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My final words of thanks are of course for my parents – Lluís and Glòria - and friends. They have been suffering my busy times and my bad temper when something went wrong or when I didn’t see something clear. Thank you for your support during all this time. Without you, this work would have never been done.

Thank you all.
Abstract

This thesis develops an in-depth study of the systems approach applied to the provision of urban infrastructure solutions. The aim of this study is to provide a wider vision of the current application of systems integration in urban planning understood both as an organisational tool in infrastructure provision and as a strategic business activity for firms involved in these kinds of processes. It is sought to develop a typology of cases from the analysis of four large-scale projects that venture into innovation related to infrastructure provision. The object of this study is analysing the different conceptions when it comes to the application of the systems approach and recognising the main barriers for its development. A strong emphasis is given to the recognition of the roles played by the different firms involved in infrastructure planning in each case and to the assessment of the possible required changes in business models; as well as to the new capabilities these firms have to develop to make innovation possible.

This work starts with the definitions of four important business concepts (business models, firm capabilities, value chain and competitive advantage) that are essential to the development of the analysis of the urban innovative processes experimenting with systems integration. The next section constitutes an introduction to systems integration both as a design tool and as a business strategic activity for firms. Integrated solutions are defined as the combination of products and systems with services in order to specify, deliver, finance, maintain, support and operate a system throughout its life cycle. The conceptual introduction concludes with the application of these theories to the urban environment.

The core of this thesis focuses in the analysis of four cases experimenting with systems integration in the urban environment: 22@ Barcelona in Spain; Hammarby Sjostad in Stockholm, Sweden; and Gallions Park (London) & Ashford both in the UK. These four case studies have been chosen because of their systems innovative approach in the treatment of the urban infrastructure systems (mainly in the energy, waste and water & sewage systems). The methodology used to develop this analysis has centred on gaining understanding of the design processes and the integrated solutions obtained, as well as studying the different kinds of firms involved in these processes, the role they play, their business models, the capabilities needed to carry out their functions and the identification of the possible appearance of new cooperation structures between local administrations and firms in order to achieve the innovative goals.

To conclude, the integrated processes followed in the different case studies and the methods related to integrated design are compared (amongst them and with the conventional method) to develop a typology of cases. Finally, after the discussion of the lessons learnt from these experiences, conclusions are reached about the adequacy of the application of the systems approach in the urban environment; which also enables us to evaluate the success of these methods till now.
Resum

Títol: Integració de Solucions d’Infraestructura Urbana
Autor: Lluís Codorniu Torguet
Tutors: Dr. Lars Frederiksen (Tanaka Business School, Imperial College, London)
Álvar Garola Crespo (ETSECCPB, UPC, Barcelona)

Resum

En aquesta tesi es realitza un estudi d’aprofundiment en la teoria de sistemes aplicada a la provisió de solucions d’infraestructura urbana. Per fer-ho, es pretén donar una àmplia visió de l’actual aplicació de la integració de sistemes en l’entorn urbà entesa com a eina d’organització en la planificació d’infraestructures i també com a activitat estratègica de negoci de les empreses implicades en aquest procés. Es tracta de desenvolupar una tipologia de casos a partir de l’anàlisi de quatre projectes a gran escala que comparteixen l’aposta per la innovació en la planificació d’infraestructures.

L’objectiu d’aquest estudi és analitzar les diferents concepcions a l’hora d’aplicar aquesta teoria i reconèixer els principals problemes per al seu desenvolupament. En aquesta anàlisi es dóna un fort èmfasi en identificar el rol de les empreses implicades en la planificació d’infraestructures i en avaluar els possibles canvis de model de negoci que es puguin requerir; així com les noves capacitats (experiència i coneixements) que hagin de desenvolupar aquestes empreses per fer que aquesta innovació sigui possible.

Aquest treball s’inicia amb la definició de quatre conceptes del món empresarial que són essencials per al desenvolupament de l’anàlisi dels processos urbans experimentant amb la integració de sistemes: model de negoci, capacitats d’una empresa, cadena de valor i avantatge competitiu. El següent capítol consta d’una introducció a la integració de sistemes en els seus dos vessants descrits anteriorment i es defineix el concepte de solució integral com aquella combinació de sistemes i productes amb serveis per tal de proporcionar, produir, mantenir, financiar i operar un sistema a llarg de tota la seva vida útil. Es conclou la introducció conceptual exposant les possibilitats d’aplicació d’aquests teories en l’entorn urbà, objecte d’estudi.

El cos central d’aquesta tesi es centra en l’anàlisi de quatre casos que actualment estan experimentant amb la integració de sistemes a l’entorn urbà: 22@ Barcelona a Espanya; Hammarby Sjostad a Estocolm, Suècia; i Gallions Park (Londres) i Ashford al Regne Unit. Aquests casos han estat escollits donada la seva innovadora aproximació en el tractament dels diferents sistemes urbans (principalment l’energia, l’aigua i els residus). La metodologia utilitzada per al desenvolupament d’aquesta anàlisi de casos s’ha centrat en l’apropiment i comprensió dels processos integrals de disseny i les solucions integrals obtingudes, així com en l’estudi dels diferents tipus d’empreses involucrades en aquests processos, el rol que hi juguen, els seus models de negoci, les capacitats necessàries per al desenvolupament de les seves noves funcions i la identificació de la possible aparició de noves estructures de cooperació entre administracions i empreses per a aconseguir aquesta finalitat.

Finalment, es comparen les metodologies i els processos d’integració de sistemes seguits en els diferents casos d’estudi (entre ells i amb el mètode convencional) per a l’elaboració d’una tipologia de casos. Els resultats obtinguts al llarg de tot el procés d’estudi han permès extreure conclusions sobre l’adequació de l’aplicació de la teoria de sistemes en la planificació urbana i permeten avaluar els èxits obtinguts fins ara.
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<tr>
<td>AIWMS</td>
<td>Ashford Integrated Water Management Study</td>
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<td>AIWS</td>
<td>Ashford Integrated Water Strategy</td>
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<tr>
<td>AMP</td>
<td>Asset Management Programme</td>
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<td>CA</td>
<td>Competitive Advantage</td>
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<tr>
<td>CABEL</td>
<td>Commission for Architecture and the Built Environment</td>
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<tr>
<td>CHP</td>
<td>Combined Heating and Power</td>
</tr>
<tr>
<td>CCHP</td>
<td>Combined Cooling, Heating and Power</td>
</tr>
<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
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<tr>
<td>CLG</td>
<td>Communities and Local Government</td>
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<tr>
<td>CNBQ</td>
<td>Crest Nicholson BioRegional Quintain</td>
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<tr>
<td>COPS</td>
<td>Complex Products and Services</td>
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<tr>
<td>DH</td>
<td>District Heating</td>
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<tr>
<td>DH&amp;C</td>
<td>District Heating &amp; Cooling</td>
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<tr>
<td>EKSDC</td>
<td>East Kent Spatial Development Company</td>
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<tr>
<td>ESCO</td>
<td>Energy Service Company</td>
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<tr>
<td>GADF</td>
<td>Greater Ashford Development Project</td>
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<td>GLA</td>
<td>Greater London Authority</td>
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<tr>
<td>GOSE</td>
<td>Government Office of the South East</td>
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<tr>
<td>HCA</td>
<td>Homes and Communities Agency</td>
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<td>IRM</td>
<td>Integrated Resource Modelling</td>
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<tr>
<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>ITN</td>
<td>Invitation to Negotiate</td>
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<tr>
<td>LCA</td>
<td>Life Cycle Assessment</td>
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<tr>
<td>LCCA</td>
<td>London Climate Change Agency</td>
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<tr>
<td>LDA</td>
<td>London Development Agency</td>
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<tr>
<td>LDF</td>
<td>Local Development Frameworks</td>
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<tr>
<td>LNG</td>
<td>Liquid Natural Gas</td>
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<tr>
<td>LTS</td>
<td>Large Technical System</td>
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<tr>
<td>MUSCO</td>
<td>Multi-Utility Service Company</td>
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<tr>
<td>OFWAT</td>
<td>Office of Water Services (Water Services Regulation Authority)</td>
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<tr>
<td>OS</td>
<td>Operational Services</td>
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<tr>
<td>PEI</td>
<td>Pla Especial d’Infraestructures</td>
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<tr>
<td>PERI</td>
<td>Pla Especial de Reforma Interna</td>
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<tr>
<td>PFI</td>
<td>Private Finance Initiative</td>
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<tr>
<td>PGM</td>
<td>Pla General Metropolità</td>
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<td>PMU</td>
<td>Pla de Millora Urbana</td>
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<td>PPP</td>
<td>Public-Private Partnership</td>
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<td>PQQ</td>
<td>Pre-Qualification Questionnaire</td>
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<td>R&amp;D</td>
<td>Research &amp; Development</td>
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<tr>
<td>RDA</td>
<td>Regional Development Agency</td>
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<tr>
<td>RES</td>
<td>Renewable Energy Sources</td>
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<tr>
<td>SEA</td>
<td>Strategic Environmental Assessment</td>
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<tr>
<td>SEEDA</td>
<td>South East England Development Agency</td>
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<tr>
<td>SI</td>
<td>Systems Integration</td>
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<tr>
<td>SME</td>
<td>Small and Medium Enterprises</td>
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<tr>
<td>SPC</td>
<td>Special Purpose Companies</td>
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<td>SSE</td>
<td>Scottish and Southern Energy</td>
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<tr>
<td>UGAP</td>
<td>Unidad de Gestión de Ayudas para Proyectos</td>
</tr>
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<td>UK</td>
<td>United Kingdom</td>
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<td>US</td>
<td>United States</td>
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1. Preface and objectives

Climate change demands most parts of society to refocus the development, distribution and use of energy, water and waste due to a world high-speed urbanization, where enlarged populations gather in small geographical areas (cities and metropolitan areas). Nowadays, the systems approach is starting to be commonly used in an effort to simulate and achieve understanding of the interaction of the multitude of variables relevant to urban planning to try solving this new challenge in the urban environment. At the same time, firms involved in the urbanisation processes (similar to those firms producing capital goods) are also experiencing a need to change their business models and develop new capabilities that enable them to carry out innovative services for an ever more complex system that is the urban environment.

Systems integration is a particularly interesting topic as it enables firms to achieve a better organisation and planning in different fields (in this case, this project focuses in urban planning and design to provide integrated infrastructure solutions in the water, waste & sewage and energy systems). It has been a long time since a number of projects have used the systems approach in an effort to simulate and achieve understanding of the interaction of the multitude of variables relevant to urban planning, but it hasn’t been till now that the systems approach is starting to be extensively used for planning and obtaining new and complex urban infrastructure solutions to solve the problems arising.

In this thesis, four comparative case studies are analysed in order to acquire a better understanding of how systems integration is carried out in the urban environment. These cases have been accurately chosen because of their innovative planning using systems integration methods and because of the business opportunities for firms that arise from these planning or restoring projects. The study of the roles and interactions of firms on each case may enable us to develop a typology of cases on how the value chain is organised for building and providing infrastructure services in these new urban areas.

A main reason for carrying out this research project is that there have not been many studies on why there is this increasing tendency to the use of these methods, if whether they are successful or not and what is the motivation for firms to involve in this type of innovative projects. This is very important because it means that the research and assessment resulting from this project will be practically one of a kind and interesting from the point of view of the evaluation of innovation processes for both those firms doubtful about the possible implementation of these processes and those already experimenting with them. Hence, the assessment and analysis of this four case studies that are currently experimenting with these methods, as this thesis aims to do, can be great value for this analysis and for the possible development of a typology.

The first of these study cases is 22@ Barcelona, which is a regeneration plan of a former industrial area that aspires to be converted in the major technological centre of the city. A huge urban plan has been developed to equip this zone with the most advanced infrastructure to make it sustainable and competitive to accomplish its goals. The second case, Hammarby Sjostad, is located in an old brownfield in Stockholm, Sweden. Its aim is to develop a new residential neighbourhood following the eco-city
model, which aims to reduce energy consumption and incorporates several new recycling technologies.

The third case, **Gallions Park**, is another project to refurbish a brownfield; in this case in the Thames Gateway, in London, and aims to deliver the first zero-carbon development in the city. Last but not least, the fourth case is **Ashford**, located in southern England, UK. This is the case that differs more from the other three, as it is not a regenerating project. This urban plan intends to enable the city of Ashford, one of the fastest-growing cities in its region, to develop sustainable growing through an accurate plan led by the local government that includes an integrated water management plan.

When developing and assessing the different cases, there is the need to use some important business concepts that have been developed at the first stages of this project to facilitate the further analysis of the case studies. Obviously, the main concept of analysis is **systems integration** both as a *design concept* for the development of technology to provide infrastructure solutions and as a *business strategic activity* (based on the business models that firms develop to deliver integrated solutions, related to their capabilities and the positioning of the firm as a system seller or a systems integrator).

For the analysis of cases from this last point of view, four more important concepts have been developed as they may be very useful for the analysis: business models, firm’s capabilities, value chain and competitive advantage.

A **business model** can be understood as the tool that mediates between the technical and economic domains, selecting and filtering technologies, and packaging them into particular configurations to be offered to a chosen target market, ensuring that the technological core of the innovation delivers value to the consumer. In our particular case, it is extremely important, and a main aim of this project, to identify and understand the different types of business models that firms involved in systems integration processes apply in order to deliver integrated solutions.

A **firm’s capability** may be understood as the power or ability to generate an outcome based on a certain competitive advantage, which is based on the possession of a few key resources and routines, organizational capabilities or core competencies (special and differentiating capabilities owned by a firm and that allow the creation of value for consumers). Throughout this project, we also analyse which are the main capabilities required of firms involved in systems integration to carry out their role in the systems integration processes.

The **value chain** is a series of activities that products undergo in order to gain some value, which will result in more value than the sum of the values of each activity. Our research in the different cases will deliver a classification of the different models for how the value chain is organised for building and providing infrastructure services in new urban areas (the different positions firms occupy in the value chain).

Last but not least, **competitive advantage** is the position a firm occupies against its competitors. A firm possesses a sustainable competitive advantage when no other firm has been able to imitate their processes or reach its position in the value chain.

When it comes to the core of the project, the purpose of this work is to answer to a series of research questions and develop proper answers after a thorough analysis. As it
has already been outlined, the main question would be to understand what *systems integration is in both the design and business fields* and how these two applications of the systems integrated approach are related to the planning and development processes of delivering urban integrated solutions. Once this has been considered, the logical question to answer is why system integration is a good approach for urban planning; trying to define which are *the advantages and disadvantages of systems integration with respect to other more conventional methods*, which are the expectations and which are the outcomes obtained till now in these processes.

However, the most important point of this project is to understand which *the role played by firms* is in innovation processes related to urban planning, to analyse which kind of firms they are and which new business models they have to develop to deliver urban integrated solutions. In this analysis, it is therefore really important to study the fundamental *capabilities* that are required for them to go through this process.

Another important issue would be to understand the reason why these firms are venturing into this business and examine what they get from systems integration and what the system gets. In a wider vision of the application of systems integration, it is essential to analyse the relationships between the different firms that take part in the development of the project. Hence, we are looking for any new *partnership structures* in the study cases that may be helpful to achieve integrated urban infrastructure solutions, understanding the reason for its appearance and the possible advantage or disadvantages of creating them.

A quite generic question may also arise at the end of this work due to the novelty of the processes we are studying. We should get a wide understanding of *why innovation is important* in the kind of processes that take place in our study cases and for the firms themselves. It is also aimed to investigate who is responsible for it and what is needed to get it. A good way to understand the benefits of innovation processes is imagining the same case in the situation of not including these innovative processes or solutions and realising what could not have been achieved without them.

Finally, after all that has been said here, the main goals of this project could be outlined in five main points:

- Review systems approach literature related to business, engineering and urban planning processes and especially that related with firms venturing into systems integration (both as a design process and as a firm’s strategic business activity).
- Assess when the two types of systems integration (in design and as a strategic business activity) go together and which are the specific circumstances in which this happens.
- Create a comprehensive overview of cases already experimenting with planning and use of integrated urban infrastructure solutions (expectations, outcomes, partnership arrangements…) and developing a typology of such cases.
- Set out clearly the role played by firms through systems integration innovation processes and identify the capabilities they need and the different Business Models produced to deliver integrated solutions for urban planning. This will be
1. Preface and objectives

exemplified by 4 cases: 22@ Barcelona (Spain), Hammarby Sjostad in Stockholm (Sweden), Gallions Park in London (UK) and Ashford in Kent (UK).

- Identify the main problems (barriers) and enablers of these processes and of firms venturing into integrated solutions for urban infrastructure change.

To finish with the introduction to this thesis, it is important to point out that a *glossary* has been included at the end of this work for the better understanding of the content of these pages. The glossary includes those words that could be difficult to understand and that are important for the reader to get a full comprehension of what has been developed in this thesis. The words included in the glossary are set in alphabetical order and are marked throughout the text with the (*) mark.
2. Important business concepts for the understanding of systems integration

In this section, some important business concepts are defined so that the systems integration theory can be fully explained and the subsequent analysis of cases can be properly developed. Although these are very basic skills for seasoned business dealers, the engineering technical background in which the presentation of this thesis is set (with very basic skills in business), makes this brief introduction to these concepts necessary for a full understanding of its content.

2.1. Business Model

Business models are conceived as a focusing device that mediates between technology and economic value creation. The role of the business model is to commercialise technology in a way that allows firms to capture value from their technology investments. “The business model provides a coherent framework that takes technological characteristics and potentials as inputs and converts them through costumers and markets into economic outputs”. (Chesbrough, Rosenbloom, 2002)

From the definition of a Business Model developed by Chesbrough, we can understand that the Business Model is the tool that mediates between the technical and economic domains, selecting and filtering technologies, and packaging them into particular configurations to be offered to a chosen target market, ensuring that the technological core of the innovation delivers value to the consumer.

The main functions of a Business Model (Chesbrough, Rosenbloom, 2002) can be described as follows:

- **Articulate the value proposition**, i.e. the value created for users by the offering based on the technology.
- **Identify a market segment**, i.e. the users to whom the technology is useful and for what purpose, and specify the revenue generation mechanisms for the firm.
- **Define the structure of the value chain** within the firm required to create and distribute the offering, and determine the complementary assets* needed to support the firm’s position in this chain.
- **Estimate the cost structure and profit potential** of producing the offering, given the value proposition and value chain structure chosen.
- **Describe the position of the firm** within the value network linking suppliers and customers, including identification of potential complementors and competitors
- **Formulate the competitive strategy** by which the innovating firm will gain and hold advantage over rivals (competitive advantage).

The initial Business Model may be a hypothesis for how to deliver value to the customer and it may develop through a process of sequential adaptation to new information and possibilities. When technological change requires it, new business models have to be developed. Identifying and executing a new or different business
model is an entrepreneurial act, requiring insight to both technological and market environments.

2.2. Firm capabilities

In common language, a capability is the ability to perform actions. When we are referring to a business framework, a capability may be understood as the power or ability to generate an outcome based in a certain competitive advantage. It is therefore all the knowledge and organisational skills that enable a firm to develop a product or to offer a certain service. Capabilities can also be defined as the appropriate knowledge, experience and skills to produce something (Richardson, 1972). As outlined by Markiewicz (2004), in the context of innovative performance, the relevant capabilities of a firm include internally focused capabilities, such as the expertise of firm researchers and organizational routines that promote creativity or knowledge sharing, and externally focused capabilities, such as the ability of the firm to identify and integrate knowledge from outside the firm.

Some economic historians and management scholars like Penrose (1959) have argued that firms grow depending on the management of their resources. This is when the concept of firm’s capabilities is important. “The key concept which we need to use to explain the beginnings and growth of modern industrial enterprises is that of organizational capabilities. These capabilities were created during the learning process involved in bringing a new or greatly improved technology on steam, in coming to know the requirements of markets for new or improved products, the availability and reliability of suppliers, the intricacies of recruiting and training managers and workers.” (Chandler, 1992, p. 487).

Penrose thought of firms as bundles of resources bound together by a set of administrative skills or capabilities which are used to deploy them as effectively as possible. These capabilities are considered the basis of the knowledge in firms and are almost always thought of as a collection of skills. Hence, as knowledge is considered as the main reason for the foundation of organizational capabilities, this means that these competencies are not assets* (and do not appear on balance sheets even though they have such an importance), and that they can only be learned or maintained through use and experience. (Geroski, 1998).

Each firm may have been created with some kind of skills or knowledge base and then it may inherit these skills and develop new skills over time with the experience and knowledge acquired. The development of the firm depends on the way firms are able to maintain their capabilities and to renew them with time adapting them to new needs.

Penrose (1959) stresses the importance of continuous maintenance of firms’ existing capabilities and knowledge bases in protecting competitive advantage. As outlined by Kor (2004), strategic experimentation is a component of the competitive process, and it is often the key to maintaining the existing capabilities and protection of a current advantage. Indeed, if firms continuously invest in renewing its capabilities via new resource combinations as Penrose (1959) explains, then this firm’s competitive advantage can be sustainable. Teece (1997) claim that rudimentary efforts should be made to identify the dimensions of firm-specific capabilities that can be sources of
2. Important Business Concepts

advantage, and to explain how combinations of competences and resources can be developed, deployed, and protected.

2.3. Value chain

The value chain is a concept from business management that first appeared in Michael Porter’s *Competitive Advantage: Creating and Sustaining Superior Performance* (Porter, 1985), which soon became a best seller and made the concept very popular.

A value chain is a chain of activities that products undergo in order to gain some value. The value that the product may gain after each activity has nothing to do with the cost of the activity itself, but with the final value of the end product after such activity. The chain of activities gives the products more added value than the sum of the added values of all activities.

This framework quickly made its way to the forefront of management because it can be very useful as a powerful analysis tool for strategic planning. The value chain categorizes the generic value-adding activities of an organization into “primary activities” such as inbound logistics, operations (production), outbound logistics, marketing and sales, and services (maintenance) and “support activities” such as administrative infrastructure management, human resource management, information technology and procurement. The costs and value drivers are identified for each value activity and its goal may be to maximize value creation while minimizing costs. One of the most important strategic choices facing a firm is deciding what activities in the value chain should be performed internally and what should be obtained from external suppliers (outsourcing).

The value chain concept can also be extended beyond individual organizations and it can be applied to whole supply chains and distribution networks. The delivery of a mix of products and services to the end customer mobilizes different economic factors, each managing its own value chain. The synchronized interactions of these local value chains create an extended value chain which is named as "value system" (Porter 1985). A value system is a branched concept that connects the different value chains related to particular product: that of a firm's supplier, the firm itself, the firm distribution channels, and the firm's buyers (and could also be extended to the buyers of the buyer’s products, and so on).

Capturing the value generated along the chain is the new approach taken by many management strategists. By exploiting the upstream and downstream information flowing along the value chain, firms may try to bypass the intermediaries creating new business models, or enabling the creation of improvements in its value system.

2.4. Competitive Advantage

Competitive advantage is a position a firm occupies against its competitors. Michael Porter, in *Competitive Advantage: Creating and Sustaining Superior Performance* (1985) identified two forms of competitive advantage: cost advantage and differentiation advantage. Cost advantage happens when a firm delivers the same kind of services as its competitors but at a lower cost; while differentiation advantage occurs when a firm delivers greater services for the same price of its competitors. These two
kinds of advantages are collectively known as positional advantages because they denote the firm's position in its industry as a leader in either superior services or cost. Therefore, Competitive Advantage enables firms to create superior value for its customers and superior profits for itself.

A firm possesses a sustainable competitive advantage when no other firm has been able to imitate their processes or reach its position in the value chain. A Resource-based View supports that a firm which uses its resources to create a sustainable competitive advantage results in the creation of above-normal rents in the long run. The primary factors of competitive advantage are innovation, reputation and relationships.

The basic premise of Penrose work (1959) is that competitive advantage is based on the possession of a few key resources and routines, organizational capabilities or core competencies. A “core competency” could be defined as something which creates value for consumers, is unique (or at least better than that possessed by rivals), durable, generates returns which are appropriable, and it is inimitable (Geroski; 1998).

If competitive advantage is based on the possession of core competencies as defined before, then firms are likely to be heterogeneous (because competencies are unique) and realize different levels of performance (depending on the value created for consumers and the degree of suitability) over long periods of time (because the resources which sustain competencies are durable, and the competencies themselves are difficult to imitate).

Michael Porter, at Harvard University, created a widely used scheme for analyzing organizations competitive position. He identifies five forces that need to be evaluated to determine whether an organization can maintain a competitive advantage and also to identify potential strategies for the organization to create this Competitive Advantage.

**Figure 1. Porter’s five forces Analysis**
(Source: Helms, 2000)

The Five Force Analysis identifies five forces and then asks for a determination of the level of that force in the specific industry. The five forces are:
2. Important Business Concepts

1. The intensity of the competition among industry competitors
2. The threat of new entrants entering the market
3. The amount of bargaining power* in the hands of the suppliers to the organizations in the industry
4. The amount of bargaining power* in the hands of the customer of the organizations in the industry
5. The threat embodied by potential substitute products to existing products.

The Five Force Analysis begins with identifying the organization’s industry competitors and then evaluating the intensity of the rivalry among those competitors.
3. Introduction to the systems approach

3.1. The systems approach

The systems approach was initially the utilization of a set of methods, techniques and intellectual tools collectively known as systems analysis for complex problem solving. A system is a collection of entities (subsystems) interrelated in a specific way to accomplish a particular objective. The members of the collection are usually termed subsystems. Any system we choose to consider must itself be a collection of objects in a hierarchy. Systems are regularly defined by system boundaries, differentiating a certain system from its surroundings. The system consists of components and relations between the components, forming some sort of whole. The system boundaries are set by the criterion that the components have to be interrelated to be included in the system.

The systems approach is generally applied to large problems whose common characteristic is that they cannot be viewed independently of their environment or context. In fact, the systems approach emerged when scientists and philosophers identified common themes in the approach to managing and organizing complex systems. In the urban environment, we will be studying what can be called “large technical systems” or “systems of systems” (Prencipe, 2005), which can be defined as a collection of distinct but interrelated systems, each performing independent tasks but organised together to achieve a common goal. Large technical systems (LTS) represent the technological, energy, communications and transportation infrastructures of the economy.

In design, the systems approach can be used to reach the optimisation of resources. In order to achieve this, some basic steps such as problem formulation, modelling, analysis & optimisation, and implementation should be followed chronologically. During these processes, it is frequently necessary to collect, organise and use large amounts of data related to both the phenomenon being investigated and its environment. For that reason, these theories are especially useful in large complex multidisciplinary processes such as urban infrastructure planning, which cannot be analysed without taking into account their environment. In spite of the difficulty of this analysis, three ingredients have united to make systems analysis feasible and useful nowadays in urbanism: a substantial improvement of the database on all aspects of the urban environment, a better understanding of land use theories and computational capacity for large-scale modelling. (Lapatra, J.W., 1973)

3.2. Systems integration

Definition: Systems integration involves integrating existing (often disparate) subsystems in order to add value to the system. This is possible because of interactions between subsystems.

3.2.1. Background

Systems integration, as an instrument to integrate tools and components to fulfil an objective, rapidly developed in the 1940s and 1950s in the military arena, and then
spread to the other capital goods* and high-volume industries. During the cold war, the US Government had to create and institutionalize a variety of special organizations and skills that allowed the military to manage effectively the design and development of complex weapon systems. Prime among them there were the systems analysis and integration skills required for building and operating complex weapons, including new project-based organisational structures.

Systems integration was then highly used for data and has been traditionally associated to information treatment (computer systems and software applications). However, nowadays systems integration has evolved beyond its original technical and operational field into an emerging model of industrial organisation whereby firms and groups of firms join together different types of knowledge, skill and activity, as well as hardware, software and human resources to produce new products for the marketplace. Major firms (producing Complex Products and Systems, CoPS*) are increasingly integrators of other firms’ activities.

Evolving from an engineering practice (as part of the wider discipline of systems engineering*) to a strategic business activity, systems integration has become increasingly important for organising networks of production both within and across many high-technology firms. Due to the increasing complexity of organisations and systems, there has been a need to mobilize multidisciplinary teams of engineers and scientists to work together in systems in a way which optimized design, engineering development, production and operations keeping cost under control.

This evolution has led systems integration to encompass a strategic business dimension becoming, therefore, a core capability of many high-technology corporations. Nowadays, systems integration is a strategic task, which pervades* business management not only at the engineering level but also in senior management decision-making (Prencipe, 2003). There have been many drivers for the need of systems integration as a strategic business activity, such as the increasing complexity of technology (products and systems), the rapid pace of market and technological change and the broadening range of knowledge and skills required to produce the product system in question.

3.2.2. Systems integration in design and as a firm’s strategic business activity

As it has already been said before, systems integration can be applied to different fields with slightly different meanings. In the urban environment, we can distinguish two types of systems integration: a systems integrated approach in design and systems integration as a strategic business activity for firms; in this case firms involved in the creation and management of the urban space (which is the evolution of the initial systems integration concept).

Today, urban design practice is developing an integrated approach to a wide range of factors including resources, emissions, health, people, culture and habitat; taking into consideration how the relationships between them can shape the urban form. The objective of an integrated process in urban design is to create places that are physically, socially and economically responsible, which means planning cities in a functional way, maximizing utility, minimizing costs and becoming environmentally-friendly.
Assuming an integrated approach is assessing and developing interconnections between the different systems. One of the ways of revealing these interdependencies and relationships is by establishing virtuous cycles. The relationships between the elements of the built environment are complex; this is why the initial task at the design stage is to identify the most important relationships for a particular situation, which should be considered in the masterplanning process. An integrated approach is assumed when the different organisations managing the different systems meet to plan and find integrated infrastructure solutions for a development. Nowadays, there are also a number of new ways of modelling the different urban systems (including energy and resources); mainly through complex computer models that are being developed to help these difficult processes.

A step further in the process of the creation of urban places is managing the previously found integrated solutions. Management issues must be considered from the start of the project and clear management structures must be identified for each asset* in a masterplan. Thinking at an early stage about how, by and for whom a neighbourhood will be managed opens up the greatest possible range of options (because it may also enable the firms to manage the systems to take part in the design process). Working through the design process with stakeholders* and capacity building improves the chances of securing a good environment. A firm acting as a systems integrator may act both as an integration designer (at least taking part somehow in the decision-making process) and as a service provider (operating and/or maintaining a system). However, the role played by firms in these urban processes hasn’t been much studied till now and proving or denying the connection between these two types of systems integration is part of what is wanted to assess in this thesis.

On the other hand, systems integration as a strategic business activity can be understood as the group of capabilities that enable firms and other actors to define and combine together all the necessary inputs for a system and agree on a path of future systems development. In other words, the way in which firms bring together high-technology components, subsystems, skills, knowledge and technicians to produce a product in competition with other suppliers. “Systems integration refers to the capability to design and integrate internally or externally developed components –product hardware, software and services into a functioning system, while coordinating the activities of internal or external component, subsystems or product manufacturers.” (Davies, A., 2005)

### 3.2.3. The two faces of systems integration

There are two different faces that could be distinguished in system integration activities that could be classified into internal and external activities. Both can be applied to the field we are dealing with, which is the urban environment (planning and design, managing and operating infrastructure systems…). **Internal activities** refer to the integration of inputs needed to produce new products in manufacturing firms (obtaining integrated solutions) or the task of integrating the different subsystems in a complex structure from the point of view of the design in the case of urban planning.

The **external activities** refer to the integration of components, skills and knowledge from other firms, including suppliers, users and partners or organisations to produce
more complex products and services. In our particular case, we can understand external activities of systems integration as the integration and management of the previously found integrated solutions and other services referring to its operation and maintenance, sometimes including the provision of services to products produced externally. These external activities create a profitable business model that derivates from firms acting as systems integrators. (Davies, A., 2004)

### 3.2.4. Firms as system integrators

The analysis of firms acting as system integrators is of capital importance in this thesis, and this is the reason why a whole chapter has been developed to cover this concept. The book “The business of systems integration” (Prencipe, A. et al., 2003) has provided an important source of information in relation to this matter and, therefore, this chapter somehow comprises a brief résumé of its main ideas on firms venturing into systems integration.

In complex systems industries, the provision of integrated solutions is attracting firms to occupy a new base in the value stream centred on systems integration. Integrated solutions are customer-centred combinations of products, services and technology that appeal to the combination of values considered more important for an individual costumer that function in a more effectively way than the sum of the individual elements that comprise it (Steve Bosserman, 2007). These firms are developing novel combinations of service capabilities which will be reviewed later on (operations, business consultancy and finance) required to provide complete solutions to each costumer’s need.

One of systems integrator firm roles is to exploit the technological capabilities which reside in other firms, sometimes in regional clusters (e.g. Silicon Valley). Firms specialising in systems integration are the result of two common characteristics of technical change that have shaped historical forms of industrial organisation: the continuous increase in specialisation in both the production of artefacts and knowledge and the periodic waves of major innovations. These firms concentrate on the knowledge-intensive elements of industrial activities rather than on manufacturing itself. System integrators may work in many fields but the term has generally been used in the information technology (IT) field, the defence industry or in media.

**Systems integrators** are more than assemblers of products, because they design and integrate internally and externally supplied components in a finished product, and coordinate and internally develop the technological knowledge needed for the future generations of products. However, as businesses increasingly outsource the design and production of systems, they need to ensure that they retain sufficient systems integration capabilities in-house in order to outsource effectively.

The diversification of a firm’s activities into a new productive or market base can be achieved through a process of vertical or horizontal integration. **Vertical integration** refers to the combination within a firm of successive stages in the flow of productive activities from raw materials to the final product or service, similar to what happened in most energy companies. Integration can be backwards towards sources of supply (movement upstream) or forwards towards marketing or distribution (movement downstream). **Horizontal integration** refers to the combination of one or more firms in
the same stage of production (basically by mergers or takeovers). In many cases there’s a transition from vertically integrated firms (doing nearly everything in-house) to being the integrator of somebody’s else’s activities by outsourcing the manufacturing of products.

