assistances, turning something that hasn't value as waste into something that is a resource and has a value. So, the means creating, the jobs creating, but also reducing the impact of the waste on natural system. [University College of London]* – *If there's a company giving something more sustainable with their waste management, it helps to alleviate a waste problem on their site but also might help to make their locality a better place to live, so that waste might not smell anymore. [Abi Agri]* – *In the end of the day, they still have to do with the economic objectives. It's just economic. But actually once you start doing it, and you do see some economic and other benefits coming out like engagement, the PR, the CSR. [Arla Food]* – *We have more heat then we need. So, "What I may do with my heat?" it's an opportunity there, to match with another possibly completely type of business. [Lower Reule Energy]* – *We've saved 45 million tonnes of landfill diversion."[International Synergies Limited]* – *The symbiosis works because it helps businesses to find solutions for their waste streams before they ever need to think about landfill. [Wrap]*

In the UK the waste disposal is a trouble due to high cost from landfill tax, 80 pounds per tonne, imposed by government and the amount of it. The companies are trying to find viable solution for some type of waste because the legislation is very strict for some of them as liquid and claim for government support. The local authority as Birmingham Council city needs to engage into an industrial symbiosis initiative to support the increase of waste production and to create job opportunity. The Europe is facing resource scarcity, thus the industrial symbiosis offers new opportunity to reduce resource input through waste input instead of raw material.

The information about waste for exchange is stimulated by information promoted into the workshops. These workshops are viable to set up relationship between potential partners. The network creation is the engine of industrial symbiosis in the UK. The International-Synergies has a huge data base available to help the companies to find potential supplier of waste for input.

The key goal of these workshops was to help companies find synergies. It was thought that firms working together would be able to sharing information on waste generation and thus create powerful relationships based on trust and confidence. Moreover, industrial symbiosis helped companies to set up their supply chain and think differently about waste alternatives. In some cases, companies were also able to improve their approach to CSR and market opportunities.

Companies are invited to workshop to find new solutions for waste. The workshops are organized by International Synergies Ltd to happen in a business plant, hotel or business offices. Each workshop attends around 70 organizations, but this number can vary depending on the place where it happens. Each 6 or 7 month one workshop was set up. The main importance in these workshops is the role of facilitator play by NISP consultants. He or she is well prepared to understand the companies needed and generally has technical and social expertise to find new solutions for waste exchange.

Each roundtable has 7 or 8 organizations and one facilitator. Each organization needs to accept to exchange information about its waste and input. Before the workshop happens, an International Synergies Ltd manager explains how industrial symbiosis works and some successful case study around the world. In workshop the most important think that can happen is a strict relationship between the organizations, trust and mutual understanding become to take place among them.

When synergies are identified in the workshop, the companies meet later to advance on technical issue. Sometimes, the International Synergies Ltd has not notice about the success or failure of synergies founded in workshops. Companies do not spread their results among others difficulty thus the wider potential acceptance.

NISP intend to have a holistic approach to reduce industrial carbon dioxide, landfilling of materials, hazardous waste streams and industrial use of water. It also dramatically reduces the demand on natural raw material resources and generates cost savings, new sales, jobs and new business start-ups. Industrial symbiosis saves companies money and creates much opportunity to partner with others in this.

According to the interviewee, NISP has generated over 1 billion of pounds cost savings for business and 993 million of pounds in sales. NISP was actively working with 15,000 businesses, the majority of which were SMEs or micros. The interviewee pointed out that NISP successfully identified and closed out thousands of synergies, collectively cutting England’s carbon dioxide emissions by 42 million tonnes and redirecting over 48 million tonnes of ‘wasted resources’ from landfill. NISP synergies involved some form of innovation, many bringing new research and development to market because of the demand-pull of the programme on eco-innovation.

NISP helped the companies to improve their corporate social responsibility practices with the community around their site. Information and public relation with the community helped them to be legitimate by their effort.

4.4. Response to institutional pressures

In the UK the firms, under institutional pressure by government through landfill tax and waste reduction targets and by NISP through best practices, response in whatever manner according their know-how. The Ab Agri set up a digestion treatment facility to reduce waste production and leverage its business forward because of favorable financial incentive by European Union. The Lower Reule Energy related that the firms engaged in the NISP due to its best practices and cost free participation helped this changing.

In the following Table 6, the study illustrates some paragraphs coded related to response dimension to support the results achieved.