Upstream stages add value to the physical value through technology development and manufacture. Downstream stages add value by performing intangible, service-based activities, such as understanding their customers’ requirements, managing systems integration projects, operating systems and providing services such as customers care, billing, advertising, branding and marketing. When a firm changes position in the value stream, it must develop new capabilities. Firms develop capabilities that fit their particular industries and value-adding stage.

Wise and Baumgartner (1999) argue that firms are moving downstream into the provision of services and solutions to distribute, operate, maintain and finance a product through its life cycle. Suppliers are moving from both downstream and upstream positions to try and capture the higher value territory situated between manufacturing and services. To achieve this, firms are combining products and systems with services (producing integrated solutions) in order to specify, deliver, finance, maintain, support and operate a system throughout its life cycle.

Many firms have abandoned their traditional backward vertical integration strategies to favour specialisation based on the division of labour. Large integrated firms have been concentrating on a few core-activities in the value chain where a firm can gain competitive advantage and outsourcing peripheral activities previously handled in-house.

Trend towards outsourcing and vertical dis-integration has given rise to a new type of specialist organization whose core activity is systems integration. These firms outsource detailed design and manufacture to external suppliers and contact manufacturers while maintaining in-house the systems integration capabilities necessary to coordinate a network of external suppliers.

Some firms moving downstream into integrated solutions have done it from a traditional base in manufacturing and have outsourced a growing proportion of their manufacturing activities and integrated forwards in the value stream. However, other firms have done the same from a base in services. At the same time, many of the world’s largest manufacturing firms, rather than abandoning manufacturing, are moving downstream into services by focusing on maintaining, financing and operating a product during its life cycle. They are repositioning in the value chain to provide high-value services.

By expanding the scope of the product offering to include services, firms find a new business model because they can capture life cycle profits associated with the product and secure more continuous streams of revenue. Integrated solutions, in contrast to product bundling* approaches, comprise product and service components that are customized and priced according to a specific customer’s needs. Integrated solution providers earn high profits when the value of the integrated package exceeds the value of individual components.
3. Introduction to the systems approach

The increasing importance of network forms

A *network* is an organisation having a core firm with both strong and weak ties with constituent members; that is, other firms, research centres, universities, etc.

Network forms of organization are increasingly important as patterns for economic organisation. A systems integrator firm is an organisation that sets up the network and leads it from an organisational and technological point of view. Systems integration capabilities are required for short-term competitive advantage where systems integrators orchestrate the network of suppliers to exploit an existing set of network relationships.

Network benefits include: first, resource sharing that enables firms to combine knowledge skills and physical assets* and second, access to information spillovers in the sense that network relationships act as information conduits through which news about discoveries and failed approaches are exchanged. Firms use collaborations to expand and improve their core competencies.

“Networks also provide capabilities to coordinate behaviour among firms” (Kogut, 2000; p. 408). The firms that lead the network and take a proactive attitude in the care of it are very important for the concept of strategic network. Markets have not emerged as the principal coordinating mechanism of innovative activities. Therefore, firms should develop systems integration capabilities to lead networks and exploit and explore network advantages (Prencipe, 2003).

3.2.4.1. Types of system integrators

There are different types of integrated solution providers along two different dimensions: the *scope of systems integration* (where components are developed) and the *vertical or horizontal spread of industrial activities*.

Firms providing solutions are developing the systems integration capabilities into **two different scopes**: to provide single- and multi-vendor systems. Single-vendor systems are “internally” developed technology, components and subsystems by vertically integrated firms (manufacturers that design and integrate components sourced from in-house product divisions, and provide services tied to internally developed technologies and products).

Multi-vendor systems are assembled or integrated from “externally” developed components. The firms involved in these kinds of systems are specialised systems integrators, as they provide services to design, integrate and service components and products manufactured by external suppliers. Literature has highlighted the importance of external sources of components and knowledge for a firm’s competitive advantage.

From the point of view of **industrial activities**, vertically integrated firms offer solutions to customers within a specific industry. Horizontally integrated firms provide integrated solutions to customers across different industries. (Davies, 2004)
3.2.4.2. Firm capabilities needed to gain Competitive Advantage into delivering integrated solutions

Firms are increasingly competing by building on their “core manufacturing capabilities” and integrating forwards into the provision of high-value services that address each customer’s needs. The relevance of external sources of component and knowledge for a firm’s competitive advantage has increased in the last two decades. This is due to two factors: increasing complexity of products (much more components composing them) and the expanding set of component knowledge bases deriving from the increasing specialisation of scientific and technological disciplines.

The traditional sources of competitive advantage in manufacturing -backwards integration, developing superior products, and scale economies*- are no longer sufficient to guarantee competitive success in many industries. Firms producing Complex Product and Systems (CoPS*) do not and cannot develop in-house all the technologies relevant for product design and manufacturing and increasingly adopt outsourcing strategies. Various product systems are key elements of large technical systems (LTS) such as the infrastructure systems that will be studied in our case studies.

Andrew Davies, in the chapter dedicated to integrated solutions in “The Business of Systems Integration” (2003), identifies three “downstream” business models for integrating forwards into services:

- **Embedded services**: service technologies (e.g.: maintenance or fault reporting) that can reduce a customer’s operational and maintenance costs and also provide valuable information on usage patterns to guide improvements in future designs.
- **Comprehensive services**: Offering services related to the product they sale that cannot be embedded in the product itself to finance, operate and maintain a product through its life cycle.
- **Integrated solutions**: To provide products and services together as integrated solutions that address a customer’s needs. The integrated solution package is made by combining products, maintenance, service and financing. Integrated solutions add value by providing different collections of products and services that create unique benefits for each customer.

Suppliers have to identify customer’s business needs and then develop the capabilities to offer products and services that link uniquely well to a customer’s priorities. A close proximity to the customer allows the solution provider to anticipate needs and work jointly in projects to develop and configure new technology, products and services to a customer’s needs. Therefore, these firms are increasing their capabilities to integrate equipment sourced from external manufacturers.

Adopting a customer-centric thinking means that firms have to rethink how value is created from the perspective of their customers; viewing the value chain through the eyes of the customer. This involves gaining a detailed understanding of the activities a customer performs in using and operating a product through its life cycle, from sale to decommissioning*.

Nevertheless, there has not been much research on the typology of the capabilities that firms leading CoPS* develop to integrate and coordinate the work of external sources
such as suppliers, research centres and universities. However, Davies, A., (2004) argue that the types of capabilities required to compete successfully in the provision of integrated solutions basically are a core capability in systems integration and other additional capabilities including operational services, business consulting and financing. These are the capabilities that are going to be used for the analysis of firms in the case studies.

Services in CoPS* are customer-oriented solutions and do not only occur after the product is delivered to the customer but also before and during the delivery. Some phases during the project life cycle include the pre-bid negotiations with a customer; the bid to contract phase; and the project implementation phase involving conceptual design and detailed design, integration and testing, and handover to the customer. This is why some firms have also been encouraged to offer business consultancy and financial services. Services in CoPS* also provide higher margins and recurring revenue streams during part or the whole product life cycle.

1) Systems integration (SI)

To provide customers with physical products that can easily be deployed with services as part of a solution to a customer’s needs, firms are developing systems integration capabilities. Systems integration is primarily interpreted as the ability to understand and integrate the different scientific and technological disciplines underlying the complex product.

Some firms that had been traditionally developing and manufacturing their own components to design and integrate systems are now focusing on just being systems integrators. These firms specialise in the provision of systems integration services using externally designed and produced components and developing little or no technology in-house.

As it has been mentioned before, most systems integrator firms outsource detailed design and manufacturing to specialized suppliers while developing and maintaining in-house systems integration capabilities to coordinate the work of suppliers. To effectively integrate externally developed and manufactured components, systems integrators develop and maintain systems integration capabilities to “compose” what they have “decomposed” (Prencipe, 1997).

Systems integration is the primary coordination mechanism that firms use to compete through innovation. Therefore, SI is not a simple static capability to produce a certain current product, but a distinctive dynamic capability of the leading firms essential for the development of future product generations.

Systems integration is a coordination mechanism of economic activities in-between markets and hierarchies. Firms to compete successfully should develop and maintain systems integration capabilities in order to manage the integration of new components and new technological knowledge developed either in-house or externally.

According to Prencipe in “Corporate Strategy and Systems Integration Capabilities” (2003, pp. 114-129), there are two types of systems integration capabilities: synchronic and diachronic systems integration. **Synchronic systems integration** refers to the
3. Introduction to the systems approach

capabilities required to compete in the short run and specifically to set the product concept design, decompose it in modules, coordinate the network of suppliers, and then recompose the product within a given product architecture.

Diachronic systems integration refers to the capabilities required to compete in the long run and specifically to envisage and move progressively towards different and alternative paths of product architectures to meet evolving customer requirements through the coordination of change across technological fields and organisational boundaries.

2) Operational Services (OS)

The provision of operational services is the second set of core capabilities for providing integrated solutions. Comprehensive services aim to manage, maintain and operate a product through its life cycle from sale to decommissioning*. Suppliers are building on their base in systems integration and crossing the boundary into the provision of services to maintain, renovate and operate products.

As they take over operational activities, suppliers have an incentive to design systems from the start that are reliable and easily maintainable, because if they have to operate them, they will design them in the easiest possible operative way. System designers and service providers operate in a close loop, in which responsibility for operational performance and costs remains in the hands of a single organisation.

![Feedback loops between systems integration and service activities](Source: Prencipe et al., 2003)

As manufacturers develop technology, integrate systems and perform operational services all in one, they are able to create feedback loops within different parts of the same firm that can lead to a virtuous cycle of innovative improvements between systems integration and service activities. These loops will enable these firms to design more reliable and efficient systems in a near future and will probably as well result in easy-to-use and easy-to-maintain products. Pure systems integrators cannot benefit from these feedback loops.
3. Introduction to the systems approach

Business consultancy

Firms are developing their business consultancy capabilities to advise customers on how to plan, design, build, finance, maintain and operate systems. These can be done internally by establishing specialist business consultancy organizations (or by developing a consultancy-based approach within existing business units) or externally by seeking a partnership or joint venture* with a consultancy organization.

Financing

While the growing importance of private finance is generally associated with large public sector PFI* and PPP* projects (we will try to assess if this is true in our case studies), providing vendor financing* and asset* management services in capital-intensive telecom, railway and other large infrastructure systems has also grown in importance in recent years. Vendor financing* is driven by high costs of constructing new systems and asset management is of growing importance for firms seeking to reduce costs and extend the operating life of an installed base of products.

The value stream in CoPS*

In the value stream for CoPS*, the outputs of one value-adding stage are the inputs of the next. Value accumulates at each stage, comprising the overall value stream. Every stage in the value stream leads to the final product or integrated solution (product plus services), and progressively closer to the final consumer. As we can see in the figure next page, the typical stages of the value stream include: manufacture, systems integration, operational services and service provision.

Upstream stages add value to the physical product through technology development and manufacture, understanding their customers’ requirements, managing projects and performing systems integration. After this, there’s the manufacturing-services interface and downstream stages (services) start. Downstream stages add value by performing intangible, service-based activities such as managing and maintaining system operations, customer care, advertising, billing, branding, marketing and other service activities.

Intangible services such as reputation, brand, billing and marketing are now regarded as more central to the competitive success of these customers than designing, building or maintaining the systems on which their services depend.

3.2.4.3. Integrated solutions and firm’s challenges

Suppliers use systems integration to meet user’s demand, so that they sell whole solutions rather than individual products (they provide integrated solutions). Suppliers are moving from both downstream and upstream positions to try to capture the higher value territory situated between manufacturing and services. This is why they try to combine systems with services in order to specify, deliver, finance, maintain, support and operate a system throughout its life cycle.
3. Introduction to the systems approach

Figure 3. Value stream in high-technology capital goods*
(Source: Prencipe, A., 2005)
“Integrated solutions will hold a strong appeal for customers searching for ways of reducing their fixed capital and operating expenses and responding to new opportunities for gaining a competitive advantage.” (Davies, A., 2004) These integrated solutions should be repeatable so that the supplier can get return on the upfront fixed investment.

Moving into integrated solutions provision should be regarded as a big challenge for firms, because being capable of developing a profitable business means that firms have to gain control of the channel to the customer, avoid moving so far downstream that they begin to compete with their customers and manage the risks associated with financing life-cycle solutions. The most challenging thing in this process can be developing the necessary capabilities for this move downstream.

Under the policy of public-private partnerships (PPP*), public projects are financed partly by private firms, while the state shares some of the risk. PFI* and PPP* suppliers perform all the activities along the value from systems integration to services provision, as well as financing and business consultancy services. However, Davies, A. (2003) claims that the firms pioneers in systems integration have been finding difficulties in making money out of PFI* and PPP* contracts.

Attempts to develop a typology of integrated solutions business models (as it is meant to do here) have to account for the variety and frequency of changes in strategies –based on different forms of specialisation and integration- being adopted by the case study firms and the possibility of failure in these endeavours.

3.3. A systems integration approach in the urban environment.

3.3.1 Introduction

Urban design, when developed correctly, can be the basis for the creation of flourishing places which should be well built, well run, well connected and well served, environmentally sensitive, inclusive and safe. These aspects are often interrelated. For example, design and management will have an impact on safety, and well-connected places are more likely to be thriving and active. Urban design has to be based on an integrated thorough understanding of the relationships between the diverse components and functions of the built environment. Nowadays, as it has already been mentioned in the intro to the systems approach, urban design practice is developing an integrated approach to a wide range of factors (the different systems) and studying how the relationships between them can shape the urban form. Although taking into consideration all these aspects in design may seem complex, the application of urban design principles and an integrated approach to the whole system can enable the delivery of quality places.

3.3.2. Infrastructure Systems, innovation and sustainability.

Infrastructure Systems (infrasystems) are large technical systems in society delivering utilities such as water and electricity, making communications and transports possible, managing the gathering and treatment of refuse* and sewage*. Infrasystems mean welfare, convenience and economic growth, but also considerable environmental impacts, which are recently taken into account and willing to be minimized.
As it has just been said, infrastructure systems (infrasystems) are large technical systems (LTS) which are particularly interesting because they have a public character and they are equally accessible for all potential users within the geographical area covered by the system. The LTS approach can be used when large, complex and technology intensive systems are studied and the consideration of the interaction with other systems and the surrounding society is required. These systems are complex in the sense that they are built up from a large number of components – technical and organisational – of various characters.

However, infrasystems are not only sets of technical components. Infrasystems, as public systems, should also be associated with the people, the organisations and the authorities that plan, build, operate, use, and regulate the systems and the economic and legal conditions for the activities when it is being an object of change.

The integration of Large Technical Systems has not been much studied till now; only somehow studied by some historians of technology or sociologists interested in how these systems are shaped by human beings, maybe because of the social desirability of some systems and how policies affect their pace of advance. In Large Technical Systems, apart from manufacturing or service firms, because most of them are public systems, governments, non-governmental organisations and regulatory bodies are also actors involved in the process.

Conscious planning and technical design at certain moments in time are necessary in order to realise the synergies inside the different systems and between them. Here it comes urban planning and design, which can be integrated to deliver systems integrated solutions both in design (solutions obtained by an integrated approach) and as a business model for firms providing services with their products.

Innovation in infrasystems should be seen as innovating towards sustainability and optimisation of resources. The concept of sustainable development summarises the challenges that the world is facing – to manage a global social and economic development, which neither degrades the ecological systems nor exhausts natural resources. Infrastructure systems, as large technical systems with a public character in society, supply, distribute and deliver specialised services, materials and assets* to households, companies and organisations (transports, water & sewage*, energy, waste and communication). Changing infrasystems in a sustainable direction is a great challenge.

A service related change, where the utility remains (as well as service content and quality), and which does not imply any changes in life-style, or great changes in the built environment, seldom meets resistance (e.g. installing water saving WCs). However, when the change also presupposes altered activity patterns or changes in life-style, the resistance usually increases in spite of the fact that the utility generally remains (as we’ll see that happens when trying to change people’s behaviour related to energy savings in some of our cases).

3.3.3. Integrated urban system modelling.

The objective of an integrated design process is to create efficient places that are as easy and cheap to manage as possible and where resources are optimized. This is a challenging thing to do, as it means changing how things work. Creating a successful
3. Introduction to the systems approach

and sustainable place requires an understanding of how all elements of the built environment work together. Considering the relationships between these various parts at the design stage can help to ensure places deliver the required social, environmental and economic objectives. As previously outlined, one of the ways of revealing these interdependencies and relationships is by establishing virtuous cycles.

The relationships between the elements of the built environment are ever more complex. This is the main reason why, at this time, a great need for planners and governments to consider the relative importance and effects of all subsystems has appeared. Therefore, the initial task in the masterplanning process should be to identify the most important relationships for a particular situation before attempting to design and choose management options and plans.

Integrated urban design is about making a whole that is greater than the sum of its parts. To ensure that the beneficial relationships between all elements are maximised, there are some steps that should be followed to integrate urban infrastructure solutions:

- Identify the relationships between the elements of the built environment and how these can help deliver the key objectives and priorities for the project. (workshop sessions with all the stakeholders* at the beginning of the project can help to identify the priorities and could also be used to set objectives).
- Assess the quality of information held on each element and their parameters. Some elements of the scheme can be flexible and others cannot.
- Use the data to develop different design scenarios.

Coordination of the design team is important as design is a multi-disciplinary task and the different disciplines and elements of the design are to work together successfully. Once the data has been obtained, the way the urban environment is modelled can also be of major importance to get better solutions. Recently, a number of new ways of modelling energy and resources have appeared. Complex urban systems can be modelled holistically using a multi-agent based framework, which can also enable us to assess the sustainability of the development designed using a systems approach.

In the urban environment, there are numerous subsystems (such as water, energy, transport, waste, telecoms and other economic and social systems) and their corresponding resources (natural, financial, human or man-made) that should be identified. All of these subsystems and their interrelations can be modelled using multi-agent systems, along with effects of human behaviour, both spatially and temporally, in order to provide planners, developers* and decision-makers with a better platform for understanding the complexities of the urban form.

“Planning, management and policy making for sustainable cities is thus not just about reducing the environmental impacts of cities on surrounding ecosystems, but also ensuring healthy economic growth, citizen satisfaction levels and adequate maintenance, development and redevelopment of infrastructure. In order to put into practice such management visions, a clear understanding of urban systems, their subsystems and interactions is required in order to gauge what effects specific policies or management plans will have on the sustainability of these systems. To allow this to occur, integrated urban modelling and integrated assessment techniques have been suggested as useful tools.” (Deakin et al. 2002).
Recently, some of such tools and models (with varying levels of integration) have emerged to help analysis of urban systems at scales ranging from individual components of housing and infrastructure to the global level.

Despite the large number of decision support tools and models in production, there are still relatively few that integrate water, waste, energy and socioeconomic systems (especially at finer spatial scales, such as housing developments or suburbs). Tools with clear methods of assessing the sustainability of these systems relative to specific goals, under certain policy scenarios or different human behavioural patterns, are even rarer. Integrated modelling and assessment nestled in a cycle can help to achieve appropriate management, especially when the goal of this management is to achieve sustainable development.

### 3.3.4. Managing integrated urban solutions

Management issues must be considered from the start of the project. Clear management structures must be identified for each asset* in a masterplan (public spaces, buildings, water & wastewater, waste, energy, telecoms, mobility…). Thinking at an early stage about how and for whom a neighbourhood will be managed makes its planning more consistent and efficient. Working through the design process with stakeholders and capacity building improves the chances of securing a good environment.

In deciding suitable management options, each asset* should be reviewed to assess the legal obligations, skills and resources required to manage it. Understanding the costs, liabilities* and implications before deciding on the management structure may lead to a successful management choice. Each asset* should be considered against the management options available for: suitability, profitability and capabilities needed for its management & the availability of these. (English Partnerships & Housing Corporation, 2007)

**Water**

Management of water is a key issue, with increasing concerns over flooding and the need to reduce water consumption. Even waste water can be turned into an asset* thanks to good design and management. One example could be sustainable urban drainage systems, that can enhance the landscape and canals can be bought back into use to create attractive waterside locations (as we will see in one of our case studies in Hammarby Sjostad).

Management arrangements are important and therefore, it is important to make a good choice on the most appropriate arrangement depending on the type of service being provided. In most cases these arrangements involve a combination of local authorities, private companies and development trusts. Supply of potable water is subject to statutory control and regulation by licensed water undertakers, usually private companies. Grey water recycling is most likely to be managed at the scale of a neighbourhood or building by a private company or individual. However, due to maintenance costs and liability*, local authorities generally manage surface water drainage where it forms part of the public highway.
3. Introduction to the systems approach

Waste

The challenge with waste is to encourage people to reuse and recycle materials. As we’ll see in some of our study cases, it is not enough just designing convenient places for people to take their recycling, they should be encouraged to recycle by raising public awareness of the importance of their action and taught what to do to be environmentally friendly. Management depends on the type of waste. In most cases the process is managed by a combination of local authorities, private companies and development trusts. Sorting materials and composting is generally managed by individuals, which is why waste collection and treatment is so challenging.

Due to the extension of this utility, local authorities or private companies generally take responsibility for managing facilities (except for where waste recycling facilities are integrated into buildings). Where communities have an aspiration to promote more sustainable waste strategies, development trusts are sometimes able to take responsibility for community composting and recycling through a devolved management agreement.

Energy

Energy service companies (ESCOs*) or multi-utility service companies (MUSCOs) can be set up to create and operate low-carbon, resource-efficient energy (like in our study case Gallions Park). Initial costs in infrastructure will be recouped in time through energy sales. They can be managed by a combination of local authorities, private companies and development trusts.

Like water, electricity and gas are generally supplied by licensed undertakers under statutory control and regulation. The supply networks are most often managed by private companies. District supply is generally managed by local authorities, agencies or private companies. In some cases where communities have an aspiration to promote more sustainable strategies, development trusts may take responsibility.

Communications

In the majority of cases, private companies provide technology in new developments and continue to manage the system. Where the technology enables a new neighbourhood to set up an intranet site, a development trust often manages and runs the facility.
4. Case studies

After the previous explanation of concepts and introduction to the systems integration theories, this chapter introduces the four case studies on which a further analysis will be based. These four cases have been chosen because of their innovation whether in the integrated design process or in the role the firms involved play in the provision of integrated solutions, for their innovative business models and their particular capabilities (or even for the implication in both).

The four cases have been studied following the same structure to facilitate the comparison. Each case study starts with the description of the project, explaining which its main features are and also including the way in which it is funded, its aims and expectations and outcomes to date. A special chapter has been dedicated to the integrated solutions obtained and the way they have been integrated, outlining the most outstanding innovations. Then, the barriers and enablers of these innovative processes have also been analysed, followed by a chapter dedicated to the firms involved in the process and their roles in each project.

Each case ends with a final case analysis studying the different partnership structures appearing and the capabilities of firms involved in the process. As it has already been explained before, the main capabilities we are trying to identify in firms moving into the provision of integrated solutions are:

- **Systems integration**: Systems integration refers to the capability to design and integrate internally or externally developed components –product hardware, software and services- into a functioning system, while coordinating the activities of internal or external manufacturers of components, subsystems or products. (Prencipe et al., 2003)

- **Operational services**: Firms with the capability of the provision of services to maintain, renovate and operate products.

- **Business consultancy**: firms that offer advice to customers on how to plan, design, build, finance, maintain and operate systems.

- **Financing**: firms with the capability of providing vendor financing* and asset* management services.

The case analysis ends with an analysis of the business models of the main firms produced to deliver integrated solutions. This structure will be very helpful for the comparison of case studies on chapter 6 and for the subsequent development of a typology of cases.
4.1 Case studies: Barcelona 22@

4.1 Barcelona 22@, the innovation district (Spain)

4.1.1. Description of the project

Location: Poblenou area in Barcelona, Spain

Client: Barcelona City Council

Planning authority: Barcelona City Council

Design team: Masterplan developed by Barcelona Regional and Urbanisme de Barcelona, with Ramon García Bragado as leading member.

Developers*: Several developers chosen by the private land-owners.

Funding body: Shared funding (60% land-owners willing to transform uses, 25% by infrastructure service providers and 15% by the municipality)

Completed: It has no final date, as it is a progressive urban plan.

Figure 4. Aerial view of the future location of the 22@ District.
(Source: Ajuntament de Barcelona. Estat d’execució, June 2008)

Outline

The 22@ project is a regeneration project of 200 ha in Poblenou, an industrial area in Barcelona (Spain) that aims to turn this neighbourhood into a world reference innovation district. Poblenou was a manufacturing quarter created some 200 years ago because of the boom of the textile industry in Catalonia and became obsolete around 50 years ago when industrial activities were still setting there despite now being a quarter in the centre of the city.

At the very beginning, this project was driven by a number of professionals from the private sector that considered that Poblenou, as a former industrial zone and currently quite degraded, should be refurbished to give momentum to the development of the city. This group of professionals called themselves “Cercle Digital” (Digital Circle) and promoted a compact and varied model of city. They proposed to promote the area for the concentration of technological and knowledge firms.

According to the 22@ plan, the district will be refurbished by changing the old land-use regulation that established that this zone should only be used for industrial purposes to the new classification of cohabitation of non-polluting urban activities. To fulfil this purpose, the PGM (Pla General Metropolità or Metropolitan General Plan) of the zone in which 22@ quarter is located has had to be changed to allow these new land uses. This is a urban plan modifying the Pla General (General Plan).
4.1. Case studies: Barcelona 22@

When it comes to the infrastructures, there is a Pla Especial d’Infrastructures (PEI) or Special Plan of Infrastructures that regulates how infrastructures have to be designed in the area (as it happens in the particularity of the galleries of services). Both the modification of the PGM and the PEI result in a Planejament Derivat (Derivate Planning), which is the base for the urban planning of this project. This planning is applied then to elaborate a PMU (Pla de Millora Urbana), which is the urban plan for each block. This process started at the end of 1999 and the modified PGM document was finished in April 2000. After this, the first thing that was done was choosing which of the former industrial buildings should be preserved because of their historical or architectonical importance and make them pay the first urbanization costs to enable them to transform land uses and start financing the process.

Approximately a 30% of the former private and industrial land will be transformed in new public land for equipments, green areas and affordable housing, making possible the cohabitation of these new spaces with the most innovative enterprises in investigation, formation and technology transference centres. 22@ represents an exceptional central urban and metropolitan hub, and it is strategically placed in the Eastern area of town, the part of Barcelona in which the most relevant urban transformation is taking place.

The “@” in the name of the project is related to “@ activities”, which are those activities associated with human talent (knowledge) as a main economic resource, independently of the sector we are referring to. These activities are characterised by their intensive use of information and communication technologies and of physical space, and they offer therefore far more jobs than most traditional economic activities. The 22@Barcelona plan establishes that at least 20% of the functional programme of the landowners’ urban refurbishment project must include such “@ activities” if they wish to make full use of the building potential of their land. The land uses allowed in this case have been expanded to include offices, hotels and light industry, excluding heavy industrial and residential uses (which are specifically forbidden) but for affordable housing (residential purposes are not included in the idea of the project because, even if they can be the most profitable for the land owners, the project driven by the municipality aims to create an economic activity by other means).

The 22@ experience in developing an innovation district can be a model to other districts and is actually being applied in some cities in South America. This project has become a testing model in mixing Urbanism Innovation, Economic Development and Knowledge Society. However, for the systems integration analysis we are interested, we will just focus on the first stage of this process, the physical part which consists of the urban planning, the urban management* and infrastructures planning and installation.

*Urban planning

The 22@Barcelona project does not specify from the very beginning a detailed planning process for each part of the territory. On the contrary, it allows the final image of the transformation to be progressively defined, in line with the specific needs of each individual block project and its surroundings (avoiding any possible traumatic effects on the existing uses and functions of the land).
4.1. Case studies: Barcelona 22@

**Funding**

Once the municipality decided how to transform the zone, they had to decide how to pay for the refurbishment, as they couldn’t take charge of the costs of the operation by themselves, and considered applying a progressive process, with the implementation of the new infrastructure networks with time, following the pace in which the different blocks decided to refurbish.

The possibility of a higher floor area ratio in the land of the 22@ zone owned by privates (so that higher buildings can be built on them; from $2\text{m}^2$ of floor per every $\text{m}^2$ of land to $3\text{m}^2$ of floor per every $\text{m}^2$ of land) and the new land uses for which this land can be used make it more worthy, as the same amount of land becomes more profitable for the owners. In order to make the refurbishment possible, these private owners have to transform their land from the old zoning (22a) to the new one allowing them these new land uses (22@).

For this transformation of the land zoning, these owners have to pay to 22ArrobaBCN,S.A., some refurbishment urbanization costs which will let them perform works to comply with the new zoning. These payments represent approximately a 60% of the total budget and are paid when the re-parceling is approved. The other 40% comes from the municipality (15%) and the infrastructure service providers (25%). The municipality invests this money in building the service nets that depend on it, which cannot be considered urbanization costs. However, to start up the plan the Municipality has to give some money in advance as a catalyst of the project (obviously, this money will be recovered by all the taxes that the companies settling down in the zone will pay). This money will be invested in putting all the installations into place so that the refurbishment is possible (infrastructure has to be created before companies arrive in place).

**Aims & expectations**

With this major Urban Plan, the Barcelona City Council aims to transform Poblenou’s old industrial area in an attraction for first class business, scientific, technological and cultural activities and an international platform for development and creation of enterprises.

The following goals are expected to be achieved to fully fulfil the objectives of this project:

- Broad territorial-planning development, urban-planning management and quality service infrastructures.

- Consolidation of the 22@ clusters (Media, ICT, Biotech and Energy) by attracting and establishing companies and science/tech institutions, providing specific spaces for innovative small and medium-sized enterprises, implementing a landing program for international companies and entrepreneurs and building housing for university students and researchers.

- Reach a significant increase in affordable housing, more public green areas, a plan for mobility and public transport facilities, services and cultural spaces.
4.1. Case studies: Barcelona 22@

**Outcomes**

As explained before, the development of this plan will take some time because of the huge extension of land to transform and the economic and urban promotion that is needed to develop it. In the 2004-2008 periods, 22@Barcelona,S.A. had invested over 91 million Euros in the Special Infrastructure Plan, with a view to refurbishing 50% of the streets of the old industrial areas of Poblenou.

From the spinal columns of networks to be built in order to supply to the newly transformed blocks, 65% have already been built and the rest is about to be finished in the next months. When it comes to solid urban waste, the project of construction of two pneumatic waste collection stations has been awarded and construction has begun for the four Poblenou stations.

The energy network is also being enhanced and the new electrical substation has already been built. The centralized climate control is already supplying from the Fòrum Station to the whole of the Llull-Pujades Llevant PERI* area and the tender to supply the Audiovisual Campus and Central Park has been awarded. Supply to the remainder of the 22@Barcelona area will be developed progressively. All this infrastructure change will result in a fully competitive innovation neighbourhood.

4.1.2. Integrating urban infrastructure solutions

A new infrastructure plan has been developed by the Municipality in order to endow the neighbourhood with the most modern and competitive technologies: energy and telecommunication networks, centralized climate control system and pneumatic selective garbage collection. The Municipality has instructed to Barcelona Regional, a partly public owned company specialised in urban planning, to draft this new plan of infrastructures for the 22@ zone. This planning has resulted in the new PEI (Pla especial d’infrastructures), “Special Infrastructure Plan”, that has evaluated the heterogeneity of the out-of-date services and networks existing now in the area and supports the special need for the planning of new infrastructures and technologies (such as those relative to telecommunications, waste treatment and water sewage*) to cater for the new needs of the firms settling in the area and to let them develop their activities at a maximum level.

The design of these new networks prioritizes the energy efficiency and the responsible management of natural resources and allows the introduction of important improvements in urban services and utilities: new optical fibre grids, new centralized climate control system (DH&C), a new power grid & a new mobility plan or the WiFi project. Hence, during this process it has been taken into consideration the creation of a global infrastructure model: more rational, more efficient and environmentally friendly for the city.

For this reason, an integrated vision has been used to develop the different network propositions for the plan: the needs for each service have been determined and an integrated solution has been given, getting scale benefits, synergies and a diminished citizen impact. The different service companies have been contacted during the design of the infrastructures so that the Municipality could make sure they agreed in the way this planning was taking place and to ensure they would supply for the zone, making
them aware of the new methods used in this case and getting to an agreement so that they can’t do any allegations in the public exposition period. However, these companies haven’t been much involved in the design process because, being natural monopolies, they are quite reluctant to innovate in the way services are installed or the way they provide services because they have their own normalised system of working and it is the easier and more profitable way to work for them.

![Example of underground galleries of services going into different blocks](Source: Barcelona City Council; June 2008)

However, to implement the new services, planners have had to face an important problem regarding the cohabitation of the new service nets with the old ones still providing services to those blocks pending to refurbish. In order to solve the problem of the collapsed space under the sidewalks, an integrated design solution has been reached when considering installing the new nets under the carriageway, equidistant to the different blocks and placing them all together in galleries that connect the underground floors of the buildings. Therefore, every building in the block can intercept the gallery at one point and take the different services into the building. This solution is suitable for those services using cables (energy, telecommunications…), but not for those using pipes (water, for example, because it generates thrust and has several mechanical problems that make it not suitable to be in the same place with other services).

**Infrastructure networks**

These are the main infrastructure changes and improvements described in the plan:

- **Electricity:** Thanks to the agreements signed previously with the energy company allowing for the renovation of the entire network, renovations are underway and a new substation has been constructed to supply the whole area.

- **Centralised climate control:** In Barcelona, the local authority requested the renovation of the heating and cooling distribution network in line with the city's Sustainable Development Policy. The implementation of sustainable solutions proved to be a challenge. The 22@Barcelona Centralised Climate Control Project uses the Districlima technology, which is a heat and cooling centralized system that produces heat (heating and hot water) and cool for the Forum building and 22@ areas. This infrastructure saves 20% in energy consumption and is already being used in several European countries. This system uses the waste treated in the solid waste treatment plant in the nearby Besós
mouth to transform them into cold or hot air which is conducted through the area by underground ducts.

- **Solid urban waste**: The project and construction of two pneumatic waste collection stations (construction has already begun for one of them) and the project for the corresponding networks have been awarded. Pneumatic waste collection networks for the four Poblenou stations are under construction, and the construction of a selective waste collection green point and cleaning park has been provided for. The pneumatic waste collection system is managed by ENVAC and Ros Roca depending on the location of the plants (giving continuity to the existing plants in Vila Olímpica and Forum) and to minimize inversions risk.

- **Water**: The existing network is being strengthened and improved.
- **Gas supply**: The existing grid is being extended, up-graded and enhanced.

- **Telecommunications**: New fibre optic cable telecommunications networks are under construction (this new network allows free competency as the cable can be used by different companies to deliver telecommunication services). At the same time, the sites for the radio communications (mobile telephony) aerials have been decided upon for those areas with approved plans.

- **Public space and mobility**: The roadway network is being constructed following a hierarchy that establishes a series of primary streets as the main hubs of mobility and secondary streets for local traffic. The need for car park space is being resolved and new areas for loading and unloading established. All the traffic control systems and street lighting is being renewed and improved. New cycle lanes have been defined and constructed. Land has been reserved for the extension of the FGC railway network (Ferrocarrils de la Generalitat) and new concourses opened at the Metro stations (underground).

![Figure 6. Current state of infrastructure network works where the spinal columns of services can be observed.](Source: Barcelona City Council; June 2008)
Of the above mentioned services, some of them are provided as central elements (providing services to more than one block). These services are:

- Electrical substation
- Centralised Climate Control
- Pneumatic Waste Collection Stations.
- Cleaning Centre.
- Selective Waste Collection green point.
- Central Hubs of Telecommunications

**Centralised Climate Control**

The District Heating and Cooling system (DH&C), being an experimental technology, has proved some benefits and some constraints. For customers, it means a 20% reduction in costs compared to traditional solutions and the noise created by traditional heating systems reduced. Energy generated by the incineration of urban waste has been utilised, with no additional impact in terms of CO2 emissions and a 50% primary energy saving has been achieved. The use of sea water to cool refrigeration units eliminates cooling towers and the risks of legionella.

However, it has also been quite difficult to put the new network into practice because first of all, it was essential to ensure that the technology was compatible with the Barcelona Sustainable Action plan (also known as “Barcelona Renovable 2004”) and then it was needed to maintain a regular dialogue with all the stakeholders*. Apart from this, the main constraint for the implementation of this technology is the huge investment needed for building both the plant and the distribution network, which has to be completely done before providing the service. This investment is therefore seen as risky by financiers because of the long period needed to recoup the inversion and the possible delays in the development of demand for provision of the utility service.

**Innovation and sustainability**

In this project innovation lies in the way services have been distributed (distribution of services in galleries beyond the carriageway or the fact of displacing the transformation centres, typically placed in each building, to a room placed underground by the urban planner for each three buildings). Innovation has also been important in the creation of a new service like the Pneumatic Waste Collection or the Centralised Climate Control.

Regarding the new transformation centre location, it ends up being more operational because with one transformation centre it is possible to give service to three buildings and this location makes not necessary to open the sidewalk every time it has to be repaired. Another change to be pointed out is the creation of technique rooms, putting services that were previously in the streets into the buildings. Technique rooms with cupboards in the blocks enable every block to have a certain space where all services go through. The main advantage of this redistribution is that services have been internalized in the buildings, which grants the free access to them so that the different companies can provide their services easier, leaving the sidewalks and streets free of service nets collapsing them and making reparations cheaper and easier (because now it’s not necessary to make works to open the streets).
In the case of the service providers, innovation is also related in some way to sustainability. When these companies innovate (or we want them to innovate), it’s most of the times because we seek an optimisation of resources. In this case, sustainability has been inherent to the process because creating infrastructures as sustainable as possible has always been a main objective of the plan: it aims to reduce the ecological footprint of the territory and improve its economical sustainability. During the refurbishment, recycled materials have been used and other sustainable activities (such as using tyres in the pavements) that had been learnt along the years have also been applied.

One example may be the Centralised Climate Control, which also integrates solar thermal plates in the roofs that absorb the heat and recirculates it to the plant. When the galleries to put the services are built, the impact that works have on the streets is also being reduced, because this way it’s not necessary to open the sidewalk to repair a service (this could be probably seen as civil sustainability rather than energetic sustainability). Finally, the politics into the attraction of the companies of @ activities can also be seen as sustainable as it promotes an economical activity to sustain the territory.

4.1.3. Barriers and enablers

- Enablers

  • The role of Municipality

The pushing role of the Municipality has been very important for the development of the project. Only by legislating is possible to make people comply with the specific rules of the project.
4.1. Case studies: Barcelona 22@

- **Dimensions of the project**

The dimensions of the project have made easier to overcome some difficulties related to profitability of inversions and have encouraged companies to invest.

- **Barriers**

  - **Infrastructure deployment**

One main logistic barrier in the development of the process has been the way infrastructures have to arrive in place. There are 115 blocks which are not owned by the Municipality and can be refurbished in different moments (or not refurbished at all) depending on the plan for each block, which is made by the land owners depending on what they consider better for their interests. This represents some 35km of streets that have to be filled with services. The planning of the infrastructures is quite difficult as it isn’t known “a priori” the order in which they are transforming. The solution has been to design some spinal columns of services so close to the first refurbished blocks that any other block willing to be transformed, can have a service net nearby.

  - **Firms’ resistance to change and innovation**

Another difficulty was to convince the people of the different companies to work for the 22@ project in operating and managing the innovative ways of services, because this particularisation of cases is not profitable for them as a result of their industrialisation and their normalised own way of doing things. In this case, at the end they agreed to apply all these innovations because the amount of service to be built and operated was big enough and the overexploitation cost was very small. But at the end, if someone wants to carry out an innovative idea in service providing, it is the Municipality that has to pay more to make it happen (which means everyone is paying for it through taxes).

  - **Sharing new knowledge**

Apart from the problems with the service provider companies, there has also been a problem with the architects and engineers to explain and teach the new ways in which things are done in the zone. In this particular case, the distribution of services is not the regular one as described in the building standards, so it requires an additional effort in learning and understanding how these innovations work. And this has not always been easy, as an additional effort is required.

### 4.1.4. Firms and public partners involved in the project

#### Firms managing infrastructure networks

Before proceeding to the analysis of the roles of firms in this process, a table summarising the firms directly involved in the management and/or design of the main infrastructure systems in the project has been developed, linking these firms with the infrastructure solutions they operate:
4.1. Case studies: Barcelona 22@

Table 1. Infrastructure solutions and firms involved in 22@Barcelona

<table>
<thead>
<tr>
<th>System</th>
<th>Infrastructure solutions</th>
<th>Firms involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>- Renovation of electrical network</td>
<td>- Fecsa-Endesa</td>
</tr>
<tr>
<td></td>
<td>- Centralised climate control</td>
<td>- Districlima</td>
</tr>
<tr>
<td></td>
<td>- Improvement of gas supply network</td>
<td>- Gas Natural</td>
</tr>
<tr>
<td>Waste</td>
<td>- 4 pneumatic waste collection stations</td>
<td>- ENVAC</td>
</tr>
<tr>
<td></td>
<td>- Selective waste collection green point and cleaning park</td>
<td>- Ros Roca</td>
</tr>
<tr>
<td>Water &amp; Sewage*</td>
<td>- Improvement of the water and sewerage existing network</td>
<td>- AGBAR (Aigües de Barcelona)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CLABSA (sewerage)</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>- Fibre optic cable communications.</td>
<td>- Telefonica</td>
</tr>
<tr>
<td></td>
<td>- New sites for radio aerial communications.</td>
<td>- Localret (representing alternative operators to Telefonica)</td>
</tr>
<tr>
<td>Mobility</td>
<td>- Hierarchy roadway network</td>
<td>- 22@Barcelona,S.A.</td>
</tr>
<tr>
<td></td>
<td>- Parking spaces</td>
<td>- Institut Municipal d’informàtica.</td>
</tr>
<tr>
<td></td>
<td>- Renewed traffic control systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- New cycle lanes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- New tube station</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Infrastructure solutions and firms involved in 22@Barcelona

Analysis of the role that firms and public partners play in the process

For the analysis of the roles played by firms involved in this process, a review of what each firm does and of the direct implication of the firm in the project has been summarised as follows:
4.1. Case studies: Barcelona 22@

a) Public Administrations

- Ajuntament de Barcelona (Barcelona City Council)

Barcelona City Council approved this project in 2000 in order to transform a great part of Poblenou’s industrial zone of Barcelona into an innovative productive district. This has been qualified both as a urban refurbishment and an economic and social revitalisation project. In order to develop this project, the City Council created the 22 ARROBA BCN, S.A. Company.

- 22 ARROBA BCN, S.A.

22ArrobaBCN,S.A. is a mercantile corporation created and owned by the City of Barcelona (Ajuntament de Barcelona) that has been set up to supervise and manage the 22@ project. It has been literally created aiming to “develop and execute all types of urban-planning initiatives in the industrial and production areas of the city of Barcelona that have 22@ and related designations”. Basically, its aim is to push the process of transformation of the quarter from the public sector to mobilize the private owners (as the vast majority of the land belongs to private owners) and firms and promote the area both nationally and internationally. At the same time, 22ArrobaBCN, S.A., is meant to stimulate the creation of new businesses and activities related to information and communication technology.

Creating a limited company (S.A.) by the municipality is reasonable because, as mentioned by Miquel Barceló (the former president of 22@BCN,S.A.) in the interview we had, the legal framework is better for this kind of company than for the municipality, especially when it comes to contracting experts (on the one hand they don’t have to sit an examination as they should if they wanted to work for the Municipality, and on the other hand they can offer services to enable them to generate revenues to fund themselves). Hence, this company is funded 50% by the municipality and 50% by providing consulting services to people out of the Municipality.

Another reason for creating this kind of corporation is because of management capacity. In this project, 2 million m² of land have to be managed. The municipality is not capable of managing a refurbishment process of this magnitude because of the amount of planning and urban management* it requires (this is not the specific role for which it has been dimensioned). But the 22ArrobaBCN, S.A. has not only been created to absorb this management but also to promote physically and economically the refurbishment process (initially, it was focused on the urban planning and building processes but, as the process goes on, there’s more people in charge of the economical promotion of the plan, the occupation of buildings and the promotion of innovation activities). This is the reason why it also provides technical services in both architecture and engineering and other activities related to technical advice.

22@Barcelona Corporation also acts as an economic development agency, as it actively participates in the economic promotion of the district and of the international projection of its entrepreneurial, scientific and teaching activities. For this purpose, as it is mentioned on its official website, it leads diverse projects and offers its firms different support services, such as:
4.1. Case studies: Barcelona 22@

- The Business and Institution Association 22@Network: serving as a point of encounter for the “@” activity for firms and institutions established in the district and other co-operators.
- Consultancy services with respect to the choice of site.
- Companion service on arrival to the 22@Barcelona district for all national and international companies.
- UGAP Programme (Aids management unit to projects), assisting companies settled in 22@Barcelona on the different public funding sources.
- Integration in the different professional networks and associations.
- Programme of corporate conferences and encounters.
- Participation in social events.
- Support for companies to research financing (pilot period complete).

![Figure 8. 22@ Barcelona innovation district area.](Source: Barcelona City Council, June 2008)

- Barcelona Regional:

  **General Profile:**

  Barcelona Regional is the Catalan Agency of Urban and Infrastructure Development which is partly of public ownership. It provides technical services for reflection, consultation and action in the areas of infrastructure and urban development in the metropolitan area of Barcelona.

  **Role in 22@:**

  Barcelona Regional has been in charge of developing the PEI (Special Infrastructure Plan) for the 22@ area. Therefore, this urban planning consulting firm has designed the whole infrastructure system of the area.

  **b) Energy companies**

  - FECSA – ENDESA
4.1. Case studies: Barcelona 22@

General Profile:

Fecsa-Endesa is the biggest electric company in Spain and the first private electric company in Iberoamerica. It is also an important electric operator in the European Mediterranean area. It has also a growing presence in the Spanish market in natural gas and in developing renewable energies.

Endesa Spain is organised in four different societies: Endesa Generation, Endesa Network (transport and distribution of electricity), Endesa Energy (energy services and supply in the liberalized sector) and Endesa Services (IT and management services).

Role in 22@:

Fecsa-Endesa is the firm responsible for providing energy to the whole area of the 22@ plan. The existing network has been renovated and they are managing a new electrical power distribution substation that has been constructed to supply the whole area.

- Gas Natural

General Profile:

Gas Natural is an energy multi-national, leader in the gas sector in Spain and Latin America, the world's fourth biggest gas transporter by volume, and one of the biggest operators of combined cycle generating plants in the world. The firm basically offers gas distribution & gas supply, and in 2004, the group entered the natural gas production business with the objective of establishing a presence throughout the entire value chain. It aims to grow from a leading gas company into a vertically integrated international natural gas and liquid natural gas (LNG) operator.

Role in 22@:

Gas Natural is in charge of the gas grid, which is being extended, up-graded and improved.

c) Water & sewage* companies

- AGBAR

General Profile:

Agbar Water comprises a number of companies engaged in the integrated management of the water cycle (the collection, transport, treatment and distribution of drinking water; the collection, treatment and reuse of sewage*, and its return to nature with a minimum environmental impact). Furthermore, the search for new sources of water (mainly through the desalination and regeneration of seawater) and integrated management of the different resources have become key aspects of the current water management process.

Through its holding group, Agbar also currently provides services aimed at satisfying its customer's needs and in which capturing savings and obtaining synergies are a priority.
4.1. Case studies: Barcelona 22@

These services are delivered in the following areas: supply chain services, information and telecommunications systems, remote control systems and specialised services (such as operational management of work centres or definition, management and execution of projects for new construction).

**Role in 22@:**

In 22@, Agbar is in charge of managing the water network, which is being strengthened and improved. It has also had an important role in the foundation of the Districlima Company to provide a centralised heat and cooling system.

**D) Waste companies**

- **Ros Roca**

**General Profile:**

The multinational company Ros Roca focuses its activities on the manufacturing of capital goods* and on the design and development of engineering systems and processes with environmental applications. Apart from the manufacturing of capital goods* which covers the entire waste collection and treatment cycle (truck-mounted compactor collectors, road cleaning machinery and sewer cleaning equipment), Ros Roca has also developed in recent years up-to-date systems for the treatment of all types of waste within its own R&D departments.

Currently, Ros Roca is designing and constructing throughout Europe numerous projects for waste selection, composting and transfer along with the most advanced technologies in bio-anaerobic digestion plants and slurry treatment in order to obtain electricity and gas, through an environmentally clean process. It has been especially successful in the creation, development and execution in-house of a new system of municipal solid waste collection through pneumatic transportation.

**Role in 22@:**

Ros Roca is a municipal concessionary* company in Barcelona managing the waste collection in the city. In the 22@ area, it is in charge of operating and maintaining pneumatic one part of the solid waste collection system (the rest is done by ENVAC) and the transport of waste to the treatment plant.

- **ENVAC**

**General Profile:**

Envac is the global market leader in automated waste collection. They develop and sell underground network systems for transportation of municipal and commercial waste. The company takes full responsibility from the planning phase to the installation including the operation and maintenance of the waste collection system (it has a systems integrated business model). Envac also plays an active part in teaching the users how to use the system and how to separate waste according to national standards and regulations.
“With the Envac solution the collection and transportation of waste is fully automated, safe and environmentally advantageous. The installation of an Envac system leads to a drastic reduction of road transportation of waste, improved hygiene and enhanced occupational health and safety standards. The Envac waste collection system supports source separation.” (Envac Official Website)

**Role in 22@:**

Envac is in charge of an existing and a new-built pneumatic waste collection stations. It has planned and installed the system and is in charge of operating and maintaining the waste collection system.

**Districlima**

**General Profile:**

The SUEZ Group entity "Elyo Iberica" was awarded the contract of the cooling and heating network system in Barcelona as part of a joint venture* with its partners Aguas de Barcelona and Axima (SUEZ Energie Services). Districlima was founded at the end of the works with Elyo Iberica, Aguas de Barcelona and public entities (Town Hall of Barcelona, and the local and national energy agencies).

**Role in 22@:**

Districlima was created in a partnership structure between Elyo Iberica (Suez), Agbar, Tersa, and the Spanish government (IDAE on behalf of Ministerio de Economia y Comercio) and local administrations (Insitut Català de Comerç). In this process, Axima (SUEZ Energie Services) carried out the installation works set out in the specifications, such as the heating production plant, storage tanks and an underground distribution network. Aguas de Barcelona (Agbar) was designing and constructing the network extensions and Elyo Iberica was responsible for the sale, technical operation and management of the service. The local authority financed the first phase of the project (2003). Districlima will be providing subsequent investments in the near future (mainly additional equipment and network extensions).

**4.1.5 Case Analysis**

In this case, systems integration was applied into the design at an early stage, when the different service companies (mainly the most affected by the new distribution of services) sat on the same table before the start of the works. These companies were: Telefonica, Localret, Fecsa-Endesa, Agbar and Gas Natural (the two last ones only attending at the beginning of the meeting as the distribution of their services is made through pipes, which were not affected by the new distribution of services in galleries). The building characteristics of all the needed infrastructures were decided by these companies sitting all together in the same table and getting to a mutual agreement. This process took two years and a final document was written specifying the construction specifications of the networks and spaces concerning the 22@ plan. This final document (PEI) is the basis for the way infrastructure is built in the area now.
4.1. Case studies: Barcelona 22@

**Partnership Structures**

Apart from these inter-firm meetings, there haven’t been many other partnership structures appearing. It hasn’t been necessary because these companies aren’t designing any infrastructure in common or giving any service together (except for the Centralized Climate Control system). When there’s a building demanding services in a refurbished block, 22@BCN,S.A. on behalf of the municipality, makes an agreement with all the service companies involved in the process to make works all in one (building the galleries and putting services at one time, so that works are only done once). They pay these works and the municipality gives the work to do to a contractor*. Sometimes there are some problems because some companies don’t want the Municipality to do certain works for them. Therefore, we could say that 22@BCN,S.A. is somehow the integrator and coordinator of all the processes and systems involved in this project.

In this case, the main problem with utility companies is that most of these companies are natural monopolies or municipal concessions*, which means that they were the only companies that could provide the service in the area and, therefore, they have no competition. According to Ramón Sagarra, the infrastructure manager in 22@, the partnership structure became fashionable when the liberalization* of services had to take place, but nowadays, this liberalization* is not real in Spain because these companies have no competition and then, these partnership structures don’t make much sense.

For the conception of the Centralised Climate Control, a joint venture* was created. In the foundation of Districlima, local authorities, Elyo Iberica, Aguas de Barcelona (Agbar) and Axima partnered so as to ensure to the communities an environmental-friendly heating and cooling system. This partnership was necessary in order to obtain the needed capabilities to design, build and operate the new system (which is by itself an integrated solution).

**Capabilities analysis of companies related to the design and operation of the whole system**

As it has previously been outlined in the objectives of this thesis, one of the aims of this analysis is to identify the needed capabilities of firms involved in the urban planning and management processes. Based on the role played by the firms involved in the 22@ project, this is the result of the analysis which lists the different capabilities required for the firms to carry out their corresponding duties in the project. It has been tried to associate the roles played by the different firms with the capabilities outlined by Andrew Davies in “The Business of Systems Integration” (2003) for the provision of integrated solutions in each case as follows:

- 22arrobaBCN, S.A.
  - **Systems Integration:** It is managing and integrating all the processes in the refurbishment project. It is not a component systems integration (like CoPS firms) but an integrator of processes and systems.
  - **Business Consultancy:** The Company provides consultancy services with respect to the choice of site and companion service on arrival. It also provides technical services in both architecture and engineering and other activities related to technical advice.
4.1. Case studies: Barcelona 22@

- **Financing**: it provides assistance for companies settled in 22@Barcelona on the different public funding sources, as well as support for companies to research financing.

  **Barcelona Regional**

  - **Systems integration**: Barcelona Regional is the masterplanner; in this case it has developed and designed an infrastructure plan for the area that integrates the different infrastructure networks (subsystems).
  - **Business Consultancy**: Barcelona Regional is also somehow giving advice on how to plan, design, build and operate the different systems (infrastructure networks).

- **FECSA – ENDESA**

  - **Systems integration**: It designs and integrates internally and externally supplied components in a finished product (both the energy network and energy as a product itself). When it comes to energy, Fecsa-Endesa is a vertically integrated firm (as most energy companies are), because it combines within a firm the successive stages in the flow of productive activities to provide energy to the customers (from generation to transport and distribution). It is also an integrator of external supplied products when it comes to designing and building the energy stations and the network.
  - **Operational Services**: It operates and maintains the whole energy network in 22@, including the new substation that has been constructed to supply the whole area. It also offers energy, IT and management services.

- **Gas Natural**

  - **Systems integration**: It designs and integrates internally and externally supplied components in a finished product (both the gas network and gas as a product itself). When it comes to natural gas as a product, Gas Natural is quite a vertically integrated firm, because it combines within the firm the successive stages in the flow of productive activities to provide natural gas to the customers (it basically offers gas distribution & gas supply but has also recently entered the natural gas production business with the objective of establishing a presence throughout the entire value chain). It is also an integrator of external supplied products when it comes to designing and building the natural gas network.
  - **Operational Services**: Gas Natural Services sells, installs and maintains gas appliances. In 22@, it operates and maintains the whole natural gas network, which is being extended, up-graded and improved.

- **AGBAR**

  - **Systems integration**: It designs and integrates basically externally supplied components into a finished product (the water network).
  - **Operational Services**: It operates and maintains the whole water network in 22@. Agbar is engaged in the integrated management of the water cycle (the collection, transport, treatment and distribution of drinking water and the collection, treatment and reuse of sewage*, and its return to nature with a minimum environmental impact).
4.1. Case studies: Barcelona 22@

- **Ros Roca**
  - **Systems integration:** the company designs and integrates internally and externally supplied components in a finished product. It focuses its activities on the manufacturing of capital goods* and on the design and development of engineering systems and processes with environmental applications (especially related to waste collection and treatment).
  - **Operational Services:** it takes charge of the operation and maintenance of the waste collection system (transport of the waste to the treatment plants). It will also exploit the new pneumatic waste collection plants in Poblenou, including its operation and maintenance.

- **ENVAC**
  - **Systems integration:** the company takes full responsibility from the planning phase to the installation (it provides turnkey* installations).
  - **Operational services:** it takes charge of the operation and maintenance of the waste collection system together with other services (monitoring of operations, operational supervision, preventive maintenance, service and repairs, spare parts, extensions, modifications, upgrades, long-term total responsibility contracts).

- **Districlima**
  - **Systems integration:** It takes charge of the design and construction of the installation works (Axima) and the design and construction of the network extensions (Agbar).
  - **Operational services:** Districlima also offers sale, technical operation and management of the centralised climate control service (Elyo Iberica).
  - **Financing:** Districlima is involved in a kind of PPP in a 25 year concession where local administrations (Ajuntament de Barcelona and Generalitat de Catalunya) invest around 25% of the overall cost.

The following table summarises the capabilities owned by each of these firms:

<table>
<thead>
<tr>
<th></th>
<th>Systems integration</th>
<th>Operational Services</th>
<th>Business Consultancy</th>
<th>Financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>22ArrobaBCN, S.A.</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Barcelona Regional</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FECSA- ENDESA</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas Natural</td>
<td>X</td>
<td>X</td>
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<td></td>
</tr>
<tr>
<td>AGBAR</td>
<td>X</td>
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<tr>
<td>Ros Roca</td>
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<td></td>
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<tr>
<td>ENVAC</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Districlima</td>
<td>X</td>
<td>X</td>
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<td>X</td>
</tr>
</tbody>
</table>

Table 2. 22@ main firms’ capabilities
**Business Models produced to deliver integrated solutions**

It is also the aim of this thesis to identify the *Business Models* of firms involved in the delivery of integrated solutions for urban planning and to understand how the *value chain* is organised for building and providing infrastructure services in new urban areas. The analysis on the business models just makes sense for the private companies which aim to maximize their revenues (therefore the analysis won’t be done for public administration corporations, which have their own way of funding that has already been reviewed). These are the business models that have been identified for the firms involved in the 22@ project:

- **Fecsa-Endesa**

Fecsa-Endesa follows the traditional energy company *business model* of supplying electricity and gas to customers. Fecsa-Endesa is the monopolistic owner of the electric network. Fecsa is not earning much by lending the use of its network to other energy suppliers; its main revenue source is on building the network, building the transformation centres or getting the energy contracts.

It’s in all these activities around the energy supply that they can earn revenue as a private company. This is why its business model also includes *comprehensive services*, as it offers services related to energy (such as IT and management services) that cannot be embedded in the product itself to finance, operate and maintain the network through its life cycle. It has a vertically integrated scheme because it combines within the firm the successive stages in the flow of productive activities (*value chain*) to provide energy to the customers (from generation to transport and distribution), but uses external components for building the network and energy stations.

In 22 @, Fecsa has experienced a change in the way of funding works, which reverts directly into its business model. For the special characteristics of infrastructure in this case, the payment for the infrastructure network is rationalized and shared between all the land owners of the area (so that the first block refurbishing doesn’t have to pay for the initial infrastructure).

- **Gas Natural**

Gas Natural is also a quite a vertically integrated firm, because it combines within the firm the successive stages in the flow of productive activities to provide natural gas to the customers (it basically offers gas distribution & gas supply but has also recently entered the natural gas production business with the objective of establishing a presence throughout the entire *value chain*). Their business model is quite the same as Fecsa’s, because both are energy suppliers and the market is much regulated. It offers *comprehensive services* related to the maintenance of their assets* and gas appliances.

- **Agbar**

Agbar’s *vertically integrated business model* focuses on the integrated management of the water cycle (the collection, transport, treatment and distribution of drinking water & the collection, treatment and reuse of sewage*, and its return to nature with a minimum environmental impact). It also offers *embedded services* (such as information and
telecommunication systems and remote control systems for the network) and **comprehensive services**, which are services related to water and the water network (such as supply chain services and maintenance) that cannot be embedded in the product itself to finance, operate and maintain the network through its life cycle.

- **Ros Roca**

Ros Roca provides turnkey* solutions, as it focuses its activities on manufacturing capital goods* which are integrated in the design and development of engineering systems and processes with environmental applications. It also takes charge of the related services of operation and maintenance of the supplied systems. It has been especially successful in the creation, development and execution in-house of a new system of municipal solid waste collection through pneumatic transportation. Therefore, its Business Model can be associated with that of **integrated solutions**, providing products or systems and services together as integrated solutions that address a customer’s needs.

- **Envac**

Envac also provides turnkey* solutions that combine the design, installation, maintenance and service of the pneumatic waste collection system. Therefore, its Business Model can also be associated with that of **integrated solutions**. Each Envac system is unique and customised (one of integrated solutions particularities is that they are customer-centric), although based on standardised, quality-assured basic solutions. The systems are built using a number of well-proven key components and design criteria.

- **Districlima**

Districlima takes charge of the design and construction of the installation works and of the network extensions, and it offers as well **comprehensive services** (such as technical operation and management of the centralised climate control service), which also means that it has a vertical integrated business model. Fully amortizing the investments and paying for the operation costs offering a good price and service to the final customers is possible thanks to the wholesale* purchase conditions for fuels and the energetic savings this technology represents.
4.2. Hammarby Sjostad, Stockholm (Sweden)

4.2.1. Description of the project

**Location:** Stockholm, Sweden

**Client:** City Planning Bureau and Land Bureau, City of Stockholm

**Design team:** Masterplan developed by Stockholm City Planning Bureau, with Jan Inghe-Hagström as lead architect.

**Planning authority:** City of Stockholm

**Developers***: The City is responsible for appointing development consortia for each of the twelve sub-districts. Different teams of developers and architects take forward development on identified blocks. Over 30 different developers have been identified. Key developers are Skanska, Family Housing, Swedish Housing, HSB, SKB and Borätt.

**Funding body:** The City of Stockholm, Stockholm Transport, the National Road Administration and private funding.

**Contract value:** Estimated at private investment of 20 billion Swedish Kronor in 2002 (approx. 2 billion €) and public investment of 5 billion Swedish Kronor out of taxes (450 million € approx.)


Outline

Hammarby Sjostad is one of the vastest projects of development of the municipality of Stockholm as it occupies 200Ha. The initial idea was drawn around 1990, when Stockholm applied for the Summer Olympics 2004, and the municipality wanted to expand the inner city of Stockholm with a focus on water, while converting at the same time an old industrial and harbour area into a modern sustainable neighbourhood.

For this project, the City of Stockholm imposed strict environmental requirements on buildings, water, waste and energy infrastructure, technical installations and the traffic environment. The main reason for the creation of this environmental program was that Hammarby was planned to support Stockholm’s request for hosting the 2004 Olympic Games and the Stockholm City Council was looking very closely at Sydney, which got the Olympics for 2000 partly because of their environmental program. Hence, a specific environmental program was drawn up for this project with the aim of halving the total

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*Figure 9. Aerial View of the north Harbour in Hammarby Sjostad.*
(Source: Lennart Johansson, 2007)
environmental impact in comparison with a district built in the early 1990s. This program outlined environmental solutions for waste, energy, water and sewage*, and was named after the project as the “Hammarby Sjostad eco-cycle” or “Hammarby-model”.

All the characteristics of the buildings, including the street dimensions, block lengths and building heights were designed to take advantage of water views, parks and sunlight. Hammarby Sjöstad’s model is a very strict environment program, which focuses on renewable energy, waste reduction, the use of ecological building materials, and alternative transportation options at the planning and implementation phases. Some features required to meet the Hammarby model are restricted building depths, set backs, balconies and terraces, large glazed areas and green roofs.

Synergies between the three main systems (water & sewage, energy and waste) have been taken into account when developing the model and the district is now famous for its integrated planning approach, where every aspect has been developed with the whole in mind. Energy is produced in a renewable fuel-fired district heating plant in the area. Wastewater is treated; the heat recovered for heating houses and the silt* is converted into biogas in the Henriksdal sewage* plant. The area is also experimenting with on-site sewage* works which plan to extract nutrients from sewage* and wastewater via a new technology for use on farmland. Surface water is treated locally to avoid overloading the sewage* works. Combustible waste in the area is recycled as heat and food waste is composted into land.

Figure 10. View of the storm water canal, Hammarby Sjostad
(Source: Poldermans, 2006)

Funding

The City of Stockholm pays for all the public investments (such as infrastructure, roads or parks). The total sum is very roughly estimated to 5 billion Swedish Crowns and the money comes mostly from Stockholm tax payers. The Local Investment Program (1998-2002) by the Swedish government also provided subsidies to projects that were aimed at energy and resource efficient technologies. From the 635 million Swedish Crowns that were allocated to Stockholm, Hammarby Sjostad shared the
money with two other projects. The private investments in Hammarby Sjostad are approximately estimated to 20 billion Swedish Crowns.

Developers* either buy or lease the land depending on the political colour of the central government – the social democrats favour leasing, the conservatives prefer purchase. They pay the City Council a levy of about 800 Euro per built square metre and a fee to be connected to the utilities. In this way, the city can recoup most of its initial investment. According to Freudenthal, it expects to recover 236m Euro. (Lane, 2007)

Aims & expectations

The main aim of this project is to create a new neighbourhood in a former harbour of Stockholm in the most environmentally friendly way possible. The initial motivation was trying to halve the total environment impact in comparison with a district built in the early 1990’s. Systems integration methodology in design enabled the municipality of Stockholm to reach these goals.

With the current project, the City of Stockholm expects to create an environmentally friendly neighbourhood with the following benefits:

- Lower life cycle costs of system investments.
- More efficient land use.
- Lower maintenance costs.
- Increased property values.
- Improved living satisfaction.
- Lower carbon dioxide emissions and reduced climate change impact.
- Reduction of direct environmental impact, such as air pollution, noise and vibrations, harmful substances, polluted water, sewage* and waste treatment.

Outcomes

The role of the Masterplan in ensuring a strong network of streets and public spaces, and a rounded and sustainable mix of uses, including community uses is particularly impressive. Today, about 75% of the project area is already complete and 10,000 people live in the area. The result obtained in the different sectors can be reviewed as follows (Energie cités, March 2008):

- **Land use**: sanitary redevelopment, reuse and transformation of old brownfield sites into attractive residential areas with beautiful parks and green public spaces. The motto of the Stockholm City Plan 99 is “build the city inwards”; meaning redevelop already used land rather than using virgin land.

- **Energy**: Renewable Energy Sources (RES), biogas products and reuse of waste heat coupled with efficient energy consumption in buildings. 23,000 Tn of sludge treated and 3,500,000 m³ of biogas produced. District heating is supplied to all Hammarby from two main sources: energy recovery from waste incineration and energy recovery from wastewater treatment process. The Combined Heat and Power (CHP) plant provides 70% of the heat requirements of the development; the other 30% comes from heat recovered from waste water.
4.2. Case studies: Hammarby Sjostad

- **Water & sewage**: water as clean and efficient as possible - both input and output – with the aid of new technology for water saving and sewage* treatment (a new wastewater treatment plant has been built in the area).

- **Waste**: thoroughly sorted in practical systems, with material and energy recycling maximised wherever possible. Original waste collection system: individual households dispose of their solid waste into a vacuum-based underground collection system that allows for separating the waste into organic, recyclable and other forms. Combustible garbage is processed and returned to the community as electricity and hot water.

- **Transport**: fast, attractive public transport – tramway, ferry (departure every 10 minutes), combined with cycling paths, car sharing system, individual car parking places are voluntarily limited, ensuring numerous bicycle parking places.

- **Building materials**: healthy, dry and environmentally sound; selected according to the Stockholm ecological construction programme taking into account the whole material life cycle causing limited impact on resources and environment.

- **Economic**: 8.000 jobs have been created and waste collection costs have been reduced.

- **Social**: use of common space, various public and commercial establishments: schools and kindergartens, homes for elderly people, sports facilities, libraries, bookshops, concert hall, hairdressers, restaurants, pharmacies, post offices, etc. The residents' involvement is an important part of the environmental work. The environmental information centre GlashusEtt provides tips, advice and answers on how to use the technology and conserve resources.