Table 10 – Response to institutional pressure

Dimension	**Characteristic**	**Main Quotes from Interviews**
Response	Innovation	– *They're looking at other options other than land spread, so putting out a digestion treatment facility is one way of treating it.[Ab Agri]* – *So, we need to find alternative ways of disposing of it, and it's not very pleasant smells, it's very wet, and we've met somebody that represent NISP for the middleling region who had started to looking at foods packaging and its disposal, and they just said "would you be interested in coming into the network and sitting on a staring committee", and each region has a staring group that's represented by people in the industry. [Lower Reule Energy]*
	Suggestion	– *They then said, "Well, we haven't got the technology," so we showed them that technology was available. […] "Okay, if we put up to 30% into this," would you be interested?" [Wrap]* – *So we work together to gather the evidence and to propose a new target, stretching, but sensible. [Arla food]*

In other hand, the firms are trying to influence the institutional context through the setting of new waste reduction targets according to their technology available. The Wrap performs a high engagement towards waste reduction and the firms are interested to engage it because they have government financial support.

5. DISCUSSION

According to normative pressure, the organizations need someone to change their mind set from a waste to a resource, so that really get them to think differently, get them to think about things that are. Rather than think about the material as waste, think about what it is inside it, think about what it is made up of, think about as they would get any other business opportunity. The British government imposed a landfill tax to meet key EU targets in 2013 and 2020. It is maintained towards a floor of £80 per ton in 2014/15 and it will remain the key driver to divert waste from landfill (DEFRA, 2011). A waste management plan for England was set out as part of the transition to a sustainable economy

as required by Article 28 of the revised Waste Framework Directive (WFD) (DEFRA, 2013).

The institutional context for industrial symbiosis could institutionalize economic rules through waste reduction strategies, new structures and a more collaboration among firms to achieve common targets (MORGAN, 2007a). The author emphasis the social compromise between government, NGO and firms, it is a collective organization of actors to create a knowledge background for industrial symbiosis development (MORGAN, 2007b; WHITLEY, 2000).

The UK government encourage the industrial symbiosis development through almost clear rules to attend EU legislation and support the firms through NGO as WRAP and NISP. The support is free for charge for firms interested to collaborate at NISP and WRAP deals with waste reduction strategies in collaboration with firms (WHITLEY, 2000).

According to Whitley (2000) argues about financial system, the UK government in collaboration with European Union finances green technology to waste reduction as digestion plant for one food because of resource scarcity and energy price volatility. European Union imperative is waste reduction due to a huge resource scarcity around the world. The NISP is wholly financed by public funds initially and now private firms need to be charged to participate into the program.

Whitley (2000) pointed out the necessity to create a background of knowledge to support the economic development. The skill development for industrial symbiosis in the UK is poor because the concept is new and “business and usual” model predominates against waste reduction. The “waste as food” is far to be understand by companies, although the UK government support them through WRAP and NISP.

According to Whitley (2000), authority relation and trust are pillar for institutional context building. In the UK, there is a set of norms which govern the relations between companies and government. These norms are waste related and the WRAP helps the firms to accomplish with them. The industrial symbiosis development has not clear norms, but an array of “best practices” performed by NISP. The relationship between actors involved in industrial symbiosis development is trust guided because without information sharing the symbiotic process does not run.

The IS development counts with specialists belonging to focus areas to make things happen. The firms which want participate to NISP are getting all in a room in a

workshop organized by International Synergies to share what they thought the possibilities were. The workshops start with some presentations around what we thought would be possible, something to strike the imagination, and to incentive people to put their own ideas on the table and then they would discuss those and try and do something and take them forward. Then, when the market saw that changing from 'business as usual' to a new model was cost-effective, it went and sourced its own private sector finance.

The IS won't happen by itself. It needs someone to facilitate it, someone who change that mind set from a waste to a resource of business and get them to think differently. The facilitators of IS which help the companies to find synergies between them come from different sectors thus their expertise is invaluable tool to things happen. They facilitate a culture of sharing, of trust and of development, and of mutual confidence in one another. The relationships were the powerful bit of NISP rather than the actual workshops which was the seed of that but it was the follow up on that relationship that was developed after that that made things happen. Rather than think about the material as a waste, the facilitators help them to think about what's inside it, think about what it's made up of, think about as they would any other business opportunity.