**Critics**

The cost of high-valued infrastructure solutions for the building of a sustainable neighbourhood has resulted in high rents for residents (even though prices of apartments on sale stay similar to those in the inner city, they have higher than average monthly management fees). “Critics of the scheme point to its exclusivity and failure to address Stockholm’s problems of segregation. Residents are described as belonging to an ‘economically homogenous’ group, incomes are on average higher than in the Katarina-Sofia city district to which Hammarby Sjöstad belongs” (CABE, 2005).

**4.2.2. Integrating urban infrastructure solutions**

The innovation in this project is that Hammarby Sjöstad project office employed a new methodology under which staff from different administrations and authorities sat in the same premises from the very beginning of the design process. The neighbourhood was masterplanned by Stockholm city council with the utility companies on board at the start. This planning process was unique and resulted in new and integrated environmental solutions where the resources provided by one player were reutilised by another.
Before making the masterplan, the different service firms involved in the process sat down all together to decide how to make the new neighbourhood as environmentally friendly as possible. The city planning department, the development department, the environmental department, the Stockholm Water Company and the Stockholm Energy Company amongst others sat down in the same table and, beforehand, they made the main decisions on how to solve the different infrastructures, which kind of buildings to build, how tall would they be and how services would be provided so that they finally came with the Hammarby Model. Hence, the unique thing in this process is the way to decide how things are done. You start off a project and then you know how all these different parts are going to come in to the building site because it has been decided all together from the beginning for the whole city area.

The infrastructure is done by the city of Stockholm, but there are some other parties that are also involved in that (Stockholm water company, for instance, is one of them because they have installed both the pipes for the drinking water and for the sewed water). Fortum, which is a Finnish energy company, takes care of supplying electricity into the buildings and also of the district heating system. Around 75% of the entire villa and the block of flats and the city of Stockholm are connected to the District Heating System. There are four major plants which are producing the District Heating for the heat in radiators and also for the hot tap water.

When it comes to putting down the infrastructure, it is done by the city of Stockholm. Even if it normally would be up to the developers* to follow an environmental program, in Hammarby, when they fill in the contract to buy the land, they all have to sign a contract about this environmental program and there are some stipulations about energy supply and the other environmental measures.

The way the water and sewage systems work has been going on for a long time in Stockholm, and the District Heating system has been used in a regular basis since the 1970’s but, in this case, an effort in the integration of the systems has been made since the very beginning so that synergies were found between them. The foreign trade commission in Sweden has developed the “Symbio city” model (producing heating or electricity out of incinerating the combustible waste in garbage; how to use a raw material that the city is producing and how to use it in a profitable way), which is focused on holistic city planning (which tries to plan the subsystems bearing in mind that they take part in a system and they behave in relation to the other subsystems, “the whole is more than the sum of its parts”). The model is named after symbiosis, which means finding synergies between urban technology systems that save natural resources and cost less; and it is a clear example of systems integration in design.

The Hammarby Model is the particular holistic model developed for the Hammarby Sjostad neighbourhood following the “Symbio city” model. The model tries to find connections between three main systems such as energy, water & wastewater and waste, finding several integrated solutions that link the three of them and result in a more sustainable resource-optimising model for a city. The unique planning process resulted in new and integrated environmental solutions whereby the resources provided by one player are utilised by another.
4.2. Case studies: Hammarby Sjostad

This model shows the interaction between sewage processing and energy provision, how refuse is handled and the added-values society gains from modern sewage and waste processing systems.

The Hammarby Model

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**Figure 11. The Hammarby Model**  
(Source: Lennart Johansson Infobild, 2007, Hammarby Sjostad leaflet)

The key features of the local ecosystem are:

<table>
<thead>
<tr>
<th>System</th>
<th>Key points</th>
</tr>
</thead>
</table>
| **Energy** | • Combustible waste is converted into district heating and electricity.  
• Biofuel from nature is converted into district heating and electricity.  
• Heat from treated wastewater is converted into district heating and district cooling.  
• Solar cells convert solar energy into electricity.  
• Solar panels utilise solar energy to heat water.  
• Electricity must be a “Good Environmental Choice” product, or equivalent. |
Water & sewage*

- Water consumption is reduced through the use of eco-friendly installations, low flush toilets and air mixer taps.
- A pilot wastewater treatment plant has been built specifically for the area in order to evaluate new sewage* treatment techniques.
- Digestion is used to extract biogas from the sewage* sludge.
- The digested biosolids can be used for fertilisation.
- Rainwater from yards and roofs is drained into Hammarby Sjö, rather than into the wastewater treatment plant.
- Rainwater from streets is treated locally using settling basins and then drained into Hammarby Sjö, rather than being drained into the wastewater treatment plant.

Waste

- An automated waste disposal system with various deposit chutes, a block based system of recycling rooms and an area-based environmental station system help the residents sort their waste.
- Organic waste is converted/digested into biosolids and used as fertiliser.
- Combustible waste is converted into district heating and electricity in a CHP plant.
- All recyclable material is sent for recycling: newspapers, glass, cardboard, metal, etc.
- Hazardous waste is incinerated or recycled.

<table>
<thead>
<tr>
<th>Water &amp; sewage*</th>
<th>Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Water consumption is reduced through the use of eco-friendly installations, low flush toilets and air mixer taps.</td>
<td>• An automated waste disposal system with various deposit chutes, a block based system of recycling rooms and an area-based environmental station system help the residents sort their waste.</td>
</tr>
<tr>
<td>• A pilot wastewater treatment plant has been built specifically for the area in order to evaluate new sewage* treatment techniques.</td>
<td>• Organic waste is converted/digested into biosolids and used as fertiliser.</td>
</tr>
<tr>
<td>• Digestion is used to extract biogas from the sewage* sludge.</td>
<td>• Combustible waste is converted into district heating and electricity in a CHP plant.</td>
</tr>
<tr>
<td>• The digested biosolids can be used for fertilisation.</td>
<td>• All recyclable material is sent for recycling: newspapers, glass, cardboard, metal, etc.</td>
</tr>
<tr>
<td>• Rainwater from yards and roofs is drained into Hammarby Sjö, rather than into the wastewater treatment plant.</td>
<td>• Hazardous waste is incinerated or recycled.</td>
</tr>
<tr>
<td>• Rainwater from streets is treated locally using settling basins and then drained into Hammarby Sjö, rather than being drained into the wastewater treatment plant.</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. New infrastructure in Hammarby for the energy, water & sewage* and waste systems.

Hammarby recognises that environmental performance is not just about design; the development also needs to influence how people use places. An environmental centre has been established at the centre of Hammarby to promote understanding of how residents can help in achieving the city’s environmental aspirations.

4.2.3. Barriers and enablers

- Barriers

  - Decision-making process and getting to an agreement.

  “The systems integration process was quite difficult because it was the first time that all the involved companies sat around the same table. Normally you contact them one by one and in two or three months you get a reply. But here they sat together till they decided how to make this project as sustainable as possible. They were a little bit relaxed at first, they came around it and now we are going to use the experience from Hammarby to new city areas in Stockholm.” (Erik Freudenthal, manager of the Hammarby Sjostad Environmental Project)
4.2. Case studies: Hammarby Sjostad

- Convincing the companies to carry out the new model because of its extra cost and the lack of knowledge on the new technologies

“The companies involved in this process, when they started in 1997 and they found out about this program, they thought they couldn’t do this, that it was too much because they had never done it before. But the City of Stockholm told them that if they wanted to build new blocks of flats in this area they had to follow the program. So finally they did it anyway and today it’s not a problem, because of course this learning process and investment in new knowledge had a cost, but it wasn’t much of a 2-4% extra. Furthermore, materials were better and also more expensive, because they had to be environmentally friendly and reusable as much as possible. For example, aluminium in the roof has to be treated and then there is also an extra cost there” (Erik Freudenthal, manager of the Hammarby Sjostad Environmental Project)

- Communicating with the citizens.

According to the project coordinator at the Glass House, the main challenge for the environmental programme has been establishing contact with residents in order to encourage them to assist the Council in achieving environmental goals.

- Enablers

The Stockholm County Governor, Mats Hellström, stressed in speech “Urban Sustainable Development in Stockholm” (held in March 2004 at the initiative “Swedish Style in Australia 2005”), that the “interaction between legislation, public agencies and business is vital for success in developing sustainable urban areas” (Hellström, 2004). This has happened in Hammarby Sjostad and has enabled the final development of the project.

- The role of the Municipality

It has also been very important for the development of the project the role played by the local government, willing to push this plan and promoting these innovative processes.

- Clear environmental objectives

Clear environmental objectives also enabled development of the Hammarby Model, which shows how the relationship between sewage processing, energy provision and waste handling in this local eco-system can be structured to deliver wider social and environmental benefits.

- The Glass House

The Glass House has been a key point in the communication with citizens to overcome what can be regarded as a main barrier to the development of the process, which is changing the behaviour of people living in this new neighbourhood by raising their awareness of the environmental project.
4.2. Case studies: Hammarby Sjostad

4.2.4. Firms and public partners involved in the project

The Hammarby model was developed by Fortum (a leading energy company in the Nordic countries), Stockholm Water Company and the Stockholm Waste Management Administration using systems integration methodology. However, more firms were involved in this project (both public and private), such as ENVAC (a technological company specialised in waste disposal), SWECO (a consulting services in the fields of engineering, environmental technology and architecture) and the Stockholm Business Region (an Investment Promotion Agency) amongst others.

The main role of the Municipality of Stockholm in Hammarby Sjostad has been leading the masterplanning process and developing the public areas (preparing the land, infrastructure, roads and parks). Six developers* have been involved in Sickla Udde, the first phase of the construction of the Hammarby Sjostad project. Two of them are municipal housing companies, one is the City’s School Office and the last three are private and co-operative developers*. (Andersson, 1994; Svane, 1999).

The City’s Administrations and Companies are the only stakeholders* to be involved in the project through all its phases. So far, three contractors* are involved in the first phase of the project. The same contractor*, Skanska, is appointed by two of the developers*. The same prefabrication system or platform is used by Skanska for both, but technical solutions differ in the details. Another developer* has engaged its own subsidiary company as contractor*. The developers have co-operated in compiling a report, evaluating different technical solutions that might comply with the environmental objectives. This might be regarded as a way of reducing competition, but also of preparing to face competition in the design phase. The report is also an example of the fast shift from a process guided by objectives to a process focusing on technical solutions.

Firms managing infrastructure networks

Before proceeding to the analysis of the roles of firms in this process, a table summarising the firms directly involved in the management and/or design of the main infrastructure systems in the project has been developed, linking these firms with the infrastructure solutions they operate:

<table>
<thead>
<tr>
<th>System</th>
<th>Infrastructure solutions</th>
<th>Firms involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>- District Heating &amp; Cooling</td>
<td>- Fortum</td>
</tr>
<tr>
<td></td>
<td>- Solar cells, solar panels &amp; full cells.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Use of biofuel in nature and combustible waste for electricity generation.</td>
<td></td>
</tr>
</tbody>
</table>
4.2. Case studies: Hammarby Sjostad

Table 4. Infrastructure solutions and firms involved in Hammarby Sjostad

| Waste                                      | - 3-level waste management.  
|                                           | - Building-based separating at source.  
|                                           | - Block-based recycling rooms  
|                                           | - Hazardous waste collection point  
|                                           | - Automated waste disposal system  
|                                           | - Waste Company of the City of Stockholm  
|                                           | - ENVAC  
| Water & Sewage                             | - Test wastewater treatment plant.  
|                                           | - Biogas extracted from sewage* sludge  
|                                           | - Store water treatment  
|                                           | - Green roofs  
|                                           | - Stockholm Vatten  

Analysis of the role that firms and public partners play in the process

For the analysis of the roles played by firms involved in this process, a review of what each firm does and the direct implication of the firm in this project has been summarised as follows:

a) Public Administrations

- Municipality of Stockholm

Role in Hammarby: The main role of the Municipality of Stockholm in Hammarby Sjostad has been leading the master planning process and developing the public areas (preparing the land, infrastructure, roads and parks). The Stockholm Municipality was the land owner of the Hammarby Sjöstad area.

- Stockholm Business Region:

General Profile:

It is the official "Investment Promotion Agency" for the Stockholm region. Together with the subsidiary, Stockholm Visitors Board, it promotes the Stockholm region internationally as one of Europe’s leading locations for business. The company provides business and economic data, assistance, contacts and solutions for foreign business entities that are considering setting up business in Stockholm.
4.2. Case studies: Hammarby Sjöstad

Role in Hammarby:

Its role has been mainly promoting the Hammarby Sjöstad project and its eco-cycle internationally.

b) Energy companies

- Fortum

General Profile:

Fortum is a leading Finnish energy company in the Nordic countries and other parts of the Baltic Rim area. Its activities cover the generation, distribution and sale of electricity and heat as well as the operation and maintenance of power plants.

“Fortum’s competitiveness is characterised by a high level of operational efficiency and a broad customer base. In all our operation we aim at benchmark business performance. Our goal is to create the leading Power and Heat Company and become the energy supplier of choice in the chosen market areas.” (Fortum’s Official website)

Role in Hammarby:

Fortum is one of the creators and promoters of the current Hammarby Model. When the Hammarby Model was being designed, the energy company (now Fortum) was owned by the city of Stockholm and then it was called Stockholm Energy Company. At the end of the 90’s, this company was sold to Fortum, which is still within the organisation for the environmental information centre in Hammarby, as well as in the city, managing the district heating system. Working with several partners, the Group is involved in a series of development projects including solar cells, solar heating, biogas, fuel cells, advanced energy control, and information systems for residents.

Fortum has innovated quite a lot in order to provide Hammarby Sjöstad with quality urban integrated solutions, such as developing the production of biogas in the nearby Henriksdal Sewage* Works. The biogas is produced from sludge from sewage* water coming from properties in Hammarby Sjöstad and is used, in the first instance, for gas cookers in the estate’s apartments, thus creating a closed-cycle solution. The district heating-cooling is another example; cold water, taken from the effluent of the combined heat and power Högdalen plant’s production process, is channelled to the district cooling system.

c) Water & sewage* companies

- Stockholm Water Company (Stockholm Vatten)

General Profile:

Stockholm Vatten produces and delivers drinking water of high quality to about one million people in Stockholm, Huddinge and nine neighbouring municipalities.
4.2. Case studies: Hammarby Sjostad

“Stockholm Vatten actively contributes to a sustainable development of our society in a long-term perspective.” (Stockholm Vatten Official website)

*Role in Hammarby:*

The Stockholm Water Company took part in the initial committee that planned in a multidisciplinary and integrated way the masterplan of infrastructures for the area that resulted in the Hammarby model. It currently supplies all the water in the area (as it is in charge of the pipes for fresh water) and is also responsible for the sewage system. The treatment of the water from the households is based in the local water treatment plant. Rainwater from streets is treated locally using settling basins and then drained into Hammarby Sjö (lake), rather than being drained into the wastewater treatment plant.

d) Waste companies

- **Stockholm Waste Management Administration**

*General Profile:*

In Stockholm, domestic waste is collected by a contractor*, whose services are hired by the City of Stockholm. Domestic waste is used for energy recovery at the Högdalen plant in southern Stockholm. The combustion process produces both heating and electricity. The residual products of the combustion process are slag and ashes. The slag is recycled and the ashes are disposed of in a landfill site. Waste management in Stockholm is financed by a waste collection fee. The fee is outlined in the waste tariff, which is passed by Stockholm City Council.

*Role in Hammarby:*

In Hammarby, the special feature is the pneumatic waste collection system, which is run by Envac (the contractor) with the aid of the Stockholm Waste Management Administration as the municipal partner.

- **ENVAC**

*General Profile:*

The firm’s general profile has already been reviewed in the Barcelona 22@ case, where it is also a firm involved in the management of the waste collection system.

*Role in Hammarby:*

In Hammarby Sjostad, Envac’s underground waste transportation system is a critical part of the district’s sustainability programme. The main features of the Envac systems are: freeing up of space inside and outside buildings, reduction of heavy traffic and reduction of waste management costs. The higher investment cost is offset by the significantly lower operating and maintenance costs, and the considerable space savings.
The property owners in Hammarby Sjostad jointly own the facility through a joint-property association. The City of Stockholm compensates the joint-property association by charging a greatly reduced rate. Envac Service is commissioned by the joint-property associations with the responsibility for operation and maintenance of the facilities.

**Figure 12.** The mobile and stationary ENVAC waste collection pneumatic systems.  
(Source: ENVAC, 2008)

e) Others (masterplanners, developers*, contractors*, consulting firms…)

- SWECO

*General Profile:*

SWECO is the Nordic region's leading knowledge sphere in the fields of engineering, environmental technology and architecture. The tangible results of their work are clean air and pure water, attractive and functional living and working environments, roads and bridges that increase traffic safety and shorten travel time and industries that are efficient, profitable and environmentally adapted.

SWECO provides leading-edge *consulting services* ranging from expert advice in pre-project planning, project support, project preparation and integrated services in design and tender actions to implementation and post-construction. SWECO places great importance on training and technology skill transfer and combines these components into an integral part of international assignments, involving clients as well as associated local consulting firms.
4.2. Case studies: Hammarby Sjostad

Role in Hammarby:

In Hammarby Sjostad, Sweco, applying their concept for sustainable urban development, participated in the planning and design of buildings, parks, streets and wharves, and also in traffic, land, geotechnical, waste management, water and sewage* and gas systems.

- NCC

General Profile:

NCC is one of the leading construction and property development companies in the Nordic region.

Role in Hammarby:

NCC Construction Sverige has been commissioned by Riksbyggen to build 137 apartments at Hammarby Sjöstad in Stockholm.

- Skanska

General Profile:

Skanska is a leading international project development and construction company; one of the world’s leading construction groups with expertise in construction, development of commercial and residential projects and public-private partnerships (PPP*).

“By combining our expertise and financial strength, we develop offices, homes and public-private partnership projects. We create sustainable solutions and aim to be a leader in quality, green construction, work safety and business ethics. Of course, we also aim to maximize the potential of Skanska with regard to returns.” (Skanska Official Website).

Role in Hammarby:

Swedish contractor* Skanska is one of the several developers* building homes in Hammarby Sjöstad. Skanska is in charge of building some lower residential buildings, a 12 floors office building and a 17 floors hotel. Björn Ljungdahl, the company’s district manager for Stockholm, declared to “Building magazine” in the article *Sweden's green utopia* (Lane, 2007), that building homes at Hammarby is not more demanding than elsewhere in Sweden because having the infrastructure in place makes construction “much easier” for the company because they are able to use the same house type at Hammarby as elsewhere.

4.2.5 Case analysis

Hammarby Sjostad case has been chosen for this thesis because of its interesting integrated planning and the resulting environmental model with new infrastructure solutions. Staff from different administrations and authorities sat in the same premises
from the very beginning of the design process, which was unique and resulted in new and integrated environmental solutions. This is also a challenging situation for firms that have to deliver this infrastructure where the resources provided by one player in the water, waste or energy systems are reutilised by another. In this context, these firms have to find a way to deliver integrated solutions for this particular case (which may mean changing their standardised way of working, changing their position in the value chain or modifying their business models).

The Commission for Architecture and the Built Environment (CABE) has been studying the Hammarby Sjostad case and outlines that: “The particular lesson from the Hammarby Sjöstad case study is the powerful role that strong public sector leadership can play in ensuring development of the highest quality. The most striking feature of the area is the similarity between the Masterplan on paper, the aspirations it embodies and the physical environment as it has been developed. To obtain these goals, integrated planning, innovative solutions and new technologies have been necessary”.

**Partnership Structures**

In Hammarby Sjostad, great emphasis is placed on the importance of collaboration and synergistic thinking between diverse actors, each having responsibility for different segments of the closed-loop integrated Hammarby system. The main partners are: the city of Stockholm, environment and health committee of Stockholm, real estate, infrastructure and mobility departments, environmental protection agencies, technical and economic partners (such as building companies, land owners), the Local Investment Programme Council, researchers, urban planning and environmental coordination committee, Stockholm Water Company, Stockholm Waste Management Administration, Fortum (before Birka Energi) or the environmental information centre (GlashusEtt).

The unique partnership between administrations, authorities, architects and developers* has led to numerous innovative environmentally-friendly technical solutions in Hammarby Sjöstad which has been essential for the development of the Hammarby model and for the construction of the whole area. In order to complement the detailed integrated plan, the City planning and design team has prepared a design code for each sub-district, in close partnership with the chosen developers* and architects for each plot.

In Hammarby, Fortum has also been working together with the City of Stockholm and property owners; involving the Group in a series of development new energy technology projects including solar cells, solar heating, biogas, fuel cells, advanced energy control, and information systems for residents. For instance, a solar-cell and fuel-cell system is being installed and evaluated in collaboration with ABB Corporate Research.

GlashusEtt, which is the centre for environmental communication in Hammarby Sjöstad, is also a partnership between the Stockholm Water Company, Fortum, the Stockholm City Development Administration and the Stockholm City Waste Management Administration. The “Hammarby Model”, that binds together the entire environmental programme, was jointly developed by the water, waste and energy companies.
4.2. Case studies: Hammarby Sjostad

Capabilities analysis of companies related to the design and operation of the whole system

Based on the role played by the firms involved in the Hammarby Sjostad project, this is the result of the analysis which lists the different capabilities required for firm to carry out their corresponding duties in the project:

- **Stockholm Business Region:**

  - *Business Consultancy and financing:* The Company provides business and economic data, assistance, contacts and solutions for foreign business entities that are considering setting up business in Stockholm.

- **Fortum**

  - *Systems integration:* It designs and integrates internally and externally supplied components in a finished product (both the energy and district cooling & heating networks and energy as a product itself). Fortum is a vertically integrated firm (as most energy companies are), because it combines within the firm the successive stages in the flow of productive activities to provide energy to the customers (from generation to distribution and sale of electricity and heat). It is also an integrator of external supplied products when it comes to designing and building the energy stations and the network.

  - *Operational services:* Maintenance and operation of Fortum’s four major thermal power plants, which supply Hammarby Sjöstad with district heating and district cooling from treated wastewater and biofuels, managing the district heating system and maintaining the network.

- **Stockholm Water Company (Stockholm Vatten)**

  - *Systems integration:* It designs and integrates basically externally supplied components in a finished product (the water network) to produce and deliver drinking water of high quality.

  - *Operational services:* Maintenance and operation of the facilities needed for the water and sewage systems such as Sjöstadsverket, the experimental wastewater treatment plant and spearhead-projects for new wastewater treatment techniques or the pump station for wastewater.

- **Stockholm Waste Management Administration**

  - *Operational services:* It manages the pneumatic waste collection system together with Envac.

- **ENVAC**

  - *Systems integration:* It is involved in the waste collection system from the planning phase to the installation. It designs and integrates internal and external components to deliver a turnkey installation, where ENVAC (the supplier) is responsible for the
entire set of activities involved in the design, integration, construction, testing and delivery of a fully functioning system.

- **Operational services**: It is also involved in the operation and maintenance of the waste collection system.

- **SWECO**
  
  - **Business consultancy**: It provides leading-edge consulting services ranging from expert advice in pre-project planning, project support, project preparation and integrated services in design and tender actions to implementation and post-construction. In Hammarby they were the main responsible for the design of the urban area and of the different infrastructure systems.

- **NCC**
  
  - **Systems Integration**: As a developer*, it has to design and build the commercial or residential projects for the new development. This process implies integrating externally supplied components into the new development.

- **Skanska**
  
  - **Systems Integration**: Skanska has to design and build the commercial or residential projects for the new development. This process implies integrating externally supplied components into the new development.
  
  - **Financing**: Skanska provides the finance and expertise for development, design, construction and operations by investing in Public Private Partnership (PPP*); companies set up to deliver infrastructure where the need for these facilities outstrips available public sector finance.

The following table summarises the capabilities owned by each of these firms:

<table>
<thead>
<tr>
<th></th>
<th>Systems integration</th>
<th>Operational Services</th>
<th>Business Consultancy</th>
<th>Financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockholm Business Region</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>Fortum</td>
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<tr>
<td>Stockholm Waste Management Adm.</td>
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<tr>
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</table>

*Table 5. Hammarby Sjostad main firms’ capabilities.*
4.2. Case studies: Hammarby Sjostad

**Business Models produced to deliver integrated solutions**

It is also the aim of this thesis to identify the Business Models of firms involved in the delivery of integrated solutions for urban planning and to understand how the value chain is organised for building and providing infrastructure services in new urban areas. The business model analysis is based on what has been reviewed from literature. These are the business models that have been identified for the firms involved in the Hammarby Sjöstad project:

- Fortum

Its business model is based on covering the different stages in the value chain for the energy system: from the generation, distribution and sale of electricity and heat to the operation and maintenance of power plants. It’s also managing the district heating system in Hammarby and has designed the cycle in which the biogas produced from sludge from sewage* water is used for gas cookers in the estate’s apartments.

For these last two solutions, it has to work in partnership with the water and waste companies. In relation to energy generation in Hammarby, there has been a purpose of partly testing the new technology and partly demonstrating methods of building a sustainable city. Fortum is also providing advanced energy control (embedded services) and customer services or information systems for residents (comprehensive services).

- Stockholm Vatten (Stockholm Water Company)

Stockholm Vatten has a vertically integrated business model that focuses in the integrated management of the water cycle as it does in Hammarby Sjostad, where it currently supplies all the water in the area (as it is in charge of the fresh water network) and is also responsible for the sewing system (which is carried out in the local water treatment plant). It offers comprehensive services, which are services related to water and the water network that cannot be embedded in the product itself to finance, operate and maintain the network through its life cycle (such as maintenance of the network and its other assets).

- ENVAC

Envac provides turnkey* solutions that combine the installation, maintenance and service of the pneumatic waste collection system (as it has already been said for the 22@ case), which means that its business model can be identified as that of integrated solutions. It aims to provide products and services together as integrated solutions that address a costumer’s needs. The integrated solution package is made by combining products, maintenance, service and financing. Integrated solutions add value by providing different collections of products and services that create unique benefits for each customer.
4.2. Case studies: Hammarby Sjostad

- SWECO

Sweco acts as a pure consultant in this process. Its *business model* is based on the provision of services (in this case the design of the urban area and the infrastructure systems). The Government outsources to Sweco the technical design because it doesn’t have the necessary capabilities (technical skills) to do it by itself. Sweco can be located in the design phase of the development of the system, at the beginning of the value chain and its main *capability* is business consultancy.

- Skanska

Skanska, as a leading international project development and construction company, has responsibility for acquiring and developing land and makes money out of building commercial and residential projects and public-private partnerships (PPP*).
4.3. Gallions Park, Thames Gateway, London (UK)

4.3.1. Description of the project

Location: London Borough of Newham, England, UK.
Client: CNBQ / London Development Agency (LDA)
Completed: Not yet commenced, awaiting for planning permission. Expected to be completed by 2012.
Design team: Feilden Clegg Bradley (Architects), Arup & ESD – (technical advice)
Developers*: One Gallions Consortium (Crest Nicholson, BioRegional Quintain and Southernhousing Group)
Planning authority: London Thames Gateway Development Corporation.
Funding body: Crest Nicholson BioRegional Quintain (CNBQ)

Outline

Gallions Park is a 1.23 ha brownfield site located in Beckton, in the Borough of Newham (Thames Gateway, London) and at the eastern end of the Royal Albert Dock Basin. This project aims to deliver one of London’s first zero carbon developments since the Mayor’s Energy Strategy was released in 2003. The Code for Sustainable Homes and the Government’s CO\textsubscript{2} reduction targets suppose a hidden revolution for the energy industry and home owners.

There are three key numbers in the targets of the Mayor’s Energy Strategy: reduce by 60\% emissions coming from the built environment by 2050; achieving a 20\% reduction of emissions through onsite renewables and the requirement of new housing to be zero carbon from 2016. None of these targets or economic benefits will be achieved unless action is taken on the ground to implement decentralised energy systems in London.

Somehow, being one of the first zero carbon sites, Gallions Park is meant to prove that it is possible to meet the targets of the London Mayor’s Energy Strategy and to demonstrate that this strategy is not a utopia but can come true. In order to make this happen, a feasibility study was undertaken by ARUP to assess how a low or zero carbon development could be delivered on this site. The conclusions of this study (which are explained in more detail in further chapters) enabled the masterplanners of the project to reach a more sustainable development with a systems approach.

Resulting from this integrated design process, Gallions Park is a 260 residential unit development that includes several earth-friendly features to reduce energy demand by up to 40 percent compared to 2006 Building Regulations. A key element of the zero-carbon strategy is that electricity will be generated on site by a combined heat and power plant (CHP) to generate electricity and provide hot water for heating. This plant
will use bio-mass (such as wood) for its fuel so that the site will produce zero net carbon emissions over the course of a year. The community’s buildings were also planned to create renewable energy through wind turbines on the roofs and photovoltaic panels that convert light into electricity. However, this last innovation is finally unlikely to be carried out due to the costs associated and the lack of suitable wind conditions.

**Funding**

The project will be funded by the developer** Crest Nicholson – BioRegional Quintain (CNBQ). They will need to go out to the market to try and raise capital to deliver this project. At the current time this will prove very challenging as the capital markets are not lending as they were some months ago.

**Aims & expectations**

The main aim of this project is, as we have already said before, achieving a zero carbon development and, even more important, it is expected to demonstrate that zero carbon can be technically and economically viable and built by commercial developers**.

The main principles for achieving a development of this kind are:

- reduce energy demand;
- supply energy from a combined heat and power plant;
- use of renewable sources of energy.

**Outcomes**

No outcome has been achieved yet as, at the time of writing this report, works had not been started. However, the design process had already finished.

### 4.3.2. Integrating urban infrastructure solutions

Gallions Park is a development where the systems integration approach is present in most of the different stages of the process. An integrated resource management tool is used for the feasibility study in design; high technology integrated solutions are applied to meet the tough sustainability objectives; and, finally, also some of the firms in charge of the management of the systems (especially in energy) have used systems integration strategies and structures.

The Integrated Resource Management (IRM) model: an integrated approach in design.

The staff at ARUP, an important engineering consulting firm, claims that sustainable solutions demand holistic thinking. This is the reason why, working in partnership with industry, governments and other organizations, ARUP have developed assessment methods and tools that enable their clients to incorporate sustainability into their business strategies, planning and operations. The IRM is one of these tools.

The IRM approach can be employed to support and evaluate the development of growth and design options for the project in terms of defined indicators and targets developed as part of the sustainability framework. It basically adopts a Life Cycle Assessment
(LCA) approach and applies this to town or city masterplans. The tool was developed in response to Arup’s recognition of the complexities of coordinating and integrating multidisciplinary inputs.

**Figure 15. Iterative processes of evaluation and refinement.**
(Source: National Audit Office, 2007)

It provides a methodology to make more efficient the complex process of masterplanning to achieve the best practicable outcome. It is designed to capture the inputs of design specialists into a common data framework to facilitate inter-disciplinary data exchange between these technical discipline inputs recognising the complex interactions and “feedback loops” resource flow issues that exist in urban systems (as shown in the previous figure). It also assists inter-disciplinary implications to be taken into account.

**Integrated Resource Management (IRM) model – linking and integrating the different technical strands**

**Figure 16. Linking and integrating the different technical strands**
(Source: Mashford, Kerry J. 2006)
In Gallions Park, an Integrated Resource Management (IRM) modelling approach was used to support the assessment of different feasibility scenarios to achieve a good design for the zero carbon development. To meet the project’s objectives, the study focused specifically on CO\textsubscript{2} and other non-CO\textsubscript{2} greenhouse gas emissions arising from different contributions to energy demand. Even if the principle emphasis placed on the strategy was directed towards achieving targets for the building energy use and carbon emissions, the IRM model was used to provide a more holistic view by assessing the relative importance of emissions associated with several other aspects. Some of these aspects could be included in the following kinds of emissions: the embodied energy of construction materials, supply chains or transport patterns.

The study focused on the use of proven technologies and minimising capital costs to ensure the technical solutions proposed gave developers an attractive short-term return on their investment, and concluded that a zero-carbon development at the Gallions Park site was technically feasible and financially viable.

However, this planning would require the buildings on the development being constructed with a high thermal capacity, so that they are cool in summer and warm in winter. The additional cost on this scheme was set somewhere between 5 and 8% over traditional build costs. These costs would be shared between the developer and the energy supply company.

**Local Power: Combined Heat and Power (CHP)**

Combined Heat and Power (CHP) is one of the innovations this project includes. The main feature of the CHP technology is that it produces heat (heating and hot water) and power simultaneously and locally. Its main advantage is that the heat produced by a CHP system is used locally and therefore the overall system efficiency is much greater than if the gas and electricity were supplied separately through grid connections.

The CHP energy solution typically requires only two thirds of the fuel it would be needed in the traditional solution, consequently lowering the carbon intensity of delivered energy:

![Figure 17. Traditional solution vs. CHP energy solution](Source: London ESCO, EDF Energy website, 2007)

With this method of lower carbon intensity of heat and power production, we can reach till a 30% reduction in emissions of CO\textsubscript{2}. Apart from this obvious reduction in emissions, CHP also means a most significant difference for customers. Instead of having traditional heating equipment at home, a small heat exchanger and metering unit...
is the tool in charge of accepting the site-distributed hot water from a central system. In the electricity case, it can either be supplied directly through a special site distribution network or via the common distribution network operator in the usual way, that depending on the size of the development.

The size of CHP units should be determined by detailed analysis of site loads profiles to ensure that the running hours are maximised and investment optimised. For schemes where there is a significant cooling demand, CHP can also supply heat to absorption chillers which will extend the base load demand into the summer months. This is often called tri-generation, as it produces cooling, heat and power.

**Innovation and sustainability.**

These are some of the main innovations One Gallions is featuring:

- Net Zero Carbon
- Biomass CHP
- Talbot air turbine (not 100% certain)
- EcoHomes excellent water standard with water recycling
- Community ESCo*
- Landmark scheme (to demonstrate the viability of zero-carbon developments)
- Public space
- Minimal parking

All homes will feature energy efficient lights, fittings and appliances. It is expected that residents will benefit from savings by using these resources efficiently. However, there are no restrictions in terms of energy or water used.

*Recycling and composting* will be made easy at One Gallions through the provision of on-site waste segregation and composting facilities. As part of a sustainable approach to resource management, support and guidance will be offered to residents to help reduce the amount of waste sent to landfill. Measures will also be implemented to reduce construction waste.

The homes will be specified with water efficient appliances and fittings, such as showers and taps, with the aim to significantly reduce domestic water consumption. Rainwater will be harvested and used within the landscape for irrigation and amenity. Areas of roof and hard landscaping will be designed to attenuate rainfall.

**4.3.3. Barriers and enablers**

- **Barriers**
  
  • *Financing problems*

  The main barrier to this project is currently the state of the financial markets; the ability to raise money to build the project. The sales values that can be achieved have also dropped with the market.
4.3. Case studies: Gallions Park

- Creating new business structures to develop a new technology

There are also technical limits due to the lack of innovation within the biomass CHP market limiting competition. Wherever innovation is present, it is always difficult to convince firms to change their structures or business models unless the new model is proven to be profitable. In this case, this project has been possible thanks to the push of the municipality in supporting this kind of plans, especially by LDA in the creation of the London ESCo*.

- Enablers

- Municipal will and clear objectives

From the beginning, this project has been seen by Ken Livingston as a way to prove that ‘zero carbon’ developments can be commercially and financially viable in the UK.

- Experienced advice and use of integrated design methods.

The feasibility study commissioned to Arup in Gallions Park has been a key point for developing a commercially viable zero carbon development within the Albert Basin. In spite of being a new activity, Arup already has some experience in these kinds of developments as it has also been working in creating the first eco-city in the world in Dongtan, China. In both cases, the IRM model has been a key point to reach the expected goals.

4.3.4. Firms/public partners involved

Firms managing infrastructure networks

Before proceeding to the analysis of the roles of firms in this process, a table summarising the firms directly involved in the management and/or design of the main infrastructure systems in the project has been developed, linking these firms with the infrastructure solutions they operate:

<table>
<thead>
<tr>
<th>System</th>
<th>Infrastructure solutions</th>
<th>Firms involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>- Biomass CHP</td>
<td>- London ESCO*</td>
</tr>
<tr>
<td></td>
<td>- Talbot air turbine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Photovoltaic panels</td>
<td></td>
</tr>
<tr>
<td>Waste</td>
<td>- Local waste collection system</td>
<td>- (yet not decided by the developer*)</td>
</tr>
<tr>
<td></td>
<td>- On-site waste segregation and composting facilities.</td>
<td></td>
</tr>
</tbody>
</table>
4.3. Case studies: Gallions Park

Table 6. Infrastructure solutions and firms involved in Gallions Park

| Water & Sewage* | - Local water & sewage* systems  
|                | - Oversized drainage and rainwater collection  
|                | - Rainwater harvesting & grey water re-use  
|                | - (yet not decided by the developer*) |

Analysis of the role that firms and public partners play in the process

For the analysis of the roles played by firms involved in this process, a review of what each firm does and the direct implication of the firm in the project has been summarised as follows:

a) Public Administrations

- London Development Agency (LDA):

General Profile:

LDA is one of the nine Regional Development Agencies (RDAs), set up by the English Government to transform England's regions through sustainable economic development. As a functional body of the Greater London Authority (GLA), they have a key role to display clear leadership on climate change by implementing practical steps to reduce greenhouse gas emissions and consequently help to achieve targets for carbon dioxide reduction.

In order to support this vision for the city, they produce the Economic Development Strategy for London, which focuses on four priorities: places and infrastructure, supporting people, encouraging business and promoting London. Regarding the places and infrastructure theme, which is the one directly related to our case, LDA is investing in some important developments, such as the 2012 Olympic and Paralympic Games, making great efforts to regenerate the Lower Lea Valley and the wider Thames Gateway.

To help LDA deliver these goals, they work with partners from industry, and the public and voluntary sectors. LDA adds value through playing the role of 'broker' or 'co-ordinator' of economic development activity. They leverage* resources from others in the public, private, voluntary and community sectors and guide the activities of our partners with economic evidence and best practice learning.

Role in Gallions Park:

The role of LDA is helping to deliver the Mayor of London's vision and priorities for London. Its role in Gallions Park has been promoting the project and investing in the development for the provision of sustainable infrastructure solutions (by selling the land...
4.3. Case studies: Gallions Park

to the developer and provide supporting expertise to drive the project forward as envisaged).

They are the land owners and they are working with the chosen development partner, Crest Nicholson Bioregional Quintain (CNBQ), to build and sell the residential units. LDA has been working with CNBQ to ensure that the scheme is Zero Carbon and meets the highest specification. LDA has also been the one to use technical advisers (Arup to assist with the technical negotiations) and legal advisors (Drivers Jonas LLP) to ensure that their contract with CNBQ is suitable.

- London Climate Change Agency (LCCA):

*General Profile:*

London Climate Change Agency Limited is a company wholly owned and controlled by the London Development Agency which was established as the main delivery vehicle for reducing London's carbon dioxide emissions. The objective of the LCCA is to deliver projects that reduce greenhouse gas (mainly carbon dioxide) emissions from London in the sectors of energy, waste, water and transport. The LCCA plays a key role in delivering the Mayor's Climate Change Action Plan and the Mayor's Energy Strategy.

*Role in Gallions Park:*

The LCCA is working with the LDA in identifying LDA development projects in which local decentralised energy systems could be delivered by an ESCO* on a design, finance, build and operate basis.

b) *Energy companies*

- **EDF Energy (London ESCO):**

*General Profile:*

EDF Energy is one of the UK’s largest energy companies and a wholly-owned subsidiary of the EDF Group, one of Europe's largest energy groups. EDF Group's activities include generation, trading, transmission, distribution, supply and other energy services.

The company is organised into three branches:

1. **Customers Branch:** sells energy to their residential, SME and business customers.
2. **Energy Branch:** manages their electricity generating portfolio, and purchases electricity and gas in the energy wholesale* market.
3. **Networks Branch:** runs a centre of excellence for the development, construction and operation of public and private power networks.
The London ESCO (Energy Service Company)

In March 2006, the LCCA selected EDF Energy as the preferred bidder to set up a joint venture* Energy Services Company (ESCO*) whose responsibility is to develop decentralized energy schemes for London. As we have already said, EDF Energy is one of the largest energy companies in the UK and the owner of London Energy and London’s public electricity network.

EDF Energy was selected between 9 energy and utility companies (including two oil companies and a US energy services company) who had submitted bids for being the private sector partner in the London ESCO. The result of this joint venture* is London ESCO Limited, a private limited company with shareholdings jointly owned by the LCCA Ltd (with a 19% shareholding) and EDF Energy (with 81% shareholding), which was subsequently incorporated in September 2006.

Figure 18. London ESCO joint venture*  
(Source: EDF Energy Website, 2008)

London ESCO Limited designs, finances, builds, operates, replaces and maintains the assets* required to provide sustainable energy solutions, including local decentralized energy systems for both new and existing developments while still being competitive with conventional energy sources. It also manages energy services. The company deals with climate change by developing local decentralized energy solutions to London’s power, heating and cooling needs. They are actively seeking to invest in sites across the capital to develop projects and create commercially viable Energy Service Companies (ESCOs*). Investment in sustainable energy technology aims to reduce carbon dioxide and other greenhouse gas emissions, which are contributing to climate change.

To meet these objectives, the London ESCO develops decentralized energy systems for London, targeting low carbon sources to achieve CO₂ emission reductions. Its main technology is the Combined Heat and Power (CHP) that has been previously explained, heat-led co-generation and tri-generation (CCHP) schemes delivering community heating/cooling and power for mixed use new build and refurbished developments. Local distribution networks have been created to supply the heat, power and sometimes cooling to connected customers.

The money saved through reduced energy bills is leveraged to offset the cost of financing, installing, operating, and maintaining the energy efficiency measures. The ESCO is paid through reduced energy bills, typically sharing the energy cost savings over a predetermined length of time, after which all of the energy savings revert to the facility owner. London ESCO contracts are typically for 20 to 30 years to enable such
projects to be suitably financed and to deliver effective, sustainable technical solutions that meet the specifics project requirements, no matter how complex they are. As well as supplying the infrastructure required, London ESCO would provide the full range of billing and customer services functions.

**Role in Gallions Park:**

EDF is the private sector partner in the London ESCO. In Gallions Park, London ESCO Ltd is in charge of designing, financing, building, operating, replacing and maintaining the assets* required to a decentralized energy systems for the new development. Basically, they invest in sustainable energy technology. They supply the infrastructure required as well as provide the full range of billing and customer services functions.

c) **Others (masterplanners, developers*, contractors*, consulting firms…)**

- **Drivers Jonas LLP:**

**General Profile:**

Drivers Jonas LLP is a leading commercial property consultant which acts at the interface between the public and private sectors. Basically, Drivers Jonas experts advise on the life-cycle of property to real estate owners, investors and lenders. Amongst its provision of services, they also include planning, development and specialised sector advice.

**Role in Gallions Park:**

In the Gallions Park case, Drivers Jonas was instructed by the LDA to dispose of the three acre, cleared site in the London Docklands. Supported by a thorough understanding of the sustainability program, Drivers Jonas undertook a national and targeted European marketing campaign proving that Gallions Park will be able to change the way lifestyle impacts on the environment.

As they mention on their official website, their role in this case has included:

- Co-ordinating the Pre-Qualification Questionnaire (PQQ) and the Invitation to Negotiate (ITN) stage of the process.
- Recommending a shortlist of potential developers* to progress to the next stage of selection.
- Managing the relationship between the London Development Agency’s consultancy team and the developer* consortia to ensure the aims of the LDA are met, which required careful negotiation of commercial issues arising from high sustainability standards.
- Liaison with client's legal representative through to completion
4.3. Case studies: Gallions Park

- **ARUP:**

  **General Profile:**

  ARUP is a global firm of designers, engineers, planners and business consultants with an innovative and fully-integrated approach. Arup has three main global business areas: buildings, infrastructure and consulting. Its work is characterized by a multi-disciplinary approach, which means that any given project may involve people from the different sectors in which they operate.

  At present, Arup is one of the rare design firms in the market place that has the skill set and culture to engage in providing holistic sustainable solutions using a multi-disciplinary team including engineers, architects, economists and even psychologists.

  “Helping developments through the planning process and organising the financial and contractual structures of projects is central to our service. Working with a range of developers*, authorities, local development agencies, planners and end users, we are creating a decision-making framework that promotes effective risk management and practical whole life costing.” (ARUP Official Website)

  With the aid of tools like the SPeAR® assessment and IRM modelling, they organise every brief to illustrate whole life cycle costing and minimise risk.

  **Role in Gallions Park:**

  In Gallions Park, Arup were commissioned to establish the feasibility of developing a commercially viable zero carbon development within the Albert Basin. Arup has provided a sustainability strategy, structural, mechanical, electrical and public health engineering, geotechnical engineering, infrastructure and environmental consulting concept design for One Gallions. In this case, they act as pure consultants.

- **BioRegional Quintain**

  **General Profile:**

  BioRegional Quintain is a joint partnership between BioRegional Properties and Quintain Estates and Development PLC. On the one hand, Quintain Estates Quintain is a UK property company comprising fund management, investment and urban regeneration businesses that is helping to regenerate inner city areas by creating new communities around landmark buildings such as the Wembley Stadium and the O2 Arena on the Greenwich Peninsula. On the other hand, BioRegional Properties Ltd, which was founded by eco-entrepreneurs and BioRegional Development Group, is a registered charity.

  BioRegional Quintain is working towards creating sustainable communities across the UK through the application of the One Planet Living® principles to encourage a dynamic and innovative approach to property development. BioRegional Quintain's thinking behind new home developments is based on the experience, skills and capabilities of both parent organisations, which support the delivery of well-designed, truly sustainable communities.
4.3. Case studies: Gallions Park

Role in Gallions Park:

BioRegional Quintain is part of the One Gallions Consortium, which aims to create sustainable communities applying some sustainable measures such as renewable energy, energy efficient architecture, the use of natural and recycled materials, integrated waste management, on-site food growing or sustainable transport measures. As developers* of the zero-carbon scheme, their role is to deliver well-designed sustainable communities. BioRegional Quintain is the result of the thinking, skills and capabilities of both members of the joint-venture.

- Crest Nicholson

General Profile:

Crest Nicholson is a leading developer* of sustainable communities which aims to be the market leader in the design and delivery of sustainable housing and mixed use communities. Crest Nicholson is dedicated to excellence in homes design and construction, quality development locations and customer service provided.

Role in Gallions Park:

The role of Crest Nicholson is the same as BioRegional Quintain as a developer* part of the One Gallions Consortium; building and selling residential units.

- Southern Housing Group

General Profile:

Southern Housing Group is an established housing association in Newham and the Thames Gateway and one of southern England’s largest housing associations. They are in charge of developing quality, affordable housing for rent and home ownership and they manage housing and resident services as well. Southern Housing Group is also dedicated to the regeneration of urban and rural communities due to their firm belief that building communities is as important as building homes.

Role in Gallions Park:

The role of the Southern Housing Group as a developer* part of the One Gallions Consortium is to develop and manage quality affordable housing for rent and ownership.

4.3.5 Case Analysis

Gallions Park was chosen as a case study because of its systems integration approach throughout the different stages of the process: both in the design stage, especially in the use of the IRM for the feasibility study and in delivering the high technology integrated solutions designed to meet the tough sustainability objectives.
4.3. Case studies: Gallions Park

**Partnership Structures**

One Gallions is one of the first developments from Crest Nicholson BioRegional Quintain LLP, a joint venture* company that combines the sustainable community development expertise of BioRegional Quintain Ltd with the home building experience of Crest Nicholson PLC. This is an example of cooperation between companies into the development of a certain outcome.

The LCCA selected EDF Energy as the preferred bidder to set up a joint venture* Energy Services Company (ESCO*) whose responsibility is to develop decentralized energy schemes for London. This is a quite interesting new structure, as the London ESCo is another example of new partnership aiming to supply energy in a decentralised manner. This kind of partnership was born from the need to join companies with complementary skills and capabilities for the realisation of infrastructure related to new technology and sharing investment risks.

**Capabilities analysis of companies related to the design and operation of the whole system**

Based on the role played by the firms involved in the Gallions Park project, this is the result of the analysis which lists the different capabilities required for the firms to carry out their corresponding duties in the project:

- **London Development Agency (LDA):**
  - **Business Consultancy:** LDA helps provide leadership, ideas, resources and investment together with the private, voluntary and community sectors. Basically, they provide supporting expertise to drive the project forward as envisaged
  - **Financing:** LDA adds value through playing the role of 'broker' or 'co-ordinator' of economic development activity. It is also the land-owner of the development area.

- **EDF Energy (London ESCO):**
  - **Systems Integration:** They design, build and supply the infrastructure required from external suppliers for the decentralised energy system for the new development.
  - **Operational Services:** London ESCo operates the decentralized energy system and it also replaces and maintains the assets* it requires. They also provide the full range of billing and customer services functions.
  - **Business Consultancy:** London ESCO has the expertise to make the most of energy efficiency opportunities. It acts as a project manager for a wide range of tasks associated with making energy efficiency improvements.
  - **Financing:** London ESCo finances the assets* for the decentralised energy system.

- **Drivers Jonas LLP:**
  - **Business Consultancy:** Basically it gives advice on certain legal aspects and manages the relationship between the London Development Agency’s consultancy team and the developer* consortia.
4.3. Case studies: Gallions Park

- ARUP:

  - **Systems Integration:** As a technical consultant, it integrates external supplied components into new products to offer solutions to advise customers on how to design systems.
  - **Business Consultancy:** They are consultants in charge of developing a feasibility study on delivering a zero-carbon scheme for the Gallions Park development.

- Crest Nicholson - BioRegional Quintain:

  - **Systems Integration:** As a developer*, it has to design and build the commercial or residential projects for the new development. This process implies integrating externally supplied components into the new development.

- Southern Housing Group:

  - **Systems Integration:** As a developer*, it is in charge of developing (designing and building) quality, affordable housing for rent and home ownership. This process implies integrating externally supplied components into the new development.
  - **Operational Services:** They manage housing and resident services as well.

The following table summarises the capabilities owned by each of these firms:

<table>
<thead>
<tr>
<th></th>
<th>Systems integration</th>
<th>Operational Services</th>
<th>Business Consultancy</th>
<th>Financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDA</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>London ESCo</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Drivers Jonas</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ARUP</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Crest Nicholson - BioReginal Quintain</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern Housing Group</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 7. Gallions Park main firms’ capabilities.**

**Business Models produced to deliver integrated solutions**

It is also the aim of this thesis to identify the Business Models of firms involved in the delivery of integrated solutions for urban planning and to understand how the value chain is organised for building and providing infrastructure services in new urban areas. The business model analysis is based on what has been reviewed from literature. These are the business models that have been identified for the firms involved in the Gallions Park project:
4.3. Case studies: Gallions Park

- London ESCo

The site will use a “Community owned ESCo***”, which will be owned by the residents and managed by London ESCO to provide hot water, heating and electricity. EDF, as part of the London ESCo managing the system, aims to gain revenue in the decentralised energy market due to a change of government policies in London. It is present in all the activities in the value chain (through different companies of the EDF Group) as it designs, builds, finances, operates and maintains energy infrastructure & manages energy services (it owns all the necessary capabilities for the delivery of integrated solutions, to which its Business Model can be associated with).

![Figure 19. London ESCo vertically integrated business model](Source: Hearn, M. 2008)

London ESCo also manages energy and other services including:

- Operation and maintenance of the onsite assets* – daily scheduling of production and managing maintenance.

- Interfacing with the wider energy markets – fuel purchasing for generation assets* e.g., biomass supply; compliance required to participate in energy markets; administration such as obtaining financial benefits such as renewables incentives; trading of top-up and spill electricity.

- Customer billing and support – billing customers for consumption of heat, power and cooling; collecting payments and managing bad debt; providing a customer contact point for billing and maintenance enquiries. In theory the energy costs should be lower and therefore a premium over standard rates may be paid.

This kind of business model focusing on decentralised energy supply is a response to the fact that there isn’t a centralised infrastructure in the UK any more. This role has been all left to private companies which, in the UK free market in gas and electricity supply, find it quite risky to invest in centralised schemes as householders can simply switch to other energy providers.
4.3. Case studies: Gallions Park

- **ARUP**

Arup acts as a pure consultant in this process. Its *business model* is based on the provision of services (in this case a feasibility study). The Government outsources to Arup the development of this technical study because it doesn’t have the necessary capabilities to do it by itself. Arup is located in the first steps in the value chain (in the design phase) and, as it has already been said before, its main capabilities are systems integration (because when designing integrated solutions it integrates external components into products) and business consultancy (providing advice on how to design, build and operate systems).

- **One Gallions Consortium**

The One Gallions Consortium is composed of three developer* companies, which should also be located upstream in the *value chain* of the development (designing and building the development). Unlike utility companies, they are not directly related to the different system networks (the networks are other products that go into the development), but they are designing and building developments compatible with the different urban network systems.

For BioRegional Quintain, their *business model* is network based, collaborative, knowledge focussed and vertically integrated. Crest Nicholson, outlines that its business model is based in different activities: acquire land, obtain planning, deliver the product cost effectively and selling skills and customer services.

For them, this project is definitely more challenging that standard residential development and will undoubtedly cost more to build than a standard scheme. This is a risky business model, because whether purchasers are willing to pay more for a home within the unit will have to been seen.

**The challenge of finding a decentralised energy provision business model**

In Gallions Park, one of the most interesting features from the point of view of both the technical innovation and the business structure is in the energy system with the decentralised energy system by London ESCO joint venture*. A requirement for onsite generation has fundamental implications as it forces a shift towards distributed generation. These targets have also produced a potential infrastructure convergence with developers* considering a change in their business models *moving into the provision of services* and the incumbent energy companies considering a *move into the provision of onsite infrastructure*, across a wider array of services.

By 2016, 100% of each London new residential development’s energy requirements must be generated onsite or by equipment directly connected by private wire to qualify as zero carbon. Therefore, by this time, every developer* engaged in the residential market will need to have decided whether or not they are willing to be an energy player and how they are going to interact with the players in that market if they are not.

When district heating using gas *CHP* become the norm, developers’ responsibilities will not end with installation of equipment such as a district heating system. A model with an element of shared ownership of generation assets* requires that a company is
employed to manage the ongoing operation and billing associated with those assets* (with operational services capabilities like EDF). Energy service companies (ESCos*) will become prevalent to manage the assets* and collect revenue from onsite customers. However, the nature of the relationship (and who carries the risk) between these ESCOs* and developers* needs to be determined.

The traditional energy company *business model* – dual fuel supply to electricity and gas customers – is not compatible with a developing market looking for site-specific solutions that integrate district heating, renewables, and address issues of shared ownership. Some of the large energy companies (like SSE or EdF that we have been looking at) have already set up subsidiaries to deal with housing developments. However the complexities of promoting two inconsistent *business models* may leave companies such as these struggling to adapt. For example, their standard billing systems are not adapted to handle the needs of multiple, non-standard products such as heat and cooling. Like a new entrant, they have to build systems to manage the particular characteristics of housing developments, where each site will have its own mix of products and tariffs reflecting its own generation and customer mix.

![Figure 20. Change from traditional remote generation to distributed generation.](Source: Jones, G. 2008)

Current practice in new developments is for individual sites to procure a mixed group of companies to provide all the services needed to meet the Code for Sustainable Homes, including grey water, potable water, telecoms, electricity, heating and cooling. However separate tendering can make it difficult to cost effectively reduce carbon emissions for a number of reasons:

- Services are generally let on a 25-40 year exclusive contract, which may create new problems by locking in homeowners who have no right to switch electricity suppliers for decades – risking both unhappy customers and a reduction in the value of property.

- Optimal generation from the site will require several different technologies to work together, which can be difficult if providers are competing to maximise profits. A procurement model which aligns suppliers’ interests from the beginning may result in a more integrated energy system that benefits the site as a whole.
4.3. Case studies: Gallions Park

- With locked in contracts and different ownership of generation assets, it becomes necessary to have bespoke management for individual sites, missing the opportunity to provide administration services across a number of developments.

Managing such sites on an integrated basis may instead increase the benefits of onsite generation by managing all resources across the site – and putting in place mechanisms that align incentives with targets and increase community buy-in.

Figure 21. Community ESCO main functions.  
(Source: Hearn, M. 2008)

Therefore, the market solution to these issues appears to be the ESCo, whether that is an independent player or a subsidiary of an established utility which incorporates all the elements of a vertically integrated utility. Separating ownership and management of generation assets enables services to be consolidated across sites, providing economies of scale and reducing administration for the providers of new housing – while allowing for local branding where this can increase community buy-in. The role of the ESCo can also be broadened for it to become the billing agency for other products such as water, telecoms or development service charges. In Gallions Park, how these other products will be tackled with hasn’t been decided yet.

Promoters of housing and multi-use developments are already looking for a single solution for the provision of an increasing range of services from electricity and heat to telecoms, water and waste management (a horizontally integrated structure). To date, no company meets that need. “Given the changing market associated with new housing developments, energy companies must embrace the more flexible ESCo model or risk losing access to new housing business growth” (Jones, 2008).
4.4 Ashford, Kent (UK)

4.4.1. Description of the project

**Location:** Ashford, UK  
**Completed:** 2031  
**Client:** Ashford Borough Council  
**Design team:** GADF Masterplan developed by Urban Initiatives Ltd and Alan Baxter. Ashford Growth developed by Atkins.  
**Delivery Board:** SEEDA, Kent County Council, English Partnerships, Ashford Borough Council, the Environment Agency, The Housing Corporation, the Government Office for the South East (GOSE).  
**Developers**: Main developers are Berkeley Homes, Crest Homes and Taylor Wimpey.  
**Planning authority:** Ashford Borough Council  
**Funding body:** the UK Government (through South East England Development Agency (SEEDA) & English Partnerships

**Contract value:** £1 billion overall infrastructure (1.13 billion Euros approx.)

Outline

Ashford is situated in South East England, between London and the Channel Tunnel. In the 1960s, Ashford was identified as an ‘expanded town’ to accommodate London overspill and then as a growth area in the Kent Structure Plan. It has the fastest growing population in Kent, growing from 79,000 to 105,000 between 1971 and 2002.

Nowadays, in Ashford, a key priority is to respond to national proposals for sustainable growth, which are contained in the Sustainable Communities Plan and regional planning guidance, which propose 31,000 new homes and 29,000 additional jobs in the city by 2031. The Greater Ashford Development Project (GADF) is the masterplan that has been developed to guide the sustainable growth of Ashford the immediate surrounds (that have been proposed as the expanded urban area) for the next thirty years.

**Funding**

The English government already allocated £55 to £60 million (around 65 million Euros) additional public investment in the three years to March 2006 to push prime growth at Ashford. At the same time, the Council also joined with key development stakeholders* to form the Ashford’s Future Partnership. With support from a range of consultants, the Partnership had to produce a masterplan and delivery plans to guide the project.

![Figure 22. Design for the future Ashford growth area](Source: GADF, 2005)
The payment for infrastructure is complicated and depends on the development. The utility companies are responsible for laying services to the development sites and normally the costs are shared between the developer* and the utility provider. The developer recoups his costs through house sales and the utility provider through future income from utility usage. The UK government and its agencies such as SEEDA and The Homes and Communities Agencies (previously English Partnership) might grant or forward fund infrastructure provision where this is necessary to unlock land for development.

SEEDA has set up the East Kent Spatial Development Company (EKSDC) to provide services which are then paid for as development comes forward. This is called forward funding infrastructure and they may be interested in enabling shared provision if this would save costs or speed up delivery. The investment costs are then repaid by the developer* to the EKSDC.

As outlined by Abigail Raymond, the former program director at Ashford’s Future, it is not possible to say at this stage what the likely public sector contribution towards utility provision would be, as it depends on: the ability of others to fund; how much profit there might be in developing the site (its viability) and other funding priorities (i.e. a new road may be needed first before sites can be opened up), which may help overall viability and the ability of developers* themselves to fund infrastructure by removing another constraint. The cost for overall infrastructure (schools, transport or green space) is around £1 billion (1,13 billion Euro). It is estimated that developers* will contribute around £400m (about 452m Euro) of this and utility companies a proportion of that.

Aims & expectations

Ashford Borough Council has established clear and relevant high level aims for the Ashford sustainable growth plan. These principles were agreed by the Council in 2001 and have been summarised in an inspection report from the Audit Commission in 2005 as follows:

- Achieving development in a sustainable way: making the best use of land, encouraging sustainable transport, taking opportunities to minimise waste and encourage recycling.
- Making best use of existing infrastructure and maximising development opportunities in the existing urban area.
- Achieving a urban renaissance at Ashford, including high standards of urban design in new developments.
- Matching housing and employment growth.
- Supporting the wider regeneration of east Kent and other regeneration strategies, including Thames Gateway.
- Respecting environmental constraints including countryside of strategic importance, flood risk areas, water supply limits and air quality standards.
- Protecting village communities from the potential negative effects of development.

It is expected that, by following these principles, Ashford will have the tools to develop in a sustainable manner and will be capable of absorbing the expected growth in the most efficient way possible.
4.4. Case studies: Ashford

Outcomes

The project is still at a very early stage, but in terms of outputs, planning permission has been given in the last 5 years for around 5,000 homes (3,000 completed), while overall Ashford is set to deliver 31,000 homes and 28,000 jobs by 2030.

4.4.2 Integrating urban infrastructure solutions

To enable the growth of the Ashford area, all forms of infrastructure need to be reviewed from a sustainability perspective. The SEA (Strategic Environmental Assessment), which is a report commissioned to Halcrow in 2005, has just been completed, and its conclusions in relation to GADF are being reviewed. This review concludes that traditional infrastructure solutions are insufficient. To meet targets set out in the SEA, the following measures need to be considered:

- Water demand management to maximise efficient use of potable water supplies, including the potential for grey water recycling. A detailed review of options is set out in Black and Veatch’s IWMS: Interim report on system based strategies for mains water.
- Photovoltaics for roofs, street lighting and other street furniture.
- Increasing use of renewable energy sources for electricity generation. EDF is proposing to reinforce the existing Ashford electrical grid with a new cable from Sellinge, but other ‘green’ solutions need to be employed to boost power to the grid.
- Micro CHP and DH.

From these measures, an interesting feature of integrated design in the Ashford Sustainable Growth Plan is the development of an integrated water strategy (AIWS) in which the Ashford Integrated Water Management Study (AIWMS) has been a key point in identifying the main problems and possible solutions.

Ashford’s wastewater infrastructure was already at capacity in some areas in 2005, even if Southern Water was providing the first phase of strategic sewerage upgrades in AMP4\(^1\) (2005 to 2010) which would serve the early phases of growth in Ashford.

The River Stour and the tributaries that flow through Ashford are highly changeable, susceptible to both extreme low flows and severe flooding at various times. Treated wastewater effluent discharging into the Stour almost doubles the river flow at times of low flow, reducing river water quality and adversely impacting its chalk stream ecology.

Ashford Integrated Water Strategy (2006-2031)

The Ashford Integrated Water Strategy outlines how the organisations responsible for planning and managing water will meet Ashford’s challenges when it almost doubles in size by 2031. Water supply, flood risk, wastewater and environmental water quality have all been identified as critical constraints to the sustainability of this growth. This is why the three most challenging delivery issues that threaten the sustainability of the

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\(^1\) The requirements for water companies to implement programmes to improve water quality are written into five-year Asset Management Programme (AMP) cycles, which are approved by government.
Ashford development are: sustainable drainage; water efficiency and demand management; and water quality of the River Stour and its tributaries. The Ashford Integrated Water Strategy (AIWS) aims to provide a framework for partnership action based on broad consensus, which has been found through consultation with Ashford’s Future partners and other key stakeholders*. The Ashford Integrated Water Management Study (AIWMS) was therefore commissioned to assess the constraints to growth that might arise in relation to meeting the demand for potable water; the provision of wastewater services and the impact of treated effluent on the receiving waters; and the management of flood risk as a key part of the AIWS.

Through an integrated approach to water management with innovative thought and strong partnership working this strategy will provide a framework to show how Ashford’s water infrastructure and environment issues can be planned and implemented alongside the spatial planning of a sustainable community. This strategy will be implemented by the Ashford’s Future partnership through the Ashford Integrated Water Strategy Group, which will follow the Programme Cycle stages shown in these figures:

![Figure 23. Ashford Integrated Water Strategy Programme Cycle](Source: Ashford’s Future & Environment Agency, July 2007)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Ashford water examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Consultation, reporting and partnership working</td>
<td>• Ashford Integrated Water Management Strategy</td>
</tr>
</tbody>
</table>
| B     | Problem identification | • Ashford’s Future Study (2002)*
• Ashford Integrated Water Management Study (2005)* |
| C     | Problem analysis, solution identification and pre-feasibility | • Ashford Integrated Water Management Study (2005) |
| D     | Detailed investigation of critical issues and solution feasibility | • Ashford River Health Toolkit (2008/08)
• Ashford SUDS Strategy (2008/07) |
| E     | Pilot of innovative solutions | • Water Renew (2008/08)
• Savings on Tap (2006/10) |
| F     | Detailed design, funding, permissions | • Ashford wastewater treatment works (2005/06) |
| G     | Implementation/construction | • Bewl Reservoir-Ashford pipeline (2005/07) |
| H     | Operation and maintenance | • Water company infrastructure
• Hathfield and Aldington flood storage |
| I     | Monitoring and evaluation | • Waste, energy and water working group (Ashford’s Future)
• Countryside and urban green spaces working group (Ashford’s Future) |

* CAMS – Catchment Abstraction Management Strategy
SUDS – Sustainable Drainage System

![Figure 24. Ashford Integrated Water Strategy Programme activities](Source: Ashford’s Future & Environment Agency, July 2007)
This AIWS strategy will be implemented in a series of five-year steps because this cycle will correspond with the Greater Ashford Development Framework (GADF) and Local Development Framework (LDF) timetables for growth and Southern Water planning periods (AMP), which they intend to influence.

**Integrated Water Management**

Integrated water management is being pioneered in Ashford to balance the competing demands on the water cycle from:

- **Environmental water**: the need to maintain healthy wildlife and ecology in Ashford, the River Stour and its tributaries.

- **Mains water**: this water is taken from the environment by water utilities, treated and piped to customers. After use, customers usually pay a water utility to take away wastewater, often loaded with sewage* and other waste, and treat it before discharging the water back into the environment. The large scale of water movement, infrastructure and public interest means that the system is highly regulated. It has been privatised in England and Wales since 1989.

- **Non-mains water**: many water users, such as industry and agriculture, abstract and discharge water directly from the environment. Although the quantities of water are often much less than mains water, the timing, location and quality of such activities can have a dramatic impact on the other water demands. The diverse and dispersed uses often make non-mains water demand difficult to identify, monitor and regulate.

- **Flood risk and drainage water** – excess water in unwanted places can be a threat to homes, businesses and land through water logging and flooding. If removed, this water may be lost to the other water demands. Drainage responsibilities are dispersed and can affect both flood risk and the chemical and biological quality of receiving watercourses.

**Integrated water management** helps to promote working partnerships between the many organisations with different responsibilities for managing water and it also allows options to be explored. Each may not individually be the best solution, but in combination with others may deliver many benefits for water supply, water quality, flood risk and wildlife.

**Infrastructure Networks**

The infrastructure requirements to support growth in Ashford include:

- Providing community facilities such as schools, libraries etc,
- Increasing transport capacity, including motorway junction improvements and new access roads as well as public transport such as SMARTLINK (services for transporting disadvantaged people and community groups).
- Increasing water supply (a new pipeline is underway and new reservoir is proposed). Water treatment capacity has already been addressed.
- **Energy supply** also needs to be increased and this is being explored with EDF.
4.4. Case studies: Ashford

**Innovation and sustainability**

As the project is still in the first phase, there are some systems that haven’t been yet totally defined. However, Ashford's Future are working on a number of projects to promote energy and water efficiency and are looking at how to promote more sustainable energy to support the new urban extension areas (e.g. Chilmington, which will have 6500 homes).