In the UK the recycling is very low, although there is recall carbs sites collection where the companies can recycle without they don't have to physically take it anywhere. The whole behaviour change is quite important, although in the UK there are big schools programs. There is awareness around behaviour change, as household ends, businesses or everyone that lives in the UK with initiates how raising that awareness and get people to do things differently.

Facilitators served as critical role in introducing companies to each other, helping to build the network either from the main players (by encouraging sub-networks), or across them (by encouraging cross-industry exchanges) (LOMBARDI; LAYBOURN, 2007b).

Industrial symbiosis approach is spread around the world as mean to increase the efficient of waste management, achieve better economic and environmental results. Various reasons led to implement this approach: water scarcity, job creation, landfill tax and restriction on waste disposal, raw material price and scarcity of resource among others.

The cases of industrial symbiosis around the world have appointed to coordinating body or *champion* company as promoter or facilitator of development. Both

are motived for various reasons such as strict environmental legislation, financial support by government, circular economy law among others.

However, barriers exist around the industrial symbiosis development such as informational, technical, relationship, economic, geographic, and law among others. These can impede, delay or end the development. Institutional context changes over time and industrial symbiosis as social phenomenon as well, thus the organizational dynamic turns key roles through which to understand *why* and *how* this happen.

The UK is highly influenced by EU policies through its directives which aim to create a sustainable economy. Thus environmental directives are mainly focused to reduce or prevent the waste production across the member states with financial support as well. The UK is obligated to implement EU directives except that they do not impede economic development of country.

The UK NBS creates an institutional context to support or impede the industrial symbiosis development. On the one hand, the UK NBS supports through financial support and a more paternalist approach between government and companies to achieve environmental targets. Landfill tax helps the government stimulated alternative waste management initiative and thus a little effort far away from *business as usual* model. On the other hand, the UK NBS limited the industrial symbiosis development because of a low environmental educational programme among citizens. The companies are bad prepared to change their mind set and the few ones are unable to share the best results or practices.

Some barriers impeded to organizations to approach industrial symbiosis such as time to spend in workshops to find new solutions, no waste availability as input, no economic results and no free service anymore. However, some organizations were involved into industrial symbiosis process because of strict environmental legislation that impeded waste disposal in landfill such as liquid or alternative solutions were more economic than waste disposal.

The study shows how the institutional context and capacity could support or imped the organizational dynamic for industrial symbiosis development through three key points such as the government successful established the NISP and this study shows economic, social, environmental results about the programme, the organizations are poor prepared to approach the industrial symbiosis because “business as usual” model is predominant still and the building of institutional capacity is low because the industrial

symbiosis is approached as waste recycling and not as business idea beyond material exchange.

This study is consistent with various Industrial Ecology thinkers when they asserted that:

1) Supra-national entities as European Union can influence the government in the industrial symbiosis development Chertow and Ehrenfeld (CHERTOW; EHRENFELD, 2012; COSTA; MASSARD; AGARWAL, 2010). UK institutional context is high influenced by EU directives and financial support;

2) The presence of coordinating body can play a key role in providing information, education, and a platform for communication (BOONS; SPEKKINK, 2012). NISP acts like a promotor to make viable a common platform to communicate: workshops;

3) The social, informational, technological, economic and political ones are factors for industrial symbiosis development (Costa et al., 2010). However in this study technological factor was not appointed as determinant for industrial symbiosis development, although relationship is developed in the workshops and economic factor is the main drive;

4) British companies deal with more transparent rule-based governance environmental and strict environmental law (Abreu & Barlow, 2013). Landfill tax incentives the companies to find new solutions for waste disposal for liquid because it is banned from landfill;

5) Actors influenced by normative, coercive and culture forces create new practice (Scott, 2014). The best practices in one sector can move for another sector and find new solution. Companies acts morally obligated to accept the industrial symbiosis because of cost reduction for waste disposal, although environmental legislation requires strict behaviour as well;

6) Institutional capacity building supports industrial symbiosis process (INNES; BOOHER, 2003). Relational and knowledge resource were appointed in UK, but these were unable to mobilize other companies to participate into industrial symbiosis process.

The EU supported the UK industrial symbiosis development overtime from 2005 by ERDF. The NISP produced successful economic, environmental and social results. The EU did not link both the funding to resulted expectation and rules and targets about industrial symbiosis programme. The UK government should focus on waste

reduction programmes on the long run because it needs to create a more favourable cultural context through: 1) A environmental education programme to level out the heterogeneous expertise and capability among companies; 2) A recognition that industrial symbiosis might be easily approached by companies with clear normative rules at national level; 3) The sharing of best practices at national level by government showing costs and benefits.