In the expansion of the sludge recycling centre, that has already been done, new technologies have been applied, such as reusing the methane gas produced in the breakdown organic matter process that is first stored on site in a gas holder and re-used to provide heat for the digestion and drying processes.

Ashford homes will follow the *Eco-Homes scheme*, which is a widely recognised quality assured scheme that independently assesses the environmental performance of a home. It is an easy way to understand the wider environmental concerns of climate change, resource use and impact on wildlife balanced against the need for a high quality of life. It allows developers* the flexibility to achieve better environmental performance of their developments along seven categories of: Energy, Water, Pollution Materials, Transport, Ecology and land use and Health and well-being.

**4.4.3. Barriers and enablers**

- **Barriers**
  
  • *Strategic and social problems of GADF*
    
    ➢ Lacks of robust plans in some areas.
    ➢ It is not clear about the implications of delivering services to an expanded town with a larger and more sophisticated public domain. It does not have a strategy for meeting these resource requirements.
    ➢ Problems in dealing with social inclusion.
    ➢ It lacks a clear plan to ensure that disadvantaged communities benefit fully from the growth proposals.
  
  - **Enablers**
    
    • *The role of the Ashford Borough Council*
      
      The Ashford Borough Council has underlying strengths, experience of handling a growth agenda, effective leadership and a strong track record of achievement in managing the masterplanning exercise. It has also a good understanding of infrastructure requirements and it is starting to consider ways of providing them. It has as well identified the main weaknesses in its current performance and the strategic risks to delivering sustainable growth.
    
    • *Effective partnerships*
      
      Another key point enabling the development of the project is that the Council has been working effectively with partners to address these social and environmental goals.
4.4. Case studies: Ashford

4.4.4. Firms and public partners involved

Firms managing infrastructure networks

Before proceeding to the analysis of the roles of firms in this process, a table summarising the firms directly involved in the management and/or design of the main infrastructure systems in the project has been developed, linking these firms with the infrastructure solutions they operate:

<table>
<thead>
<tr>
<th>Systems</th>
<th>Infrastructure solutions</th>
<th>Firms involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>- Increased energy supply by RES.</td>
<td>- EDF Energy</td>
</tr>
<tr>
<td></td>
<td>- British Gas</td>
<td></td>
</tr>
<tr>
<td>Waste</td>
<td>- Waste collection</td>
<td>- Ashford Borough Council</td>
</tr>
<tr>
<td></td>
<td>- Waste disposal</td>
<td>- Kent County Council</td>
</tr>
<tr>
<td>Water &amp; Sewage*</td>
<td>- New wastewater treatment systems (sand and nitrifying filters).</td>
<td>- Southern Water</td>
</tr>
<tr>
<td></td>
<td>- Expansion of the existing sludge recycling centre by reusing methane gas.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Improvements to the Odour Control System</td>
<td>- Mid Kent Water (now South East Water)</td>
</tr>
<tr>
<td></td>
<td>- Increase in water supply</td>
<td></td>
</tr>
<tr>
<td>Telecommunications</td>
<td>- Cable network</td>
<td>- British Telecom</td>
</tr>
</tbody>
</table>

Table 8. Infrastructure solutions and firms involved in Ashford.

Analysis of the role that firms and public partners play in the process

For the analysis of the roles played by firms involved in this process, a review of what each firm does and the direct implication of the firm in the project has been summarised as follows:

a) Public Administrations

- Ashford Borough Council

In Ashford, the public sector is the promoter of these systems-integrated urban planning solutions. In order to achieve its goals, the Ashford Council has constructed the following delivery structure:
4.4. Case studies: Ashford

Ashford’s Future Delivery Board: Ashford's Future is a partnership of local councils, government agencies and others from the public and private sector. The partnership is responsible for delivering regeneration throughout the borough and ensuring the town develops and grows in a sustainable way. By working together, the main partners are able to bring their own expertise and resources in their areas of responsibility.

The Ashford’s Future Delivery Board includes high-level representatives from each partner agency to put in place the targets set within the Sustainable Communities Plan. The Board is responsible for overseeing the delivery of the growth programme, which includes approving policy and key documents and performance management. It has no legal status, but has a key role in providing vision, direction and leadership. It ensures that the range of tasks needed to deliver growth are planned and carried out; sets the overall quality standards and ensures all stages of planning and implementation represent best practice and innovative solutions to deliver sustainable development.

The following graphic shows the Ashford’s Future organisational structure regarding water, one of the main constraints for sustainable growth in Ashford:

**Figure 25. Ashford’s Future Water organisational structure**  
(Source: Ashford’s Future, 2007)

Delivery Co-ordination Team: It is the ‘core team’ - a technical team whose members are employed by the Borough Council, but answerable to the Delivery Board. The team is managed by a managing director employed by the South East England Development Agency (SEEDA), but also accountable for the Board. The team formulates policies and proposals for the approval of the Board and coordinates implementation of the delivery plans with partners. It forms the link between partners, the community and other stakeholders*, challenging and inspiring to get the best outcomes. It will also have a performance management role.

Delivery Managers Group: responsible for providing strategic advice to the Delivery Board and chaired by the managing director of the Delivery Co-ordination Team.

Masterplanning Group: chaired by the Homes and Communities Agency (before English Partnerships). It is accountable to the Board and responsible for the day to day management of the masterplanning process. It is responsible for commissioning consultants and draws on staff from the Delivery Co-ordination Team and the partners.

- Ashford’s Future Company

The Ashford’s Future Company has been established by the Ashford’s Future Partnership Board to support the delivery of housing and economic growth in Ashford.
4.4. Case studies: Ashford

The new company will not duplicate the role of the Partnership Board. Its focus will be on making things happen and ensuring that new investment is diverted into the delivery of key development sites and infrastructure projects.

These projects will help to bring about the vision for a truly sustainable community as set out in the Greater Ashford Development Framework (GADF) and Ashford Borough Council’s Local Development Framework (LDF) Core Strategy. The company will build on existing partnership arrangements led by Ashford Borough Council, Kent County Council, South East England Development Agency and English Partnerships by providing strong private sector representation on the company Board.

The staff of the company has considerable experience in working on the Ashford Growth Agenda along with European, National and Regional experience in regeneration and economic development. This has been strengthened by additional appointments, including a new Managing Director who will bring strong leadership to the team.

- **English Partnerships (now HCA)**

  **General Profile:**

  English Partnerships (now the Homes and Communities Agency, HCA) is the British national regeneration agency, supporting high quality sustainable growth in England. They are a non-departmental public body and their sponsor government department is Communities and Local Government (CLG). They work with a wide range of partners including local authorities, the Housing Corporation, Regional Development Agencies and the Commission for the Built Environment (CABE).

  HCA overall aim is to achieve high-quality, well-designed and sustainable places for people to live, work and enjoy. They have three core areas of activity, which are: Land Supply, Communities and Quality & Innovation. English Partnerships has a portfolio of strategic sites comprising some 6,000 hectares of land. They remediate sites and develop new communities across the country, helping to bring new opportunities, new jobs and new hope.

  **Role in Ashford:**

  In Ashford, English Partnerships has responsibility for bringing forward the residential development particularly on government owned sites such as ex-hospitals. It is also responsible for ensuring that there is a supply of affordable homes through grant funding developers* and Registered Social Landlords. It sets standards for developers to meet in bringing sites forward and might share some abnormal development costs to enable sites to come forward (e.g. contaminated land).

- **SEEDA (South East England Development Agency)**

  **General Profile:**

  SEEDA is the Government funded agency set up in 1999 responsible for the economic and social development of the South East of England - the driving force of the UK’s economy. SEEDA’s aim is to create a prosperous, dynamic and inspirational region by
helping businesses compete more effectively, training a highly skilled workforce, supporting and enabling their communities, while safeguarding their natural resources and cherishing their rich cultural heritage.

SEEDA aims to be a catalyst for change within the South East, working with partner organisations- businesses, education at all levels, local authorities, Government agencies, voluntary and community organisations and many others - to produce clearly recognisable results. Accountable to Government, SEEDA is a business led organisation, governed by a Board whose Members have wide-ranging experience in industry and commerce, local government, education, trade unionism and voluntary service.

Role in Ashford:

SEEDA's role in Ashford is to promote economic development and that can include assembling land for development or setting up infrastructure companies to provide infrastructure ahead of development.

b) Energy companies

- EDF Energy

General Profile:

The general firm profile has been previously reviewed for the Gallions Park case.

Role in Ashford:

EDF Energy is exploring the need for the energy supply to be increased. Once this is done, EDF will be the energy supplier for the new borough.

- British Gas

General Profile:

British Gas is a British-owned company part of the Centrica Group. They provide gas, electricity and home repair services (they install and maintain central heating and gas appliances) to millions of customers in Scotland, Wales and England. British Gas was sold as a single monopoly in 1984. Although it was split in the mid-1990s, the retail arm, Centrica, retains a comfortable position in gas and electricity markets thanks to its original nationwide monopoly (although Centrica has made almost no attempt to expand outside the UK, the international gas exploration company, BG, remains successful).

Role in Ashford:

British Gas is in charge of the gas grid, which is being increased in order to supply for the forthcoming new neighbourhood.
4.4. Case studies: Ashford

c) Water & sewage* companies

- Southern Water and Mid Kent Water

*General Profile:

Southern Water supplies fresh, quality drinking water to more than one million households and treats and recycles wastewater from nearly two million households across Sussex, Kent, Hampshire and the Isle of Wight. Southern Water continues to be responsible for the safe collection, treatment and recycling of wastewater and sewage* sludge, in line with UK and European law.

*Role in Ashford:

Southern water is responsible for the safe collection, treatment and recycling of wastewater and sewage* sludge in the Ashford area, and then South East Water is supplying water to their customers in the city. Water treatment capacity has already been addressed by sewerage upgrades, which are also part of the Southern Water planning periods (AMP). It is one of the organisations managing water and therefore an actor in the AIWMS.

- Mid Kent Water (now South East Water)

*General Profile:

Mid Kent Water is also a water industry utilities provider in Kent, England, which in 2007 merged with South East Water.

*Role in Ashford:

Southeast Water is in charge of the supply of drinking water in Ashford. Its role in the Ashford Growth Strategy has been planning and increasing the water supply (a new pipeline is being built and a new reservoir is being considered). As one of the organisations managing water, the need for it developing infrastructure in Ashford has been assessed in the AIWMS.

d) Waste companies

- Ashford Borough Council & Kent County Council

*General Profile:

The general profile of both authorities has already been reviewed in the section dealing with the public administrations involved in the project.

*Role in Ashford:

The two authorities work in partnership to reduce waste through recycling and reuse. New waste treatment/transfer facilities will be needed to support this (it is still being studied in which way).
4.4. Case studies: Ashford

e) **Others (masterplanners, developers*, contractors*, consulting firms…)**

- **Urban Initiatives Ltd**

  *General Profile:*

  As they claim on their official website, their “business is to deliver innovative ideas and achievable solutions in complex urban environments for the public and private sector. Urban Initiatives’ integrated approach is particularly well suited to projects where a strong overlap of professional disciplines is demanded.”

  *Role in Ashford:*

  In the Ashford case, they had to deal with growth and change in a sustainable and innovative manner. The challenge was to deliver a framework (the Greater Ashford Development Framework, GADF) that deals with the scale of the growth achieving an environment for growth directed by sustainable and innovative intervention to make Ashford a desirable place both for people to live and recreate in, as well as a place that can attract significant public and private investment.

  ![Figure 26. Ashford’s growth area map](Source: GADF, 2005)

- **Alan Baxter**

  *General Profile:*

  Alan Baxter & Associates is an engineering practice which range of work is now broad and covers urban design, masterplanning, sustainability, conservation and civil and structural engineering.
4.4. Case studies: Ashford

Role in Ashford:

In this case, they were commissioned by the Masterplanning Group from Ashford’s Future to give engineering advice on a transport strategy supporting sustainable travel patterns in development areas. Alan Baxter engineering advice for the Ashford Future UDC is founded on a transport strategy that supports sustainable travel patterns in development areas. They have used a top-down, multi-modal modelling approach that sees their transport, masterplanning and urban design experience acting as an interface between the transport modelling and land use planning processes.

- Black & Veatch

General Profile:

Black & Veatch Corporation is a leading global engineering, consulting and construction company that provides reliable solutions to their customers most complex challenges. A single integrated global workforce allows Black & Veatch to deploy optimal multi-disciplinary teams from around the world. They offer a wide range of services such as: conceptual and preliminary engineering services, engineering design, procurement, construction, asset management, environmental, security design and consulting, and management consulting.

Role in Ashford:

It was commissioned to undertake the Ashford Integrated Water Management Study (AIWMS) to assess the constraints to growth that might arise from the proposed development from Ashford’s Future capacity study (which assessed the extent of growth possible within acceptable environmental, economic and social limits). Black & Veatch especially constructed and commissioned the Ashford wastewater treatment works to assist in the delivery of Southern Water’s current capital program.

- WS Atkins

General Profile:

“WS Atkins is a multinational engineering and design consultancy, providing expertise to help resolve complex challenges presented by the built and natural environment. They plan, design and enable solutions.” (Atkins official website)

WS Atkins is a provider of project management, technical consultancy and support services across different sectors (such as transport, building design, communication or defence). Atkins designs and integrates external manufacturers’ equipment across diverse sectors; maintains, operates and provides services to end-users and has a consultancy-based approach to meet customer needs. It has also developed financing capabilities, as it has created a joint-venture company, TS4i, with the Royal Bank of Scotland to provide integrated solutions for design, construction, maintenance and finance.
4.4. Case studies: Ashford

Role in Ashford:

WS Atkins has been in charge of developing “Ashford Growth”, a sustainable development capability study for Ashford. Atkins’ role in the project has been working in some proposals for a new mixed-use sustainable village, providing 1,100 new homes and up to 70,000 square metres of business space (as part of a series of development of masterplans for sustainable new communities on land on the outskirts of towns earmarked by the Sustainable Communities Plan led by Government for major growth).

- Developers* (Crest Homes, Berkeley Homes, Taylor Wimpey, Jarvis Homes, Henry Boot PLC, Pentland Homes and Persimmon Homes)

Role in Ashford:

Developers* have responsibility for acquiring and developing land. To do that, they need to lobby for the necessary policies to be in place to support the principle of development and then they need to get the appropriate consents (planning/building control) to take forward that development. They are responsible for paying (at least in part) for the necessary services/utilities to be put in place to serve developments, negotiating with service providers like gas, water etc. They obviously recoup these costs when selling the individual homes.

4.4.5. Case Analysis

Ashford is the case that is more different from the other three. Firstly, it’s not a regeneration plan but a growth plan for a fast-growing city with some goals to accomplish in the next 30 years. Therefore, it’s understandable that its organisational structure is quite more complicated than the rest of the plans because of a wider scope of the plan. Secondly, in this case, we cannot find new integrated solutions provided by single firms, maybe because the provision of infrastructure is still being studied to cover future needs, but what we can find is an integrated planning in the different fields of the urban environment.

Figure 27. Ashford International Eurostar station and other attractions
(Source: own pictures)
From transport to telecoms and land use, all the systems are being planned following an integrated approach, involving all the stakeholders, with a special attention to the water system, where an innovative water management study is included integrating the different water subsystems and its main actors to remove this constraint and find suitable infrastructure integrated solutions to enable sustainable growth for the city.

**Partnership Structures**

Ashford's Future complex structure is a partnership of local councils, government agencies and others from the public and private sector. By working together, the main partners are able to bring their own expertise and resources in their areas of responsibility. The Ashford’s Future Company will build on existing partnership arrangements led by Ashford Borough Council, Kent County Council, SEEDA and HCA by providing strong private sector representation on the company Board.

Due to the importance of the water system for the growth of Ashford, the *Integrated Water Management Study* (AIWMS) carried out for this project also helps to promote working partnerships between the many organisations with different responsibilities for managing water (such as local administrations and the different utility providers).

**Capabilities analysis of companies related to the design and operation of the whole system**

Based on the role played by the firms involved in the Ashford Future project, this is the result of the analysis which lists the different capabilities required for firms to carry out their corresponding duties in the project:

- **Ashford Borough Council & Ashford Future**

  *Systems Integration:* It is the systems integrator of the whole process, coordinating the different actors involved in the creation of the new neighbourhood on behalf of the public administration. On the other hand, Ashford Future focuses on making things happen and ensuring that new investment is diverted into the delivery of key development sites and infrastructure projects.

- **SEEDA (South East England Development Agency)**

  - *Systems integration:* SEEDA aims to be a catalyst for change within the South East, working with partner organisations to produce clearly recognisable results.
  - *Financing:* SEEDA has set up the East Kent Spatial Development Company to provide services which are then paid for as development comes forward. This is called forward funding infrastructure.

- **EDF Energy**

  - *Systems integration:* It designs and integrates internally and externally supplied components in a finished product (both the energy network and energy as a product itself). For now, it has been exploring the need for the energy supply of being increased (designing the network). When it comes to energy, EDF Energy is a vertically integrated firm (as most energy companies are), because it combines within
4.4. Case studies: Ashford

- British Gas

  - **Systems Integration:** It designs and integrates internally and externally supplied components in a finished product (both the gas network and gas as a product itself). When it comes to natural gas as a product, British Gas basically offers gas distribution & gas supply. It is also an integrator of external supplied products when it comes to designing and building the natural gas network.
  
  - **Operational Services:** They install and maintain central heating and gas appliances.

- Southern Water

  - **Systems Integration:** It designs products and integrates basically externally supplied components in a finished product (the water network and sewage stations) to produce and deliver fresh, quality drinking water.
  
  - **Operational Services:** Responsible for the safe collection, treatment and recycling of wastewater and sewage* sludge.

- Urban Initiatives Ltd

  - **Business Consultancy:** Design advice on how to deliver an infrastructure framework that deals with the scale of the growth in a sustainable and environmentally friendly way.

- Alan Baxter

  - **Business Consultancy:** Engineering advice on transport strategy, developing the cost and action plans and giving advice on the design of the public realm.

- Black & Veatch

  - **Business Consultancy:** B&V offers conceptual and preliminary engineering services, engineering design, procurement, construction, environmental, security design and consulting, and management consulting (basically, how to plan and design).
  
  - **Financing:** It offers asset* management services.

- WS Atkins

  - **Systems Integration:** Atkins designs and integrates external manufacturers’ equipment across diverse sectors. It is a pure systems integrator, as it specializes in providing systems integration services using components sourced from external manufacturers.
  
  - **Operational Services:** Operates and provides services to end-users.
  
  - **Business Consultancy:** WS Atkins provides expertise to help resolve complex challenges presented by the built and natural environment. They plan, design and
enable solutions for their customers in a consultancy-based approach to meet customer needs.

The following table summarises the capabilities owned by each of these firms:

<table>
<thead>
<tr>
<th>Systems integration</th>
<th>Operational Services</th>
<th>Business Consultancy</th>
<th>Financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashford Future</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEEDA</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>EDF Energy</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>British Gas</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Southern Water</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Urban Initiatives Ltd.</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Alan Baxter</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Black &amp; Veatch</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>WS Atkins</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 9. Ashford’s Future main firms’ capabilities.

**Business Models produced to deliver integrated solutions**

It is also the aim of this thesis to identify the Business Models of firms involved in the delivery of integrated solutions for urban planning and to understand how the *value chain* is organised for building and providing infrastructure services in new urban areas. The business model analysis is based on what has been reviewed from literature. These are the business models that have been identified for the firms involved in the Ashford Future project:

**Utility providers**

These are responsible for laying services to development sites. They recoup part of the costs of laying services from developers* and part is met through future income from the occupiers of the properties.

They are each overseen by regulatory agencies. That may include ensuring that the companies are operating in an efficient manner including exploring cost efficiencies through joint provision although other imperatives such as timescales and commercial confidentiality/conflicts of interests. A clear example would be OFWAT, which is the regulatory agency for water whose main function is to ensure that delivery standards are met and that the customer receives best value for money.

* EDF Energy

EDF Energy is a vertically integrated firm (as most energy companies are), because it combines within a firm the successive stages in the flow of productive activities to
provide energy to the customers (from generation to transport and distribution). EDF Energy follows the traditional energy company business model of supplying electricity and gas to customers. This is why its business model also includes comprehensive services, as it operates and maintains the whole energy network in Ashford.

- British Gas

British Gas is also a quite a vertically integrated firm, because it combines within the firm the successive stages in the flow of productive activities to provide natural gas to the customers (mainly gas distribution & gas supply). Their business model is quite the same as for EDF Energy, because both are energy suppliers and the market is much regulated. They also offer comprehensive services as they install and maintain central heating and gas appliances.

- Southern Water

Southern water’s vertically integrated business model focuses in the integrated management of the water cycle. It is responsible for the safe collection, treatment and recycling of wastewater and sewage sludge. In Ashford, Southern Water’s plans form part of its continuing investment in major infrastructure projects in Kent, but in this case they are of main importance as they have to cater for the Ashford Growth needs (as outlined in the AIWMS). It is also in charge of the expansion of the existing sludge recycling centre, operating the new wastewater treatment plant and improving the Odour Control System

Masterplanners

- WS Atkins

WS Atkins acts as a pure consultant in this process. Its business model is based on the provision of consulting and design services (in this case a sustainable development capability study for Ashford). The Government outsources to WS Atkins the development of this technical study because it doesn’t have the necessary capabilities to do it by itself. WS Atkins is located in the first steps in the value chain (in the design phase) and, as it has already been said before, its main capability is business consultancy.

- Black & Veatch

Black & Veatch also acts as a pure consultant in this process. Its business model is based on providing engineering, consulting and construction services (in this case developing the Ashford Integrated Water Management Study, AIWMS). The Government outsources to Black & Veatch the development of this technical study because this firm, unlike the Ashford Borough Council, owns the necessary capabilities to do it. Black & Veatch is also located in the first steps in the value chain (in the design phase) and its main capability is business consultancy.
5. The business of infrasystems operating firms

5.1. Firms, natural monopolies and competition

**What is a firm?**

A firm could be defined as a business organization that makes money by producing or selling goods or services. However, we could find different definitions of a firm depending on the theory we use to define it. In the “neoclassical economics theory”, a firm is viewed as a production function, while the “transaction cost theory” treats a firm as a bundle of internalized transactions. From a “resource-based view”, a firm could be defined as a collection of resources and a modern definition of a firm that includes some of the previous ones, would be a firm viewed as a knowledge-creating function.

However, a simple definition would be viewing a firm as a collection of assets with one owner that contracts with other assets to produce and sell goods; that is to say, a legally recognized organization designed to provide goods and/or services to consumers. The owners and operators of a firm have as one of their main objectives the receipt or generation of a financial return in exchange for work and acceptance of risk.

**What is a natural monopoly?**

An industry is said to be a natural monopoly if one firm can produce a desired output at a lower social cost than two or more firms— that is, there are economies of scale* in social costs. Unlike in the ordinary understanding of a monopoly, a natural monopoly situation does not mean that only one firm is providing a particular kind of good or service. Rather it is the assertion about an industry, that multiple firms providing a good or service is less efficient (more costly to a nation or economy) than would be the case if a single firm provided a good or service. There may, or may not be, a single supplier in such an industry. Should economies of scale* and of scope* both apply, then a natural monopoly exists.

This is a normative claim which is used to justify the creation of statutory monopolies, where government prohibits competition by law. Examples of claimed natural monopolies include railways, telecommunications, water services, electricity, mail delivery and computer software. Some claim that the theory is an inconsistent basis for state prohibition of competition. This can be a problem as competition is usually good as it generates innovation and usually drives down the cost of achieving an objective.

5.2 Background in infrasystems service provider firms in Europe

**The water market**

*In Europe*, public sector operation is the dominant mode in most countries except for France, the UK, the Czech Republic, Spain and Hungary. In the privately operated segment, however, water is highly concentrated in the hands of the two largest French multinationals that hold around 70% of the world market.
5. The business of infrasystems operating firms

In the UK the first feature of the consolidation has been through takeovers by established water multinationals – all French. A second feature of a number of mergers has been the creation of water and energy combines, not always successfully. A third category has been horizontal consolidation through mergers or takeovers between existing companies. However, a number of proposed and attempted mergers have been blocked or discouraged, because of OFWAT’s desire to maintain a plurality of companies as comparators for regulatory purposes (OFWAT is the economic regulator for the water and sewerage industry in England and Wales).

The Energy market

Since 1 July 2007 every household and industrial consumer of electric energy in the European Union is entitled to freely choose its supplier. Nonetheless, a truly competitive internal market for electricity has not yet been achieved due to various reasons such as the market power of the former monopolists on the wholesale* level or cross-border transmission constraints.

In Europe, three large companies (the French EDF and the Germans E.ON and RWE), are emerging rapidly as dominant international companies with the resources to take-over and dominate European electricity markets. A second layer of companies, such as Vattenfall (Sweden), ENEL (Italy), Endesa (Spain) or Tractebel/Suez (Belgium) still remain as strong regional players. Others, such the Finnish energy company Fortum and perhaps a Scottish power company may survive in small niches.

Most national governments are not leaning towards checking the activities of these companies, which in most cases are seen as ‘national champions’ because they capture profits in foreign markets and bring them back to their home country. However, Spain is the only country, apart from the UK, which has so far protected national pluralities in front of international companies by, for instance, declining to approve the proposed merger of Endesa and Iberdrola.

The companies which are expanding most successfully in the European market are large, national-scale companies. There is a clear trend towards vertical unification (not unbundling*) and mergers, not separation. For instance, Germany was dominated by four major companies, which have been reduced by merger to two, an oligopoly position which is being concentrated by mergers, rather than unbundled.

The UK electricity industry was privatized in 1990 by the public sales of shares on the stock exchange. The industry was ‘unbundled’ into generating companies. The reasoning implicit in the regulation of the industry in the UK was that companies involved in activities that would remain a monopoly (basically distribution and transmission activities) should not be involved in competitive activities (generation and retail supply). This had to ensure that those involved in competitive activities could gain non-discriminatory access to the network.

There should also be some separation between companies involved in generation and those involved in retail supply to final consumers. If generation and retail supply were integrated, the wholesale* market would not be a primary price-setting forum as integrated companies would be generating to supply their own consumers. This was the basis for the effective ban on vertical integration which was finally lifted in 1998.
However, as isolated businesses, both generation and retail supply are highly risky businesses. For a standard product like electricity, retail suppliers will quickly lose their market share if they cannot match the cheapest prices on offer. The evidence from California and Brazil, where integration wasn’t allowed either, made the investment in new generation collapse after liberalization*. *Integrated companies can ensure they have enough capacity to supply their own consumers reliably. Therefore, supply security is improved but by reducing competition.

For these reasons, *vertical integration* of generators and suppliers is a feature of liberalised electricity markets in Europe. In Scandinavia, for example, the dominant generating companies bought distributors to secure outlets from the start of liberalization*. Vertical integration is now seen as a key principle for the major companies – the CEO of Eon has declared that the collapse of Enron showed the dangers of a business model that was largely focused on wholesale* energy trading. He stated that “We have never been attracted by such a model; instead, we have stuck to our approach of vertical integration, including power stations, grids, wholesale* trade as well as the final consumer.” (Hall, 2003)

The decision on lifting the ban to vertical integration in 1998 meant the beginning of the shift to integration. The generator companies in the UK not owning distribution companies are in financial difficulties. Therefore, the current state of the industry in the UK is run by a small number of *vertically integrated* groups owned by non-UK groups (basically EDF, RWE and EON) and by the Scottish groups, Scottish Power and SSE, operating alongside Centrica (which is still operating as British Gas).

**The Waste Management Market**

In the period from 1988 to date, in the UK, the municipal waste management sector was opened up to the private sector. In order to facilitate this, an integrated (but poorly funded) waste management service was broken up. Finally, the industry is being re-integrated on a private sector basis, both in terms of the service offered to municipalities (collection, disposal and treatment) and that offered by the same companies to their large commercial and industrial customers. Therefore, the British market reforms broke up an integrated waste system in the public sector and, after a brief period of relative competition, have now laid the basis for the re-integration of the industry in the private sector.

Most waste disposal is now controlled by the private sector, which has been accelerated by the use of the Private Finance Initiative (PFI*) in waste disposal. Under the Private Finance Initiative (PFI), introduced in 1992, private sector companies “design, build, finance and operate” public sector projects ranging from schools to complex weapons systems.

Waste collection is a more labour intensive operation than waste disposal, and contracts for waste disposal are generally longer than those for collection. It is common for collection tenders to attract a relatively small number of bids (usually up to six) while the bigger disposal contracts may attract larger numbers.
5. The business of infrasystems operating firms

The UK is in line with the industry trends across Europe, which has seen: continued push for privatisation, environmental pressures and a move towards concentration and vertical integration.

5.3. Why innovation is important

Innovation is important because it is the way by which there is progress and an improvement in the way things are done, which results in an optimisation of resources, minimisation of costs and an improvement of the standard of living of the final customer. It enables firms to offer better products and services to their customers, which at the end means being chosen for selling a product or providing a service and increasing their revenue.

Innovation is essential for the maintenance of competitive advantage respect to other firms which are competing for the same potential customers (their competitors). It is important to remind that innovation is considered to be one of the three primary factors of competitive advantage (together with reputation and relationships).

Innovation and sustainability

The four different cases this thesis has been studying have an important point in common: all of them include a series of integrated solutions in the urban environment which constitute an important innovation respect to the common way of planning cities, neighbourhoods and developments. It is really interesting that all these innovations arising from masterplaners, design consulting firms and utility companies are leaning into the same direction: sustainability.

Embracing sustainability is fundamental to managing a company’s risk profile and is essentially a good business practice. Nowadays, for most, sustainability is at best a ‘nice to have’, but it is rarely a ‘must have’. However, company boards and directors have an obligation to act in the best long-term interests of their firm, which should include addressing issues about how that business interacts with its surroundings. Hence, if our society is going to make a peaceful transition from fossil fuels to renewable energies, companies, governments and individuals should start acting now.

Despite the increasing belief that there is a higher cost to business associated with compliance than with integration of sustainability into business practices, self regulation is unlikely to work. However, the discontinuities that the inevitable changes to society will bring are creating and will create in the future considerable business opportunities.

Existing business models will no doubt be modified (some have already started to change) and new services and new businesses will also be created to exploit the changes. The early mover could actually make a business out of these significant changes, but an approach that waits to see what those changes will bring will simply cost money in order to comply with regulations (Singleton, 2003).

The problem of infrasystem service provider firms and innovation

A main problem of infrastructure service providers is that some of them are natural monopolies in some countries. Therefore, if the social cost wants to be minimized, there
can only be one company supplying the service and it must be legally regulated by the
government or the state in which it is working. These companies industrialize their
processes and, not having any competition, they have no need to innovate. Thus, these
companies don’t care about the needs of the city or the innovation processes to improve
the quality of services, because they only have to care about their Income Statement.

Even if these companies are providing a public service of general interest and legally
regulated, they act as a private corporation (that it is what they actually are) and they
aim to have a good Income Statement, to improve the value of their shares on the Stock
Exchange Market and to pay dividends amongst their share-owners (or even buying
other companies abroad like the Spanish energy company Fecsa-Endesa did). To reach
all these goals, these companies industrialize, and in these kinds of processes,
partialisation doesn’t work well because they have to buy different materials, they
have their own purchasing policy, which may change with the innovation process and
their staff has to learn new skills on how to manage and operate different tools or
machines.

On the whole, infrastructure service provider companies don’t earn much money
directly from the service they are providing. Their business is quite intervened, but they
earn money in all the other businesses related to the main one. For example, Fecsa-
Endesa is the monopolistic owner of the energy net in Barcelona and it earns most of
the money from building the net and the transformation centres in the buildings,
obtaining most of the contracts so that they get them and not other companies…

Possible solutions

It is quite difficult to solve this problem because all these companies that operate
services have high fixed costs that make it difficult for other companies to go into the
market. In the current state, the only way to change things is by political will and
pressure.

The model via public service concessions* would be a possible solution as then the
service is awarded to one of the companies through a tender, while all of them are in
competition. Another option would be transferring the net to public property, like what
happens with electricity that the net and energy through that net is considered separately
(the net is the same and can be used by different energy sellers).
6. Typology of cases

6.1. Review of cases

Before going through the attempt of delivering a typology of cases, a brief summary of the four cases reviewed in the previous chapters has been added in order to remind the four different processes we are dealing with.

1. Barcelona 22@ (Catalunya, Spain)

Barcelona City Council wanted to promote a change of land use in a former industrial area of the City (from industrial towards knowledge activities called “@ activities”) to promote innovation. For this reason, it developed a new urban plan that modified the existing General Metropolitan Plan and created the public enterprise 22 ARROBA BCN S.A. to make sure the new local plan was carried out correctly. The infrastructure planning to improve the zone and attract the new users of land has been undertaken by the City Council in cooperation with the different companies that take part in the improvement of the different networks.

2. Hammarby Sjostad (Stockholm, Sweden)

With the main idea of expanding the inner city of Stockholm converting an old industrial and harbour area into a modern neighbourhood, the City of Stockholm developed a program that outlined environmental integrated solutions for waste, energy and water & sewage*. This programme was named after the project and it is known as the “Hammarby Sjostad eco-cycle” or “Hammarby-model”, which is the result of a unique planning process and intensive systems integration programming work.

The model was developed by Fortum, Stockholm Water Company and the Stockholm Waste Management Administration using systems integration methodology. Other firms involved in carrying out this project (both public and private) have been: ENVAC, SWECO and the Stockholm Business Region.

3. Gallions Park (London, UK)

Gallions Park will be the first London zero-carbon development since the Mayor’s Energy Strategy was released in 2003. Located in an old industrial area, it is part of a regeneration project in the Royal Albert Dock. The first phase in the design process was ARUP’s feasibility study to demonstrate that a zero carbon development could be delivered in that site. This study proved that a carbon-free development was both technically and economically viable. The main sustainable innovation has been the use of a Combined Heat and Power (CHP) plant that produces both heat and power in situ. The CHP is managed by a partnership scheme between EDF Energy and LDA (with the LCCA as the delivery vehicle for the project).

4. Ashford (Kent, UK)

Being one of the fastest growing cities in the South East of England, Ashford faces the possible problem of uncontrolled growing. For this reason, the Ashford Borough
6. Tipology of cases

Council, in cooperation with the Regional Assembly (SEERA), has developed a new urban plan in order to prepare the city for the achievement of this growth in a sustainable way. The Council has joined with key development stakeholders* to form the Ashford’s Future Partnership that may enable the city to achieve sustainable growth by applying an integrated planning by the masterplanners (GADF) and including several growth studies and an Integrated Water Management Study developed by Black & Veatch. The delivery structure reflects the integrated planning approach as it is formed by several public and private partnerships: the Ashford’s Future Delivery Board, the Delivery Co-ordination Team (technical team), the Delivery Managers Group and the Masterplanners Group (managers of the masterplanning process). This project is being funded by the governmental agency SEEDA & English Partnerships on behalf of the UK Government.

6.2. Comparing case studies

The case study method has been chosen to examine both the use of integrated planning and the role firms play in integrated innovation processes (their business models, the capabilities they require and the position they occupy in the value chain, especially if they have made any strategic decisions into the provision of services). The case studies provide a rich resource of comparison because they are located in different countries (and therefore they are set in different frameworks) and they include firms operating in different fields. However, we can note that the figure of a development agency, business consultancy firms and the firms managing the main infrastructure systems (energy, water & sewage* and waste) are always present in these four cases.

Overview

The cases that have been studied in this thesis resemble in some aspects while differ on others. We could classify these cases into two different groups depending on the final objective of the project in refurbishment of old brownfields (22@, Hammarby Sjostad and Gallions Park) and creation of new neighbourhoods in growth areas (Ashford); or in neighbourhoods (22@, Hammarby Sjostad and Ashford) and developments (Gallions Park) depending on the dimensions of the projects. However, all these cases resemble in the integrated approach that has been given to the planning and design process.

One could think that, nowadays, the way cities are planned all around the world should be quite similar because of a generalised globalisation that makes the world more homogeneous as people’s habitudes, tastes, trends and ways of life get more similar everyday. However, traditional national schemes in designing and planning cities are still present; firms have their own way of working (especially utility companies, which in some countries are still local natural monopolist companies), governments have their own view on how to develop land and people respond quite different to new concepts gaining importance in society such as sustainability.

For instance, the focus in the UK is to turn homes into self-sufficient islands by plastering them with expensive renewable technologies and incorporating water recycling at a localised level (as exemplified in Gallions Park). The Swedes take the opposite approach: building comparatively conventional homes and providing heat and power through carefully planned infrastructure at a district level. This is paid for upfront
6. Tipology of cases

by the city council and the utilities companies. Similarly has been done by the Spaniards in Barcelona in the 22@ case while Ashford is a mix of both conceptions.

In Hammarby, combustible waste is cleverly sucked through a system of tubes, rather than being taken away by polluting lorries and burned in a combined heat and power plant to provide electricity and heat via the district heating system. There is a dedicated wastewater treatment plant, which generates biogas from sewage* and uses it to power local buses. Even warm wastewater is made to yield its energy, which is then used for space heating.

But the UK, with councils having economical problems and privatised utilities not being much efficient, is very different from Sweden or Spain, where there is only one water and one electricity provider in every zone. Therefore, the development models must be different for these places. The Swedes and the Spanish take the view that it is far cheaper and more efficient to provide green heat and power centrally, rather than using expensive bolt-on renewables. It also means the developers* of the individual apartment blocks don’t have to reinvent themselves as power generators but can concentrate on building in much the same way they would on a more traditional development.

The following table summarises some important figures related to costs, dimensions and state of the works for each of the four cases that can be useful for the current comparison of cases in the next sections:

<table>
<thead>
<tr>
<th>Case</th>
<th>Overall investment(^{ii}) (€)</th>
<th>Area (Ha)</th>
<th>Infrastr. inv. (€)</th>
<th>Infr. Vs. overall inv. (%)</th>
<th>Infr. Inv./Ha (€/Ha)</th>
<th>% built (2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcelona 22@</td>
<td>12 billion(^{iii})</td>
<td>200</td>
<td>180 million</td>
<td>1,5</td>
<td>0,9 million</td>
<td>50%</td>
</tr>
<tr>
<td>Hammarby Sjostad</td>
<td>2 billion</td>
<td>200</td>
<td>432 million</td>
<td>21,6</td>
<td>2,16 million</td>
<td>75%</td>
</tr>
<tr>
<td>Gallions Park</td>
<td>(iv)</td>
<td>1,23</td>
<td></td>
<td></td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Ashford</td>
<td>1,08 billion</td>
<td>133,6</td>
<td>400 million</td>
<td>37</td>
<td>3 million</td>
<td>10%</td>
</tr>
</tbody>
</table>

Table 10. The four study cases in figures.
(Source: own source from interview data)

6.2.1 Systems Integration in design

In this section, we are going to compare and contrast the different methods used in the integrated planning and design processes in the four case studies. This comparison will be made both amongst them and with the conventional method, which is commonly used in everyday projects. At the end of this section, an assessment of the advantages

\(^{ii}\) Overall investments: real estate + infrastructures + urbanisation costs+ other costs
\(^{iii}\) Note that in English 1 billion is 1,000,000,000 (one thousand million).
\(^{iv}\) It has been impossible to obtain this data: “Unfortunately both these figures are commercially sensitive and I am unable to disclose them at the current time” (Michael Payton, LDA)
6. _Tipology of cases_

and disadvantages of systems integration respect to these other more conventional methods is also included.

**Systems Integrated planning in our case studies**

The systems integrated approach in design is a topic to which this thesis is constantly referring to because of its importance in the conception of these urban projects. In 22@ and Hammarby Sjostad, the integrated approach was taken into consideration from the first moment when the firms managing the different systems and all the stakeholders* sat in the same table to design large technical systems to provide integrated solutions for their respective cities. Hammarby Sjostad even followed the Symbio city holistic scheme which finally resulted in the Hammarby model. Therefore, this integrated approach let the masterplanners work out integrated design solutions in cooperation with utility firms and other stakeholders*.

For the design of One Gallions, a feasibility plan was commissioned to Arup in order to assess the best way in which a zero-carbon development could be carried out. The IRM, which is an integrated resource management tool, was used to meet this objective and the results demonstrated the site was feasible (taking into consideration the synergies between the different subsystems in the development). In this case, the integrated approach was holistically applied to the design of the best way in which utilities should be managed for the development.

Finally, in Ashford, a long process has also been followed in order to decide in which way the city should grow. Several studies have also been developed (the integrated water management study, AIWMS, amongst them) which also have a systemic view and the objective of integrating the different systems and subsystems in the most suitable way. Regarding the integrated management water study, it should be said that it is more about integrated planning in the water system (taking into account the different interrelated subsystems such as mains water, non-mains water, environmental water and flood risk and drainage water) than integrating the different infrastructure systems as it happens in other case studies.

Integrated planning has been possible thanks to the important figure of development agencies or coordination local partnerships. This figure is exemplified in the different cases by 22@BCN,S.A. (22@Barcelona), the partnership of the Stockholm Municipality, Stockholm Vatten, Fortum and the Stockholm Business Region to develop the Hammarby Model (Hammarby Sjostad), LDA (Gallions Park) or Ashford Future (Ashford).

**Conventional urban infrastructure planning**

Conventional projects with no special emphasis in urban infrastructure don’t require any specific planning authority to decide how infrastructure is laid. Usually, urban planning is done by developers and utility companies are responsible for laying services to development sites. The market is highly regulated and there are specific rules on how to deploy utilities and a normalised system to do it. In the design stage, developers contact each company separately and they follow a standardised way of working due to the industrialisation of processes. There isn’t any development promoting agency
coordinating or integrating the different systems because the planning process is less complex and it doesn’t demand any cooperation or coordination between firms.

This way, each company acts separately and gives service independently to each infrasystem; there is no interrelation between companies managing different systems. Systems work properly but synergies between the different systems are not exploited; which means that the potential effectiveness that an integrated scheme would produce is considerably reduced, and then it may be cheaper at first but proportionally more expensive in the long run. On the other hand, innovation also requires both a special technical and economical effort because of the novelty of all processes and it may result expensive in the short-run though quite profitable when repeatable.

In spite of all this facts, it is extremely difficult to predict exactly how much more effective or expensive may one method be respect to the other because these large-scale capital intensive projects are only carried out one way (we cannot compare two identical projects performed in two different ways) and hence, costs cannot be compared but only esteemed. Moreover, the outcome resulting from each method is not the same. The integrated solution, generally being a bit more expensive at first, may result in a more efficient and operational final solution obtained, for which may be worth paying for.

The following table contains data related to extra costs and includes the main advantages of the final integrated solutions obtained in each case.

<table>
<thead>
<tr>
<th>Infrastructure extra cost (%)</th>
<th>Integrated Infrastructure Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcelona 22@</td>
<td>very small</td>
</tr>
<tr>
<td>Hammarby Sjostad</td>
<td>2-4 %</td>
</tr>
<tr>
<td>Gallions Park</td>
<td>5-8 %</td>
</tr>
<tr>
<td>Ashford</td>
<td>(not known yet)</td>
</tr>
<tr>
<td></td>
<td>- More operational infrastructure design (less works; better organisation and service)</td>
</tr>
<tr>
<td></td>
<td>- Districlima (DH&amp;C): Saves 20% in energy consumption, no additional impact in terms of CO2 emissions and 50% primary energy savings.</td>
</tr>
<tr>
<td></td>
<td>- Enables coexistence of old and new infrastructure while refurbishment.</td>
</tr>
<tr>
<td></td>
<td>- Hammarby Model: Reduction of environmental impact to 50% compared to a 90s district.</td>
</tr>
<tr>
<td></td>
<td>- Outputs from one player are reutilised by another becoming inputs.</td>
</tr>
<tr>
<td></td>
<td>- Reduction of 40% energy consumption compared to 2006 Building Regulations.</td>
</tr>
<tr>
<td></td>
<td>- CHP: requires 2/3 of the fuel needed in the traditional solution. 30% reduction in CO2 emissions.</td>
</tr>
<tr>
<td></td>
<td>- Huge potential savings in energy bills.</td>
</tr>
<tr>
<td></td>
<td>- Enables sustainable growth.</td>
</tr>
<tr>
<td></td>
<td>- Energy demand covered by renewals (CHP and reuse of methane gas from sludge).</td>
</tr>
</tbody>
</table>

Table 11. Extra costs and Integrated Infrastructure Advantages
6. Tipology of cases

Regarding costs, the only data that can be obtained from these processes is that at 22 firms finally agreed to apply all the innovations planned because the amount of service to be built and operated was big enough and the overexploitation cost was very small. In Hammarby, the cost of the learning process and investment in new knowledge wasn’t much of a 2-4% extra, and in Gallions, the additional cost on the scheme was set somewhere between 5 and 8% over traditional build costs. We still don’t know about the Ashford case (because the infrastructure planning is still on course), but it can be guessed that the integrated planning will lead to similar averaged extra costs.

As we can see from the table above, integrated planning has resulted in interesting more effective outcomes for each case, which should be considered best value for money. In 22 the needs for each service have been determined and an integrated solution has been given, getting scale benefits, synergies and a diminished citizen impact. In Hammarby, this planning process was unique and resulted in new and integrated environmental solutions where the resources provided by one player were reutilised by another. In Gallions, IRM provides a methodology to make more efficient the complex process of masterplanning to achieve the best practicable outcome (a zero-carbon site). And finally, Ashford, will achieve sustainable growth and, with its integrated water management, helps to promote working partnerships between the many organisations with different responsibilities for managing water (which may not individually be the best solution, but in combination with others may deliver many benefits for water supply, water quality, flood risk and wildlife).

Advantages and disadvantages of the different methods

As we have been observing throughout the whole report, the main advantage of systems integration in design is that the resulting solutions are more efficient (even if this may also mean that they are more expensive and complex). Therefore, systems integration should only be applied in those cases where the complexity of the goals we want to achieve require a planning method such as systems integration that takes into account the interaction between the different subsystems to get the best possible solution. It seems quite clear from what has been observed in our cases that the same outcome wouldn’t be possible by conventional methods.

The next table tries to summarise the main advantages and disadvantages of systems integration in the design stages of infrastructure planning compared to the conventional way of planning infrastructures in developments.

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Conventional planning| ➢ Each company works on its own, they don’t have to cooperate or reach to an agreement. It is better for the self-interests of companies.  
➢ It is quite straight-forward. The standardised way of working requires less effort and this saves money and time. | ➢ Less resource-efficiency in operation.  
➢ Only valid for simple solutions (doesn’t take into account possible synergies with other systems). |
6. Tipology of cases

| Systems integration | An integrated approach enable the masterplanners to work out customer-oriented integrated design solutions in cooperation with the utility firms and other stakeholders. That is to say: specific solutions for complex problems. |
|                     | Better understanding of the interaction of the multitude of variables relevant to urban planning which results in better solutions. |
|                     | Within a firm, if the same company designs, operates and maintains a system, products become easier-to-use and easier-to-maintain. |
|                     | Complex organisation and working structures (but necessary to develop complex solutions for large technical systems). |
|                     | May take more time than conventional planning. |
|                     | Demands making an effort in learning new knowledge and skills. |

Table 12. Advantages and disadvantages of Systems Integration with respect to more conventional methods of organisation.

6.2.2. Systems integration as a firm’s strategic business activity

The role firms play in systems innovation processes

As it can be appreciated in the different cases, in integrated processes, some firms are more willing to innovate than others. Competition is important for innovation, as it is a source of creating competitive advantage. Usually, municipalities take the lead in proposing innovative solutions for their cities and outsource to other firms those capabilities that they don’t have because they are not necessary to develop their main activities. Therefore, the final customer of most of the activities outlined in this project is the municipality.

Usually, the most common way of selecting a firm for the provision of services is a tender. Tenders promote innovation as firms in competition try to offer the best product or service in a bid to be chosen in a tender. For this to happen, competition is obviously essential. As it has been outlined before, in some countries, liberalization* is not yet a reality. If there is only one company providing to manage a system (e.g. utility companies in Spain or Sweden), then innovation has to be promoted by other means (e.g. external grants).

This is why, in the urban environment, when planning cities, neighbourhoods or developments, which are large technical systems (and therefore need large-scale capital intensive and complex infrastructure solutions), the push of municipalities is so
6. Tipology of cases

important (being usually demonstrated as administrational and economic support or facilitating means for funding).

Obviously firms also have their R&D departments which work in researching other ways of providing better products and services to enable firms operate with the most profitable possible business model, but the effort they make in finding new solutions will be much bigger when firms are in competition because is the way to maintain CA.

**Systems integration activities as a business for firms**

From the planning point of view, in most cases, it has been the municipality that wanted to achieve the goal of improving services and offering innovation and finally it has been achieved thanks to political pressure. This has also encouraged firms to provide a certain service or to develop integrated solutions. In some cases, there has also been a change in Business Models as a result of new code requirements (as in Gallions Park with the London ESCo, where EDF Energy and developers* have to adapt to comply with decentralised energy services).

From the point of view of systems integration in management, companies became more efficient because of economies of scale*, but in the case of infrasystem service provider companies in some countries such as Spain, this can’t be true because they have no competition, and a company only offers innovative services if it has to compete with others. However, firms being the only company providing a service also have to respond to the needs of its customers (in this case municipalities) and, in some cases, these can demand the provision of certain services if they consider so (such as the provision of integrated solutions).

<table>
<thead>
<tr>
<th>Integrated solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ditriclima DH&amp;C</strong></td>
</tr>
<tr>
<td>Districlima takes charge of the design and construction of the installation works and network, and it also offers comprehensive services such as technical operation and management of the centralised climate control service.</td>
</tr>
<tr>
<td><strong>Ros Roca &amp; ENVAC waste collection system</strong></td>
</tr>
<tr>
<td>Ros Roca and Envac provide turnkey* solutions that combine the design, installation, maintenance and service of the pneumatic waste collection system.</td>
</tr>
<tr>
<td><strong>London ESCO</strong></td>
</tr>
<tr>
<td>London ESCO designs, builds, finances, operates and maintains decentralised energy infrastructure &amp; manages energy services.</td>
</tr>
</tbody>
</table>

**Table 13. Some examples of fully integrated solutions in our case studies.**

In the technological market, component suppliers are growing by making components and products for systems integrators. Firms benefit from specialising in systems integration because these activities require fewer assets* and generate higher margins than product manufacturing. Because systems integrators have an in-depth knowledge of their customers’ operational needs as well as the products they have designed, they are best placed to provide services to monitor, operate, maintain, finance and support a
6. Tipology of cases

product and gain revenue through their integrated solutions life cycles. A good example of this would be the pneumatic waste collection systems by both Ros Roca (22@) and Envac (22@ and Hammarby Sjostad) or the decentralised energy system by London ESCo (Gallions Park) mentioned in the previous table.

Some utility firms are also expanding the scope of the product offering to include services. This allows firms to find new business models because they can capture life cycle profits associated with the product and secure more continuous streams of revenue. Most utility firms (especially energy and water companies) are vertically integrated. Vertical integration enables these companies achieve coordination which, in the network organization, is systems integration. For systems integrator firms, an intimate knowledge of their products and customer’s needs enables systems integrators to provide operational services. By effective outsourcing and managing of upstream component manufacturers, these firms can concentrate on their core systems integration and operational service activities, while building up their capabilities in business consultancy and financial services to offer entire solutions to a customer’s needs.

Energy firms are vertically integrated and don’t concentrate only in systems integration capabilities (because they are not abandoning energy generation) but they are moving downstream into services by focusing on maintaining, financing and operating the supply network. They are single vendor systems integrators when it comes to energy (developed in-house), while multi-vendor system integrators when it comes to building the network.

Engineering consultancy firms (like Barcelona Regional, Sweco, Arup or Atkins) provide multi-vendor systems as they provide services to design, integrate and service components and products manufactured by external suppliers. They are horizontally integrated because they provide integrated solutions to customers across different industries.

Capabilities to deliver Integrated Solutions

Throughout the whole thesis, firms involved in the different projects have been evaluated to determine which their capabilities were in relation with those that are supposed to be the capabilities needed for delivering integrated solutions. These capabilities are: systems integration, operational services, business consultancy and financing. As we have already seen in the previous analysis of cases, it is quite difficult to find firms in the urban environment that own all of these capabilities. It seems that, being infrastructure networks large-scale capital intensive systems, it is probably more difficult to offer all these services by a single company.

Systems integration

Systems integration capabilities have been developed by some firms in order to provide customers with physical products that can easily be deployed with services as part of a solution to a customer’s need. Some firms may have traditionally designed and integrated systems using in-house developed components or may have always been based on providing services. The service providers with no in-house technology specialise in providing systems integration from products sourced from external manufacturers (some examples can be found in WS Atkins or Arup).
Customers (in this case municipalities) demand turnkey* solutions where the supplier is responsible for the entire set of activities involved in the design, integration, construction, testing and delivery of a fully functioning system. As it has previously been said, ENVAC or Ros Roca seems to be the firms offering what we could call integrated (turnkey) solutions. Systems integrators can also cooperate with partners in joint ventures* or consortiums to carry out other products, services or capabilities required to provide complete solutions to customers. Some examples can be found in Gallions Park, where LCCA selected EDF Energy as the preferred bidder to set up a joint venture* Energy Services Company (ESCO*) whose responsibility is to develop decentralized energy schemes for London. The centralised climate control in 22@ Barcelona, designed and managed by Districlima (partnership of Suez, Agbar and Axima) could be another example.

Operational Services

A general trend that has also been identified is that suppliers are moving into the provision of services to maintain, renovate and operate products. Utility companies, such as energy and water companies, offer comprehensive services to manage, maintain and operate a product through its life cycle from sale to decommissioning*. These services are usually related to the maintenance of the networks they operate or customer services.

A less common practice is providing embedded services, such as Fortum’s advanced energy control service or Agbar’s remote control systems for fault report in the network. But the most interesting product resulting from both systems integration and operational services is providing integrated solutions. The most significant integrated solutions in the cases reviewed are those provided by Envac and Ros Roca in the pneumatic waste collection system; and Districlima and London ESCO in the centralised climate control and the decentralised energy system respectively, where products and services are offered together as an integrated solution.

Business Consultancy

Some firms are also developing business consultancy capabilities to advise customers on how to plan, design, build, finance, maintain and operate systems. However, it can be noticed that, in our case studies, most firms owning business consultancy capabilities are concentrating on developing this capability; usually isolated. Some examples would be: 22@BCN,S.A. and Barcelona Regional for 22@; Stockholm Business Region, and Sweco for Hammarby Sjostad; LDA, London ESCo, ARUP and Drivers Jonas for Gallions Park and Urban Initiatives LTD, Alan Baxter, Black & Veatch and WS Atkins for Ashford.

These firms are usually pure design, legal or engineering consultants that are commissioned to develop a certain study for the new area or have to develop a plan with the premises previously established by partnerships involving the municipalities and utility companies. What’s more, they usually work with stakeholders*, municipalities and firms to develop their products and services, but customers outsource these works because they don’t have the necessary skills or expertise to develop them.
6. Tipology of cases

Financing

Some firms have also increased capabilities to provide finance (usually asset* management or vendor finance). The provision of finance has sometimes been together with design, construction and maintenance. However, the most common companies offering finance services are municipalities or local administrations pushing sustainable developments.

Actually financing is a real barrier for the development of these processes, as innovative processes are usually most expensive, at least the first ones, some of them not becoming profitable till they can get returns from repeating the integrated solution in other projects. Sometimes it is quite difficult even for municipalities to find funding for their projects. However, some consulting firms offer financing capabilities to help develop their projects and, in the construction field, certain developers* like Skanska also offer financing facilities participating in PPP*. In utility firms, this is not so common. However, London ESCo owns and finances the assets* for the decentralised energy system and Districlima in 22@ is involved in a kind of PPP* in a 25 year concession where local administrations (Ajuntament de Barcelona and Generalitat de Catalunya) invest around 25% of the overall cost.

Not many large public sector PFI* and PPP* projects have been identified in our cases (they are usually more related to other infrastructure fields such as transport or healthcare, as they appear in the Ashford’s Future project). Some examples of PPP*, apart from the Districlima case, could also be found in Hammarby Sjostad, such as the Sea Bus (a biogas driven commuter ferry).

Partnership Structures

Customer with limited technical experience may require partnerships as early as the pre-bid phase to discuss business plans, user requirements, and conceptual solutions, prior to specifying and integrating systems. This is what happens with municipalities when it comes to planning infrastructure.

Municipality-firm and inter-firm relationships

Inter-firm co-operation is very often concerned with the transfer, exchange or pooling of technology. New products also require the co-operation of firms with different capabilities. The indirect exploitation of new technology could be sought either through market transactions (transactions in licences, for example, where there is still some kind of cooperation between firms) or through co-operation with other firms. However, technology can’t be transferred just by selling the right to use processes (it consists of experience and skills, the “know how” rather than “know that”).

In the cases we have been studying, some partnership examples can be identified. Usually, for the characteristics of these innovative processes, they are both partnerships between the municipalities or local administrations and firms (to deliver a certain infrastructure), but also firm to firm partnerships to offer a new product or service joining capabilities from the different firms that are required to develop this new solution.
6. Tipology of cases

The most important partnership structures identified in these four cases can be classified into administration-firm partnerships and inter-firm partnerships. Regarding the administration-firms partnerships, we can find examples in the work done at 22@ Barcelona, Hammarby Sjostad and Ashford, due to the complex innovations that had to be delivered; municipalities had to work with all the firms involved in the process. In Hammarby Sjöstad, for instance, the unique partnership between administrations, authorities, architects and developers* has led to numerous innovative environmentally-friendly technical solutions which have been essential for the development of the Hammarby model. GlashusEtt, which is the centre for environmental communication in Hammarby Sjöstad, is also a partnership between the Stockholm Water Company, Fortum, the Stockholm City Development Administration and the Stockholm City Waste Management Administration and a way of explaining to the inhabitants how the innovations they live with work.

In Ashford, Ashford Borough Council also joined with key development stakeholders* to form the Ashford’s Future Partnership, which had to produce a masterplan and delivery plans to guide the Ashford Future project. This kind of partnerships is also advantageous for consultants like ARUP, which working in partnership with industry, governments and other organizations, have developed assessment methods and tools that enable their clients to incorporate sustainability into their business strategies, planning and operations such as the previously explained IRM tool.

When it comes to inter-firm partnership, our study cases also provide some examples. In the foundation of Districlima, a firm to manage the Centralised Climate Control in 22@, a joint venture* was created. Local authorities, Elyo Iberica, Aguas de Barcelona (Agbar) and Axima partnered so as to ensure to the communities an environmental-friendly heating and cooling system. This partnership was necessary in order to obtain the needed capabilities to design, build and operate the new system.

The same happened with BioRegional Quintain, which is a joint partnership between BioRegional Properties and Quintain Estates and Development PLC that at the same time is member of the One Gallions Consortia, aiming to deliver sustainable developments for Gallions Park in the Thames Gateway. Finally, the London ESCo is another example of new partnership aiming to supply energy in a decentralised manner. This kind of partnership was born from the need to join companies with complementary skills or capabilities for the realisation of infrastructure related to new technology.

6.2.3. Developing a typology of cases

One of the main goals of this thesis meant to be developing a typology of the study cases reviewed in chapter 4; which means identifying a number of common characteristics in these cases that somehow identify those cases as “a certain kind of processes”.

Integrating Urban Infrastructure Solutions
Therefore, a list of common features for the four previously reviewed cases identifying them as “areas experimenting with planning and use of integrated solutions for urban infrastructure change into sustainability” has been developed as follows:

1. All processes are capital intensive and technologically complex.
2. All projects have an integrated approach in design due to a holistic view* of the urban system.
3. There’s a strong focus on sustainability
4. Municipality takes the lead in promoting and financing the delivery of integrated solutions to urban infrastructure.
5. The four capabilities needed to deliver urban infrastructure integrated solutions are usually not in the same firm neither in municipalities. Administrations outsource design and management capabilities to other firms.
6. Cooperation between firms: there’s technological transfer between different sectors in the market.
7. Appearing both private-public and inter-firm partnerships (the first ones usually to manage the design process and the others to deliver integrated infrastructure solutions).
8. Some integrated solutions provided by single actors, especially in waste collection and heat and power systems.
9. Problems with delivering innovation and convincing private firms to follow.
10. Some repeating structures, especially in utility companies, which are usually vertically integrated (such as water and energy) now also providing services.
11. New business models (comprehensive services, embedded services and integrated solutions).
12. Problems with innovation in non-competitive markets.
13. Problems in financing innovation in some cases, but not many PPP*, PFI* appearing.
14. Most of the firms offer customer-centred solutions but search these solutions to be somehow repeatable in other places.
7. Conclusions

In this section, we’ll proceed to describe the final conclusions obtained from the previous work that will try to answer the questions proposed at the beginning of this thesis. The case study methodology has been quite suitable for the development of this analysis because it is a good approach for comparison of cases and offers enough information to extract conclusions from the proposed cases and get some answers to the questions that arose at the beginning.

After reviewing the systems literature and going through a thorough analysis of the proposed cases, we can conclude that systems integration is a good approach for urban planning because it takes a holistic view on the way infrastructure systems are planned. Subsystems are designed bearing in mind that they take part in a more complex system (“the whole is more than the sum of its parts”) and that they behave in relation to the other subsystems; which is particularly useful for taking advantage of the synergies that exist between these subsystems.

From what has been assessed in the case studies, we can confirm that the integrated approach in design clearly outweighs the conventional way of working because it enables the masterplanners and consultancy firms in charge of the network design, to work out integrated design solutions in cooperation with the utility firms and other stakeholders. These solutions may certainly have an extra cost, but this is more due to the better quality of the infrastructure solution provided than to the integrated process followed (without which most of these solutions wouldn’t have been reached). Many of these solutions also become profitable in the long run because they provide considerable energy savings and a more efficient management of the system (which may cut costs).

In assessing what firms get from systems integration and what the system gets, we can conclude that systems integration enables firms to plan and manage the system they develop in an integrated way; the design solution found is customer-oriented and serves their own customer’s needs and so do the services and maintenance during its life cycle. Therefore, the system is better operated and managed, and may also work more effectively because its interrelationships with the other subsystems are born in mind from the design stage.

Regarding the situations when the two types of systems integration (in design and as a strategic business activity) go together it has to be pointed out that integrated design solutions (technical solutions resulting from an integrated approach in design) are not always integrated solutions for firms. On the whole, they are different concepts. However, integrated design solutions can become integrated solutions for firms if the resulting system from this integrated design requires products going together with services and other products to work more effectively. That is to say, integrated design solutions can be integrated solutions for firms if they have been conceived as products, technology and services working all together in a customer-oriented way to achieve an aim; which is quite common because integrated design facilitates the creation of more efficient but also more complex solutions that may require that firms creating and operating these solutions follow new models of industrial organisation (such as systems integration).
When it comes to the expectations on the case studies, we should say that, even if expectations for each case are a bit different (transforming brownfields into technological areas, environmentally friendly neighbourhoods, zero-carbon sites or planning new growing areas), all these projects aim to develop innovative sustainable areas. Some cases, like One Gallions expects to demonstrate the economical and technical viability of zero-carbon sites, so somehow innovation in these processes aims to serve as a role model for future actuations.

Similarly happens with barriers and enablers. Although each case has its own specific barriers, a common constraint for these complex high value processes is funding. Firms are reluctant to invest in developments, systems or technology which initially cost more than usual (because of its novelty, complex design or technology) and that are not as economically profitable as the standard ones (or at least not proved to be so by now).

In general, funding for these projects is met out of taxes by municipalities (when it comes to the public space) and developers invest in the infrastructure required by their own developments. Usually developers and utility companies share the investment for their infrastructure because they believe they will recoup the money once the system is in service. Municipalities also invest hoping to recover their money from future tax payers in the area.

It is particularly interesting the 22@ case, where land owners have to pay taxes to finance the urban refurbishment when they decide they want to adapt to the new urban plan. In Gallions Park, developers pay for the whole development, while LDA (government development agency) is the owner of the land. In Hammarby Sjostad, Stockholm municipality was also the land owner. Lending the land for a development is also another way of public investment and promoting certain land uses. Finally, it is also curious that the property owners in Hammarby Sjostad jointly own the Envac’s underground waste transportation facility through a joint-property association.

Another recurrent limitation for the development of integrated solutions in the urban environment is convincing firms to change business models or create new capabilities to adapt to the performance needs of these solutions. New technical skills are required and also new capabilities have to be developed for delivering solutions for these cases, which may not be profitable in the short run.

The main enabler in these cases has been the municipal push of innovation in the four case studies and the creation of effective partnerships to carry out the integrated design and the conception of innovation in the waste, water and energy systems. Cooperation between administration, utility firms, developers and stakeholders* has proved to be central to the successful development of these processes. An important figure in these endeavours has been the development agencies or different partnerships in charge of the coordination of the projects which can be identified in each case.

Municipalities are the leaders of these urban projects and at the same time the customers to which integrated solutions are provided. In all cases, they are the pushers of innovation in these areas and the responsible for the creation of the above mentioned specific companies or agencies to manage these complex processes. Some of these agencies had even been created a long time ago specifically for dealing with these kinds of innovation processes in certain areas. Innovation is quite important in infrastructure.
planning because it means optimising resources and improving the way things are done (besides, from the business perspective, it is also necessary for firms to maintain competitive advantage).

What seems clear is that integrated design cannot happen without the cooperation between firms involved in the management of the systems to be designed; technological, engineering and legal consultants, administrations or companies managing the masterplanning process and all the other stakeholders* of the process. This is demonstrated by the four case studies previously reviewed, as they had to take cooperation into consideration from the beginning of the process to reach their goals and reaching to an agreement from the beginning became the key of the working process.

In Hammarby Sjostad, this cooperation was very important for achieving the resulting model (the Hammarby Model), which interrelates the waste, water & sewage* and energy systems in a way where the resources provided by one player are reutilised by another. In the Gallions park case, another kind of cooperation between firms took place. In this case, a joint venture* was created to develop the decentralised energy system required for the project (the London ESCO Limited). This is a private limited company with shareholdings jointly owned by the LCCA Ltd (a public agency) and EDF Energy (a private utility company).

Even if the four chosen case studies are significantly different, we have been able to identify common features in them that have enabled the development of a typology of cases that encompasses the common features of the different cases in different fields such as: their general approach, the kind of design processes they follow, the business models used by firms, the distribution of capabilities or the role of the different actors.

Systems integration as a business strategic activity refers to the design and integration of products and systems out of components developed in-house or sourced from external manufacturers. The case studies demonstrate that some firms are changing their strategies, some just adding services to existing products, others occupying new positions in the value chain, and developing the capabilities to offer integrated solutions. The clearest examples in our case studies of what an integrated solution embodies are: Districlima (DH&C in 22®), Ros Roca and ENVAC waste collection systems (Barcelona and Hammarby) and London ESCO (in Gallions Park).

Sometimes, like in the Gallions Park case, the change in business models has been motivated by a change in policies. The new targets in carbon emissions have produced a potential infrastructure convergence with developers* considering a change in their business models (developers moving into the provision of services and energy companies considering a move towards onsite infrastructure) and the incumbent energy companies considering a move into the provision of onsite infrastructure, across a wider array of services.

As we already know, the change in business models requires developing or acquiring new capabilities. As pointed out in the comparison of cases, the supposed capabilities needed for the provision of integrated solutions are distributed between the different firms involved in the process of creation of infrastructures for the built environment, being really difficult to find a single firm encompassing all the capabilities.
7. Conclusions

Obviously, by changing their business models firms seek to maintain competitive advantage. In our complex world, a firm’s competitive advantage is not simply about providing services, but how services are combined with products to provide high-value “integrated solutions” that address a customer’s business or operational needs. Firms venturing into systems integration have chosen their way to seek the achievement of a sustainable competitive advantage.