The future of regulation should inspire more collaboration between companies and public authority. The media and NGOs might be engaged more in industrial symbiosis programme to spread results and to aware public opinion about waste as business opportunity.

The promoter is essential for industrial symbiosis development because it creates a network never established for waste exchange before. It might focus not mainly on waste recycling but on waste prevention creating a more environmentally aware culture, although waste disposal costs are the main drivers for industrial symbiosis development. Moreover, it might focus on regional level to reduce logistic costs due to waste exchange and best practices achieved needed to share by companies and incentive others to do the same. The promoter might function as a hub where feedbacks received turn input for other organizations.

The companies might develop more relational capacity to share between them not only best practices but also the results achieved. They might find new solutions for waste reduction together. On the short term, informational barriers should be overcome seeking superior results on the long run. When the company embraces an industrial symbiosis process on the long run, it needs to consider internal culture change as well. The "Business as usual" mind set should be substituted by "circular economy" one, where the supply chain organizations and customer engage with companies to find new solution for no waste.

However, the industrial symbiosis stopped in the UK at pre-institutional phase because: 1) Government stopped to support a successful industrial symbiosis programme and thus the free service for companies to find new solution; 2) Waste reduction was not conceived as business opportunity among the companies. Thus companies did not arise this concern; 3) To date, results achieved by industrial symbiosis were not shared and understood by UK companies and government; 4) Companies tried to imitate best practices instead of looking for normative solutions; 5) The institutional capacity building achieved by industrial symbiosis is low because the firms were not able to involve others; 6) The

promoter was unable to look beyond the workshops to create a close network and to publicize the successes achieved.

Strategies to response to institutional pressure as innovation and suggestion characterize the institutional dynamics of industrial symbiosis development because the organizations might need to change their policies and practices according to their availability resources and objectives (OLIVER, 1991).

6. CONCLUSION

This dissertation contributes to understand the dynamics of industrial symbiosis in the UK. Our results demonstrate that the government actions through progressive landfill tax and national waste strategies promoted a successful political environmental for industrial symbiosis. However, the limited European Union funds jointly with UK ones could limit the institutionalization of industrial symbiosis. The “Carrot and Stick approach” help the companies to establish a positive relationships with the government and achieve the waste reduction targets. The companies demonstrate a still conservative stance due to understand the value of “waste as food” principle and industrial symbiosis concept.

The waste disposal represents the main driver that trigged the industrial symbiosis development accompanied by economic interest because of landfill tax progression. The Europe is facing serious problem with resource scarcity, thus the supra and national governance support waste reduction strategies. The industrial symbiosis in the UK was cemented by NISP, a national program for industrial symbiosis promoted by private company, International-Synergies based in Birmingham sponsored by UK government to achieve EU and UK waste reduction target. Therefore, the NISP was free for charge for memberships interested to participate. The International-Synergies have a huge date base that collect information about waste production over 1 million of companies, thus it supports the companies with "best practices" in industrial symbiosis just implemented by others. The network development by NISP though the workshops turn the information sharing among companies feasible because the companies could meet each other and create a trust relationship to find common solution. However, the environment conscientiousness among companies represent the major obstacle to industrial symbiosis process due to misunderstand of "waste as food" and industrial symbiosis concept. Business as usual is the predominant model among companies. When the industrial symbiosis happens, the economic benefit emerges as main results because the waste goes far from landfill, consequently the environment outcomes takes off for whole society. In same case, the job creation, through new structure to turn the waste feasible for others, is promoted by public and private initiative.

This organizational dynamic field is sponsored by institutional capacity because the companies need to be open for new business opportunity and change their business as usual practice, thus they need to have a native background to industrial symbiosis development. To achieve a higher level of collaboration among the actors involved need to build the trust because of the sensitive information sharing among them and the time spent to find common solution. The International-Synergies mobilizes the companies to engage in the programme through the successful case studies showing economic results, but the companies are not able to involve others to keep part in the programme because of the lack of power, thus the government need to create a massive influence for waste reduction into the country through business and engineering school for example.

NISP experience can provide us with useful ideas and lessons for the future. One lesson is that strong regulations and enforcement are essential, but should be

structured in a way that allows companies to pursue innovative approaches to meet legislative requirements. Secondly, Governments should create a more favourable context for cooperation and involvement of diverse actors throughout the supply chain. There is also a need for acquisition and development of technological solutions to support IS. Finally, it is fundamental to incorporate environmental, social and ethical perspectives into corporate agendas.

This study is exploratory and not without its limitations. One possible limitation is the fact that the data were collected in 2014. However, industrial symbiotic systems demand a long-term institutional setting. Another possible limitation arises from the small number of firms surveyed. While it is acknowledged that the empirical core of this paper is somewhat restricted, the firms were carefully chosen to represent key actors and the interviews were conducted rigorously and in-depth.

Despite these limitations, the NISP experience was a good initiative in that a number of cases of industrial symbiosis in the UK were possible. Companies will not perceive with industrial symbiosis without a free service to fund initial investigations of waste solutions. Results achieved through NISP were not complete shared and understood by UK companies and the government. Finally, NISP was unable to go beyond the workshops to create an efficient network and publicize successes achieved. To embrace industrial symbiosis processes firms should consider organizational, cultural and technological changes.

To achieve the general objective, this research needed to attend the four specific objectives proposed. The Table 7 relates the objectives proposed and results achieved.

Table 11: Relationship between objectives and results

Objectives	**Results**	
1) To explore the institutional context needed to run the industrial symbiosis process;	▪ *Landfill Tax;* ▪ *UK Waste Strategy;* ▪ *Limited European Union Funds;* ▪ *Carrot and Stick approach;* ▪ *Conservative;*	
2) To analyse how the institutional context and capacity influence the antecedents, mechanisms and outcomes of industrial symbiosis;	Antecedents	▪ *Resource shortage;* ▪ *Waste Disposal;* ▪ *Landfill Tax;*

	Mechanisms	▪ *Information;* ▪ *Network;*
	Outcomes	▪ *Culture;* ▪ *Cost reduction for waste ;disposal;* ▪ *Waste reduction;* ▪ *Job creation;*
3) To investigate the institutional capacity for industrial symbiosis;		▪ *Open to collaboration;* ▪ *Trust;* ▪ *Know-how;* ▪ *Collaboration;* ▪ *Active;* ▪ *Promoter;*
4) 4) To explore institutional pressures and responses by organizations involved into industrial symbiosis process.		▪ *Landfill tax;* ▪ *NISP;* ▪ *Innovation;* ▪ *Suggestion;* ▪ *Normative behaviour influenced the landfill tax*

The UK is a European member, thus the UK institutional context is highly influenced by the European Business System (EBS) such directive and funding system to understand how it works at national level and how the EBS could change overtime.

The industrial symbiosis in UK showed a complex institutional dynamics at work. Coercive and normative forces influenced each other. Since Environmental Protection Act in 1990, NISP was proposed to UK as national programme for waste reduction and overtime the landfill tax escalation helped the IS to run.

The industrial symbiosis acted within an organizational field boundary undefined and unclear because the institutional forces did not share a common strategic vision. Institutional theorist might investigate the elements needed to incentive the forces for a common vision for the industrial symbiosis.

Organizational field is too complex, thus the three elements which support the industrial symbiosis development might influence each other to strengthen or weaken the process. At what extent it is happen, it is still few clear up now. In this study have emerged some elements which support or imped the organization to enter into the organizational field, although is still few clear how they influence each one.

This study should be replicated in other institutional context as Brazil because might emerge new concepts for example how the abundance of natural resource and land might influence positively or negatively on industrial symbiosis development. This study

appointed to some gaps encountered during the investigation such as, a grounded theory is desirable to saturate the concepts emerged, thus more interviews might be necessary.

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8. APPENDIX A

NISP CONCEPT

1. What events led to the UK Government adopting and developing an industrial symbioses program?
2. What was the logic and rational behind the NISP?
3. What processes were used to plan and control the cicyling of wastes among companies ? What are the key government and corporate capabilities for implementing the symbioses program?
4. Have organizations such as NGOs, media, labour unions or communities organizations been influencial in pressuring Government to adopt industrial symbiosis programs?

STRENGHTS AND WEAKNESS TO INDUSTRIAL SYMBIOSIS

5. What were the strongest points of the NISP?
6. What factors have encouraged company participation in NISP?
7. What were the weakest points of the NISP?
8. What barriers were faced in Industrial Symbiosis devolopment?
9. How were these Barriers overcome?

REGULATORY AND FINANCIAL SYSTEM

10. Have regulatory requirements been the main driving forces for industrial symbiose by companies? Or have other organizations such as NGOs, media, labour unions or communities organizations been influencial in pressuring company to participate in the NISP?
11. Has symbiotic program made it easier for the companies to meet waste control requirements?
12. Have the UK Financial Incentives encouraged symbiotic collaboration? And if so, in what way?
13. What has been the impact of changes in these UK financial incentives on the continuity of the industrial symbioses?

RELATIONSHIP AMONG FIRMS

14. What are the roles and responsibilities of the various actors involved in the implementation of NISP?
15. What processes were used to plan and control the cicyling of wastes among companies ?
16. What are the networking aspects of the NISP? Who are the participants? What is the value of the workshops and how often are they held?
17. What steps are taken to achieve: (a) trust and mutual understanding; (b) shared information about resources and (c) participation of firms in the Network?

CSR, OUTCOMES, CULTURAL AND ORGANIZATION FIELD

18. Has NISP contributed to business success of company and if so in what way?
19. How have Corporate Social Responsibility policies changed as a result of company participation in NISP?
20. What improvement in environmental performance has been achieved through company participation in NISP?
21. What social improvements have been achieved through company participation in NISP?
22. Has the organizational culture of companies supported participation in NISP? and has NISP influenced company organizational culture?
23. To what extent does British public opinion support programs such as industrial symbiosis?

INDUSTRIAL SYMBIOSIS LESSONS LEARNED

24. How do you envisiage the future of Industrial Symbiosis in the UK?
25. What is the impact on NISP of the "Waste Prevention Programme for England" prepared as a requirement of the revised Waste Framework Directive (2008/98/EC)?
26. What is been done at the international level to transfer NISP technology among countries? How has Brazil been involved in this process?
27. What is opinion on progress in Brazil related to implementation of industrial symbiosis?
28. How has the NISP evolved from a Government funded program to wholly owned and independently run commercial enterprise?
29. Based on your experience with NISP, do you have any suggestions for Brazilian Government and companies to consider in developing Industrial Symbiosis?

NISP CONCEPT

1. What were the events that triggered your participation in NISP?
2. How did your company enter in NISP?
3. What is the company role in NISP?
4. Have any of your competitors embraced symbiotic programs such as NISP?

STRENGHTS AND WEAKNESS TO INDUSTRIAL SYMBIOSIS

5. What were the strongest points about the NISP?
6. What factors have encouraged your participation in NISP?
7. Has NISP contributed to your business success and if so in what way?
8. What were the weakest points about the NISP?
9. What factors have limited the extent of your participation in NISP?
10. What Barriers were faced in Industrial Symbiosis devolopment?
11. How were these Barriers overcome?

REGULATORY AND FINANCIAL SYSTEM

12. Have the UK Financial Incentives encouraged symbiotic collaboration? And if so, in what way?
13. What has been the impact of changes in these government financial incentives?
14. How has the UK Environmental Agency promoted participation in Industrial Symbiosis?
15. Has symbiotic program made it easier for your company to meet Environmental Regulatory requirements?

RELATIONSHIP AMONG FIRMS

16. What are the networking aspects of the NISP? Who are the participants? What is the value of the workshops and how often are they held?
17. What processes were used to plan and control the cicyling of wastes among companies ?
18. Has your company increased trust and mutual understanding with its symbiotic network?
19. How has your company shared information about your resource and wastes with network participants?
20. Has your company mobilized other firms to join a network?

CSR, OUTCOMES, CULTURAL AND ORGANIZATIONAL FIELD

21. What are the key corporate capabilities for implementing the symbioses program?
22. What Environmental training has been required to support your participation in NISP? And, how has this participation influenced the employee skills and commitment in your company?
23. How have your Corporate Social Responsibility policies changed as a result of your participation in NISP?
24. What improvement in environmental performance has been achieved through your participation in NISP?
25. What improvement in social aspect has been achieved through your participation in NISP?
26. Has the culture organization within in your company supported participation in NISP? and has NISP influenced your companies culture or organizational behavier?
27. Have any of your company's stakeholders pressured you to participate in the NISP? For example, have NGOs, media, labour unions or communities organizations pushed your participation in NISP?
28. To what extend does British public opinion support programs such as industrial symbiosis?

INDUSTRIAL SYMBIOSIS LESSONS LEARNED

29. How do you envisiage the future of Industrial Symbiosis in the UK?
30. Based on your experience with NISP, do you have any suggestions for Brazilian companys to consider in developing Industrial Symbiosis?