As we know, innovation is essential for the maintenance of competitive advantage in firms respect to their competitors. Nevertheless, we have assessed that a main problem with urban infrastructure and service providers is that some of them are natural monopolies in some countries. These companies industrialize their processes and, not having any competition, they have no need to innovate.

In capital goods, the reason why firms are moving downstream in the value chain is that a mixture of stagnating product demand and a growing installed base of products are forcing economic value to migrate downstream from manufacturing to services. This is due to the fact that the purchase cost of the product represents only a fraction of the total cost of operating and maintaining it during its life cycle. In large technical systems, the situation is a bit different, because the purchase costs or initial investment in these systems is much higher than that of capital goods. Even if the costs of operating and maintaining these systems are also higher and more profit can be made from offering related services, “downstream business” models seem more profitable for capital goods manufacturers whose purchase cost is quite low and much more proportional profit can be made from providing services throughout the whole life cycle of these capital goods than by selling more product units.

To conclude, concerning future case studies, it would be really interesting to follow the processes of the four cases reviewed in this thesis in time, in order to assess the final outcome. Some of these processes are still in a very initial stage, which means that some systems haven’t been planned yet and that some innovative business models haven’t been tested. Once the cases are finished, there will be more data about costs and time spent in the planning of integrated solutions, which will enable a deeper comparison of outcome respect to conventional methods (even if, as it has been argued before, this comparison may be difficult to carry out).

Finally, regarding different future case studies and developing typologies, it could be interesting to extend the same kind of analysis to cases out of Europe, trying to develop a worldwide typology of cases if possible (taking also especial attention to the way things work in the US, China, Japan or Australia). Another possible future study would be following the same kind of case study methodology focusing on cases innovating in other urban systems that haven’t been studied here, such as telecoms or transport infrastructure (such as roads, railway, underground or bridges) where Public Private Partnerships (PPP*) are more common.
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9. Glossary

- **Asset**: a thing of value, especially property, that a person or company owns, which can be used or sold to pay debts.
- **Bargaining power**: Negotiating power; when discussion of prices and conditions takes place with the aim of reaching an agreement that is acceptable.
- **Capital goods**: In economics, *capital goods*, in contrast to *consumer goods*, are goods used in the production of (physical) capital. Capital goods refer to real products that are utilized in the production of other products but are not incorporated into the other products themselves. They are often called fixed human-made means of production. Capital goods include factories, machinery, tools, and various buildings. They are different from raw materials which are used up in the production of goods. Many goods could be categorized as capital goods or as consumer goods according to usage; for example cars and personal computers, these - and most capital goods - are also durable goods. Capital goods are also different from financial capital. Capital goods are real objects owned by entities (individuals, governments, and other organizations) in order to get a positive return of some sort from production, while financial capital refers to pieces of paper (or other kinds of promises) that represent claims on these types of goods and on other sources of promised future income.
- **Concession**: A concession is a business operated under a contract or license associated with a degree of exclusivity in business within a certain geographical area. In the case of a public service concession, a private company enters into an agreement with the government to have the exclusive right to operate, maintain and carry out investment in a public utility (such as a water supply system) for a given number of years.
- **Contractor**: A person or company that has a contract to do work or provide goods or services for another company.
- **CoPS (Complex Product Systems)**: CoPS are the high-technology and high-cost capital goods that underpin the production of goods and services. Examples include telecommunications systems, flight simulators, high-speed trains, air traffic control systems, intelligent buildings, missile systems, aircraft and baggage handling systems. These engineering and software-intensive products, systems, networks, constructs and services are produced by project-based organisations as one-offs or in small tailored batches for individual business users.
- **Decommissioning**: formal process to remove something from active status.
- **Developer**: A person or company that buys land or buildings in order to build new houses, shops / stores, etc., or to improve the old ones, and makes a profit from doing this.
- **Economies of scale**: cost advantages that a business obtains due to expansion.
- **Economies of scope**: they refer to efficiencies primarily associated with demand-side changes, such as increasing or decreasing the scope of marketing and distribution, of different types of products. If a sales force is selling several products they can often do so more efficiently than if they are selling only one product.
- **Energy Service Company (ESCO)**: An ESCO is a business that designs, installs, maintains, and in many cases finances retrofit and upgrade projects to improve
the energy efficiency of buildings and facilities. ESCOs have the expertise to make the most of energy efficiency opportunities. They generally act as project managers for a wide range of tasks associated with making energy efficiency improvements, and typically offer the following services: identify and evaluate energy-saving opportunities, design an energy efficiency program that meets the development needs, manage the project from design to installation to monitoring, arrange for financing, train staff and provide ongoing maintenance services, guarantee that energy savings will cover all project costs. When an ESCO undertakes a project, its compensation, and often the project’s financing, is directly linked to the amount of energy that is actually saved.

- **Holistic View**: A holistic view is taken when the idea of the whole of something has to be considered to understand its different parts. The whole thing or being is thought to be more than the collection of its parts.

- **Joint Venture**: A joint venture is an entity formed between two or more parties to undertake economic activity together. The parties agree to create a new entity by both contributing equity and they then share in the revenues, expenses, and control of the enterprise. The venture can be for a specific project only or a continuing business relationship.

- **Leverage**: Borrowing money to supplement existing funds for investment in such a way that the outcome is magnified. Borrowed funds to attempt to increase the returns to equity.

- **Liability**: the amount of money that a person or company owes.

- **Liberalization**: fewer government regulations and restrictions in the economy in exchange for greater participation of private entities; the doctrine is associated with neoliberalism. Although economic liberalization is often associated with privatization, the two can be quite separate processes. For example, the European Union has liberalized gas and electricity markets, instituting a system of competition; but some of the leading European energy companies (such as EDF and Vattenfall) remain partially or completely in government ownership. Liberalized and privatized public services may be dominated by just a few big companies, particularly in sectors with high capital costs, or high sunk cost, such as water, gas and electricity. In some cases they may remain legal monopolies, at least for some part of the market (e.g. small consumers).

- **(to) pervade**: to spread through and be noticeable in every part of something.

- **Private Finance Initiative (PFI)**: It is a subtype of PPP. The Private Finance Initiative (PFI) is a controversial method, developed initially by the United Kingdom government, to provide financial support for "Public-Private Partnerships" (PPPs) between the public and private sectors. PFI projects aim to deliver infrastructure on behalf of the public sector, together with the provision of associated operational services. Every PFI project has its own particular characteristics; however there are some common threads that run through all projects. The public sector authority signs a contract with a private sector Special Purpose Vehicle (SPV). The SPV is a company formed for the specific purpose of providing the PFI. It is owned by a number of private sector investors, usually a construction company, a service provider, and a bank. PFI contracts are for long terms, typically 30-60 years. PFI is not just a different way of borrowing money. Not only does the private sector consortium provide the finance for the project, it also operates the services. This means that many public sector staff that work in the PFI facility have their employment contracts automatically transferred to the private sector.
• **Product Bundling**: it is a marketing strategy that involves offering several products for sale as one combined product. This strategy is very common in the software business (for example: bundle a word processor, a spreadsheet, and a database into a single office suite), in the cable television industry (e.g. basic cable in the United States generally offers many channels at one price), and in the fast food industry in which multiple items are combined into a complete meal.

• **Public Private Partnerships (PPP)**: It describes a government service or private business venture which is funded and operated through a partnership of government and one or more private sector companies. PPPs bring together consortia including developers and investors, constructors and other service providers to finance, create and operate assets* - such as highways, hospitals, schools and power plants - through long term contracts. These development consortia and the Special Purpose Companies (SPCs) that they form, are designed to deliver services according to strong contractual agreements that are negotiated with their public sector clients. These contracts generally last for between 15 and 50 years.

• **Refuse**: Garbage, rubbish.

• **Sewage**: mainly liquid waste containing some solids produced by humans which typically consists of washing water, faeces, urine, laundry waste and other material which goes down drains and toilets from households and industry.

• **Sewage works**: a place where chemicals are used to clean sewage so that it can then be allowed to go into rivers or used to make manure.

• **Silt**: sand, mud, etc. that is carried by flowing water and is left at the mouth of a river or in a harbour.

• **Stakeholder**: a person or company that is involved in a particular organization, project, system, etc., especially because they have invested money in it.

• **Systems Engineering**: Interdisciplinary approach and means for enabling the realization and deployment of successful Systems. It can be viewed as the application of engineering techniques to the engineering of systems, as well as the application of a systems approach to engineering efforts.

• **Turnkey solutions**: Monitoring and project management until the system is up and running.

• **Unbundling**: It is the contrary of product bundling (separating products from a bundle).

• **Urban Management**: A specialty in the field of urbanism, traditionally studied by architects, engineers and lawyers. It comprises the set of practices establishing the technical and legal way to implement urban plans. Its purpose is to clarify and conclude the work of different actors in the process: governments, owners, developers and promoters. Compared to urban planning, given the need of an overall vision in the urban field, management involves much stronger technical and legal dimensions.

• **Urban Manager**: His task is to ensure the provision of Basic urban services such as water, waste, removal, security, transport and an environmental conducive to economic activity while maintaining fiscal sustainability of city operators.

• **Vendor financing**: A loan from one company to another which is used to buy goods from the company providing the loan. In this way, the vendor increases sales, earns interest, and may sometimes also acquire an interest in the customer.
• **Wholesale:** connected with goods that are bought and sold in large quantities, especially so they can be sold again to make a profit.
Appendix
Ramon Sagarra depèn del departament que porta l’urbanisme i el territori del projecte 22@ en l’empresa 22@Barcelona,S.A. Aquest són 3 parts: direcció de planejament urbanístic (morfològia de l’edificació i dels carrers, rasant, alçades reguladores i aprofitaments), gestió urbanística (procés d’expropiacions i tot allò que fa viable la gestió urbanística, en el nostre cas amb una lògica molt privada perquè la major part del sòl és privada) i infraestructures (refer 35 km de carrer amb un seguit de xarxes que en bona part s’han de construir de nou). Treballa per 22@Barcelona,S.A. Societat anònima mercantil, 100% de titularitat municipal que actua de catalitzador del procés de transformació.

El Poble Nou era un barri fabril que es va crear fa més de 200 anys per temes tèxtils i fa uns cinquanta anys va quedar obsolet del tot. Van començar a venir activitats que no eren pròpies per estar al centre d’una gran ciutat o una àrea metropolitana com és Barcelona (terciàries, restes d’indústria pesada, etc.) i és per això que arrencà el 22@.

La major part del sòl és privada i l’ajuntament crea aquesta empresa per empènyer el procés de transformació. Es modifiquen els escenaris patrimonials del sòl i es permet fer unes coses diferents en aquest sòl, s’amplien molt els usos admesos, es prohibeixen les activitats industrials pesades, es prohibeix l’habitatge específicament (perquè és l’ús més lucratiu del sòl i s’allunyaria d’aconseguir l’activitat econòmica que es pretén crear) i s’incrementa l’edificabilitat del nombre de pisos respecte la situació actual. Aquestes són les claus del pla per tirar-lo endavant.

Per què s’ha creat l’empresa pública 22@BARCELONA,S.A.? Quin és el seu rol en referència a la planificació i disseny d’infraestructures? Per què s’ha utilitzat aquest model (més barat, més fàcil de gestionar...)

Hem de gestionar 2M de m$^{2}$ de sòl. A Barcelona es lloguen cada any un promig de 250.000 m$^{2}$ d’oficines i el 22@ acabarà pràcticament amb 3.5M de m$^{2}$ d’oficines i mig milió de metres quadrats d’altres usos (equipaments...). La maquinària municipal no està preparada per absorbir un procés d’aquestes dimensions per la quantitat de planejament i gestió urbanística que estem concentrant aquí. Si fiquem la maquinària municipal aquí, la traiem d’allò per lo qual ha estat dimensionada. Llavors es crea aquesta empresa no tan sols per l’absorció de la gestió sinó per la promoció del procés de transformació i per la promoció econòmica que s’ha anat desenvolupant amb el temps (es va començar més amb la part urbanística, edificatòria i constructiva però cada cop hi ha més gent que es dedica a la part de promoció econòmica perquè el pla rutlli, els edificis s’ocupin i hi hagi activitat innovadora).

Com es finança??

L’increment d’edificabilitat que es dóna als privats i aquests nous usos fa que els seus sòls valgui més, perquè es poden fer edificis més alts i que n’obtinguin més rendiments. Per poder-se transformar, han de pagar unes quantitats a l’ajuntament (al 22@Barcelona,S.A. com a braç instrumental de l’ajuntament) per poder fer aquestes obres i això representa aproximadament el 60% dels ingressos que tenim. Són les anomenades cargues d’urbanització (càrregues dels privats per poder fer les obres
d’urbanització). L’altre 40% surt aproximadament meitat i meitat entre companyies de serveis i el propi ajuntament. L’ajuntament aporta aquesta quantitat sobretot per construir les xarxes que depenen d’ell. Aquestes no es poden considerar càrregues d’urbanització com el paviment o els arbres perquè són xarxes que gestions l’Ajuntament. Per exemple, si construïm una xarxa de recollida pneumàtica de residus, no passaran camions ni tindrem contenidors però tindrem uns tubs que recullen les escombraries (que qui reculli les escombraries deixa de pagar) i per tant es paguen posant aquesta instal·lació. Aquest 60, 20, 20 aproximadament, són les proporcions crítiques d’aquest pla. També s’ha de dir que per arrancar aquest projecte l’ajuntament sí que ha posat diners avançant part de la inversió, que després recuperarà, perquè sinó el procés era inviable en sí mateix. Per tant hem de començar arribant als llocs amb els serveis perquè es donés el procés de transformació, de manera que es van avançar diners al principi i ara ja s’han començat a recuperar.

Són 225 illes de titularitat privada. L’ordre en què es transformaran no el sabem. Cada propietari del sòl aprofita aquesta oportunitat per treure el màxim de rendiment d’aquest de la manera que li sembla més oportuna. Per tant no sabem quines seran les primeres illes en transformar-se. Per tal de donar servei a aquests 35 Km i 115 illes, s’han articulat unes columnes vertebrals dels serveis de forma que garantim que estem a una distància de 2 illes de qualsevol promoció possible. Llavors, quan qualsevol propietari decideix transformar-se, jo sé que tinc uns serveis en aquesta columna vertebral i que en el temps que ell tarda en fer-se l’edifici, si li poden portar els serveis des d’aquesta columna vertebral. Quan es porten aquests serveis es decideix si es fa reurbanitzant sencer un carrer determinat o com es fa. Per crear aquesta columna vertebral han calgut els diners de l’ajuntament, que han hagut d’avançar part de la inversió.

- Existeix una data límit perquè es doni aquesta transformació??

Els instruments que s’han posat perquè es doni tot això és la modificació del Pla General Metropolità (PGM) de la zona del districte on està situat el 22@, que és un pla urbanístic que modifica el Pla General. Després hi ha un pla especial d’infraestructures (PEI) que és el que regula com s’han fet les columnes vertebrals de què parllavem, i entre aquests dos, donen lloc al que s’anomena el Planejament Derivat. Per cada illa (el més comú) o cada paquet d’illes, se’n fa un pla especial de reforma interior (PERI®) o actualment Pla de Millora Urbana (PMU). Els PMU són els que limiten el temps. Típicament, si parlem d’una illa, diem que el pla es durà a terme amb un mínim d’un any i un màxim de quatre amb un afegit de quatre més (si en 4 anys no ha passat res i cap privat ha començat a construir res; els següents 4 anys pot ser l’administració que, des de la seva iniciativa, impulsi el pla si creu que és d’interès general), per tant amb un màx. de 8 anys. Cada illa o paquet d’illes en els quals es fa el planejament derivat està sotmès al seu PMU i cada PMU té la seva pròpia planificació (amb aquest màxim de 8 anys). L’administració pot promoure la repartimentació si creu que el projecte és bo i d’interès general com a part interessada d’aquest procés de transformació si en els 4 anys que ha tingut el privat per tirar-lo endavant no ha passat res. La repartimentació fa que el sòl es redistribueixi en nous propietaris. Si no passa res en aquests 8 anys, aquest pla deixa de tenir vigència i se n’hauria de fer un altre. Si en una mansana ningú hi vol fer res, allò es queda tal i com estava.
- **Quan va començar aquest procés?**

La modificació del PGM és de l’abril de l’any 2000 i el primer que es va fer per començar a dur a terme aquest projecte va ser veure quins eren els edificis consolidats i d’interès històric o cultural que valia la pena conservar i que l’activitat que tenien a dins també era desitjable que es conservés però que era il·legal. Se’ls va donar un termini per regularitzar-se. Per fer-ho van haver de millorar les seves infraestructures amb una intenció clarament productiva perquè els feia més competitiu i van haver de pagar les primeres càrregues d’urbanització. Eren edificis i, per tant, la part de càrrega que els tocava era relativament petita i a la vegada era una manera de fer començar a funcionar el projecte.

- **Quan es paga aquesta càrrega d’urbanització?**

Es paga amb la reparcel·lació, quan es crea una nova distribució del sòl entre els nous propietaris per adaptar-se a la nova normativa (amb un espai per serveis i zones verdes que és d’aproximadament un 5%). La reparcel·lació, un cop aprovada, és inscrita al registre de la propietat. A partir del moment en què s’aprova definitivament aquest repartiment, que és quan s’aprova la reparcel·lació i es poden fer els nous edificis, és quan es paguen les càrregues urbanístiques. Conseqüentment, no es podrà començar un edifici si no s’ha pagat. Si un propietari té un edifici i no el vol tirar, aleshores el pla l’ha de respectar, mantenint-se aquest amb l’anterior qualificació (22a), que és industrial i no passarà a 22@, que serien gairebé tots els usos menys habitatge (oficines, comerç, hotels...).

- **El que es manté segueix pagant les càrregues urbanístiques?**

Aquestes càrregues es paguen per transformar-se. Per passar de poder edificar 2m² de sostre/m² de sòl a edificar-ne 3. A més a més, els nous usos són entre el doble i el triple de cars que el sòl industrial (es cobra més transformant-se). En fer la reparcel·lació es genera un balanç de drets i deures. Si tinc un edifici que s’ha de respectar i hi ha un percentatge de sòl que tinc dret a edificar però no puc, puc vendre’m aquest dret. De totes maneres, hi ha una lògica econòmica i una formal o arquitectònica, no deixarem construir un gran bloc al costat d’un edifici baix.

- **Com s’han planificat les xarxes d’infraestructures?**

De normal estem acostumats que els serveis passin per sota la vorera i a cada casa entren tots els serveis i, per tant, les voreres estan completament col·lapsades. Aquí al 22@ ja hi ha unes xarxes preexistentes que van subministrant els diferents serveis i les voreres ja estan ocupades amb aquests serveis. Qualsevol de les illes del 22@ es pot transformar amb un ordre indeterminat, i si ho fa, jo li he de fer arribar els serveis adequats. Aleshores, faig la graella de nous serveis, però no puc eliminar els serveis antics perquè em segueix donant servei a les illes que encara no s’han transformat. La xarxa elèctrica i de telecomunicacions es farà nova, però no puc tallar la instal·lació existent. Les voreres estan bastant ocupades.

Davant d’aquest problema, es va decidir crear una nova manera de desplegar els serveis. Tots els edificis tenen planta soterrani. Rebentar la vorera i desplaçar els serveis costaria molts diners. Llavors portem els nous serveis per la calçada, els posem a sota quan fem
el carrer i al mig de cada illa aproximadament, fem unes galeries que connecten les plantes (-1) dels diferents edificis. De manera que aquests serveis els intercepto i el fico a dins de l’edifici. Per la galeria hi poso tot el que són cables, perquè pels tubs és una mala solució (com l’aigua té empentes i problemes mecànics grans, de normal no es posa amb els cables). Aquesta solució és molt bona per telecomunicacions i energia elèctrica. El clavegueram normalment no es toca, només es fa de nou el clavegueró quan es fa l’edifici, que és el tub que connecta l’edifici amb la claveguera. La distribució d’aigua, quan es substitueix, de vegades l’escomesa passa per la galeria, perquè és petit i es comporta com un cable de polietilè bastant flexible i que es pot clavar amb unes brides per contenir les empentes. Els tubs de transport mai, mirem que passi per fora perquè provocaria problemes de juntes i condensacions.

- **Qui ha fet aquest disseny de les infraestructures?**

Les respectives companyies no han fet res. Tot el referent a les infraestructures del 22@ està definit en el PEI, que és un pla que l’ajuntament ha encarregat a una empresa de planificació urbana que es diu Barcelona Regional, que també és pública, tot i que no és el 100% de l’ajuntament. A mi em toca desenvolupar el PEI com a cap d’infraestructures del pla 22@.

- **Llavors, en quin moment es posen en contacte amb les empreses de serveis?**

Com volem que ens paguin el 20%, hem de contactar amb elles durant el disseny. La tramitació administrativa, perquè l’urbanisme està molt reglat, fa que hagis de garantir que una pila d’agents vagin alhora. Aleshores, el planejament passa per una etapa d’exposicions públiques i les companyies interessades fan les seves al·legacions. Totes les companyies, si no se’ls diu res, haguessin al·legat que tenen el sistema normalitzat i que el sistema del 22@ no entra dins els seus esquemes, i que la galeria la fessim nosaltres. Per tant, abans de portar el PEI a aprovar, es va pactar amb totes les companyies que haguessin de donar servei a la zona 22@ en quines condicions es feia aquest PEI perquè no es presentessin al·legacions en el període d’exposició pública. Després es van desenvolupar totes aquestes relacions fins arribar a les formes constructives que han permès fer les obres i en aquest moment ja està fet un 30% aprox. d’obra feta, havent canviat la forma de distribuir els serveis.

Tots els serveis dels quals parlem són monopolis naturals. Només n’hi pot haver un i ha d’estar regulat. Els monopolis naturals que presten els seus serveis no només a Espanya sinó multinacionals, industrialitzen els seus processos. I com no tenen competència, no tenen perquè innovar. Per tant, la companyia no té en compte el que vulgui fer la ciutat perquè el que li interessa és el seu compte de resultats. Presten un servei públic, d’interès general, regulat, però això no treu que sigui un servei prestat per companyies privades, que al final tenen un compte de resultats i unes accions que pugen i baixen i perseguixen repartir dividends entre els accionistes o comprar empreses a l’estranjer com feia Fecsa-Endesa. Per perseguir aquests resultats s’industrialitzen, i en aquest procés d’industrialització, les particularitzacions van fatal, perquè necessiten comprar materials diferents, els perjudicen en la política de compres, els seus tècnics han de saber operar i reparar diferents models i formats, ...

A nosaltres ens ha tocat fer la pedagogia de tot això i convèncer-los de que era una cosa posibila per a ells. Vam tenir la sort que 35 km de carrer equival a una població d’una
CERTA DIMENSIÓ. A FECSA, PER EXEMPL, SE’LS VA AMENÇAR DE QUE SI NO VOLIEN FER-HO ELLS, ES BUSCAVA UNA ELÈCTRICA ALEMANYA QUE TENIA MOLTES GANES DE TENIR INFRAESTRUCTURA A BARCELONA I QUE HO FARIEN ELLS. DE MANERA QUE, TOT I QUE VAN VEURE QUE ERA UNA COSA COMPLICADA, TAMBÉ VAN CONSIDERAR QUE, PER LES DIMENSIÓNS, ERA PRÀCTICAMENTE GRAN COM PER FER-HI DEDICAR UN PARELL DE TÈCNICS A VEURE COM ES PODIA FER PER COMPATIBILITZAR AQUESTA INDUSTRIALITZACIÓ.

- **On radica la innovació i quines són les particularitats d’aquest projecte?**

En aquest cas seria distribuir serveis a través de galeries o crear un servei nou com és la calefacció centralitzada o desplaçar els centres de transformació que típicament estan en un local que un senyor ha de cedir en el seu edifici, aquí no es fa així; es posa el local des del planejament urbanístic. Es col·loca el centre de transformació en el subsòl, i des d’allí es donarà servei a tres edificis sense que calgui que cada edifici faci el seu, per tant serà més operatiu i no caldrà aixecar el carrer. Per tant, s’ha canviat la forma de distribuir els serveis; també s’ha ficat dins les cases molts serveis que estan al carrer: sales tècniques d’armaris a dins les illes de forma que hi ha una xarxa d’espais per passar els serveis. Per tant, la innovació és haver distribuït els serveis d’una manera diferent i de manera que no estiguin al carrer ni estiguin a la vorera sinó ficats en sales dins edificis, i garantint el dret d’accés i de pas a aquestes sales i edificis perquè les companyies puguin prestar els seus serveis de forma que el carrer queda més lliure de trastos i obres i menys sotmès a la obstaculització de les infraestructures amb el ciutadà.

- **Aleshores tampoc hi ha hagut cap relació de cooperació entre empreses de serveis?**

En el moment que vam començar la primera obra vam assegure en la mateixa taula els més afectats, que eren les empreses de telecomunicacions (Telefònica i Localret en representació de les altres). Localret és una associació d’Ajuntaments que treballa amb totes els operadors, i que també té un bon perfil tècnic. També hi haguem asssegut Fecsa-Endesa, i Aigües de Barcelona i Gas Natural van venir els primers dies però després ja no es va fer falta. Amb aquestes empreses vam decidir fins el menor detall quines eren les característiques constructives de tot el que anàvem a fer, i amés de mutu acord, perquè les galeries són comunes. Vam treballar durant dos anys i al final vam redactar un document d’especificacions constructives de les xarxes i espais del 22@. En base a això vam construir els carrers i les xarxes quan s’han anat fent les obres de transformació.

- **Per tant, no hi ha cap servei que impliqui la col·laboració de dues empreses de serveis?**

Nosaltres quan fem el carrer, quan toca fer-lo perquè hi ha un edifici amb prou demanda per fer-lo, nosaltres ens possem d’acord amb totes les companyies per fer nosaltres la major part de la feina possible. Agafem un contractista (FFCC, DRAGADOS...) i aquests senyors aixequen les calçades i es dedica a posar-hi servei. Nosaltres tenim acord amb les companyies per fer-li nosaltres l’obra a ell. I ells la paguen (aquest 20% de la finançament que ve de les empreses de serveis). Però aquesta obra és unitària, s’aixeca el carrer i es fa tot de cop. Hi ha part de les obres que les companyies no volen que les fem nosaltres, i aquesta és certa fricció. Però l’obra és única i s’hi fica tot el que convingui, perquè no anirem obrint el carrer cada cop que hi possem un servei.
- Aleshores, aquestes han estat les principals dificultats a l’hora de dur a terme aquest procés?

Des de la lògica pública, o de relació amb les empreses són aquestes i després hi ha un problema amb els privats. Hi ha unes normes de com es fan els edificis, que són a la norma tècnica de l’edificació o el codi de l’edificació aprovat més recentment, que són segons les quals es regeixen els arquitectes. Aquí s’han canviat aquestes normes, amb lo qual quan un arquitecte ve aquí, el primer que s’ha de fer és explicar-li les innovacions: sales tècniques, les galeries i totes aquestes coses, ensenyar-los per on passen els serveis... I el que s’ha de fer és enganxar els arquitectes al principi i convèncer-los que ho han de fer, perquè això és normatiu (va segons el pla urbanístic), que ho entenguin i ho acceptin. Si per les companyies era complicat, però al fer-ho en 35 Km van acabar veient que podia ser rentable, documentar bé tota aquestes arquitectes ha estat un esforç pedagògic molt gran.

- Quines són les empreses implicades en la gestió de les infraestructures?

Localret no presta cap servei, és una associació de municipis que venia en representació dels operadors alternatius a Telefònica. Les que hi estan implicades són: Telefònica (telecomunicacions), FECSA-ENDESA (energia), Aigües de Barcelona (aigua), Gas Natural (gas), Districlima (servei de climatització centralitzada), l’Ajuntament de Barcelona a través de 2 concessionaris (ENVAC i Ros Roca) gestiona el servei de recollida pneumàtica d’escombraries, l’Ajuntament també té una xarxa de telecomunicacions pròpia que administren entre 22@ i l’Institut Municipal d’Informàtica tant per prestar serveis propis com els semàfors (per sincronitzar-los o centralitzar les seus de districte o Guàrdies Urbanes) com també part d’aquesta xarxa es posa al servei de tercers. Els privats podran llogar la capacitat excèdent d’aquesta xarxa. La resta de serveis urbans: clavegueram amb l’Ajuntament de Barcelona que delega en CLABSA (propietat de l’Ajuntament, però més operativa).

- El clavegueram es manté tal i com estava?

A molts llocs, en el 35% del carrer es refà, perquè al refer el carrer, en un 5% dels llocs ens molesta on està i no deixa passar la resta de serveis, per cota o el que sigui, i el 30% és un clavegueram vell que quan fas l’obra et cau esmicolat. Ara ja s’ha après a priori a saber que s’haurà de refer, però fins fa un any i mig o dos intentàvem no tocar-lo i queia. Ara ja n’hem après més i podem incorporar el tema clavegueram als projectes.

- Per què s’han escollit aquestes empreses? Com han treballat?

La majoria són monopolis o concessionàries municipals i per tant no hi havia més opció. Aquestes empreses han treballat sempre per separat. Això dels partnerships va estar molt de moda quan es van lliberalitzar els serveis i es parlava que en una sola factura poguessis pagar tots els serveis, però en aquell moment la gent es pensava que això funcionaria, però com la liberalització de serveis ha estat una entelèquia, i la major part del sector telefònic que és el que s’ha liberalitzat més amb diferència (tot i que encara està en mans de Telefònica després de 15 anys de liberalització). En l’energia, FECSA-ENDESA segueix venent-la... Si realment s’hagués obert la porta a què FECSA pogués oferir la distribució d’aigües sí que tindria sentit però, a part de que són
infraestructures que s’amortitzen a molt llarg termini i han d’estar a una sola mà... que
uns escombrin els altres ha estat un fracàs en aquest sentit. En teoria, al pensar en la
liberalització de serveis, això tenia sentit però com no n’hi ha hagut, té poc sentit.

- **Com es pot trencar això?**

Home, és molt complicat però nosaltres ho hem fet bastant. Ara, ha costat bastant... En
la teoria de la integració de sistemes les empreses eren més eficients per economies
d’escala... però a la pràctica no es pot dur a terme tal i com està ara, perquè una empresa
es busca la vida i ofereix més serveis si està en competència, però com no és el cas... Ha
estat molt complicat i ha estat el nostre esforç que al menys la ciutat hi surti guanyant,
pерqué no hauríem de rebentar els carrers varis cops, els serveis estaran de forma
organitzada perquè el manteniment sigui correcte i el servei no calgui anar-lo tallant
cada dos dies... Hem estat els treballadors municipals els qui teníem aquest repte i l’hem
fet realitat.

- **Té difícil sortida això?**

Home, el model via concessionària i que siguin les concessionàries les que estan en
competència és una sortida: que la xarxa sigui de titularitat pública, que en la xarxa
electrica és bastant així (Endesa i Gas Natural han separat la xarxa de l’energia que hi
passa). Però són models que s’aguanten poc.

- **Com s’aconsegueix aleshores fer nous models o innovar en la implantació
dels serveis?**

La única manera és la pressió política. Aquesta és una qüestió de voluntat política, si els
polítics diuen que hem de ser més sostenibles, jo em barallaré amb les companyies i
acabes i acabem pagant tots la factura, perquè les companyies tenen els seus ingressos
taxats i les seves despeses amb la seva industrialització i tot allò que els canviïs ho
acabes pagant. En aquest cas, al final hi van estar’al d’acord perquè els costos de
sobreexplotació era relativament petit. Quan tens idees les pagues des de
l’administració. No és cert que les companyies inverteixin. Tot el que inverteixen en
I+D és perquè ho dá la l’Estat en programes de foment a la innovació. L’empenta
sempre ha de ser municipal.

Per les companyies de serveis, continuar sent un monopoli d’aquestes característiques,
les atribucions i competències que tenen depen només de la voluntat dels polítics. Les
companyies de serveis, amb el servei que presten guanyen francament poc. El negoci és
molt intervingut. Però on guanyen diners és en tots els negocis associats al negoci
principal. És a dir, Feesca-Endesa és el titular en règim de monopolí de la xarxa electrèica.
Posant a disposició la xarxa de la pròpia Feesca a altres operadors energètics, Feesca
guanya pocs diners. On guanya diners és construint aquesta xarxa, fent els centres de
transformació dels edificis, aconseguint els contractes d’energia perquè aquests vagin a
parar a ells i no a altres companyies... És a dir, tot allò que gira entorn als seus serveis
són negocis privats, i allà és on s’hi guanyen la vida. Per això es parla del déficit tarifari
d’Endesa, que els costos energètics que paga Feesca-Endesa són molts més que els que
reflecteixen la tarifa, que és veritat, però tots els diners que també guanya perquè té el
control de la xarxa electrèica també s’aurien de comptar si es volgués fer un càlcul ben
fet. Però no s’hi posen perquè actua com agent en competència privat (tot i que és
fictícia, perquè actua en el mercat, amb preus lliures, però exerceixen de monopolis). I buscar un altre proveïdor que et munti una altra xarxa seria massa complicat.

- Com s’ha tractat el tema de la sostenibilitat en aquesta planificació?

És inherent al procés. S’ha tingut en compte bastant, i el servei de climatització centralitzada n’és una mostra. En aquest servei també s’integraran les plaques solars tèrmiques en la climatització de manera que l’escalfor que aconseguiu de les teulades la recirculem allà. El fet de construir les galeries de serveis, també fa innecessari anar rebentant el carrer i per tant no cal trençar el que ja s’ha construït (això seria més un tema d’impacte o sostenibilitat civil que de sostenibilitat energètica). Les polítiques d’atracció d’empreses també al final té la sostenibilitat del territori perquè hi hagi una activitat econòmica que aguanti el territori.

La concepció del 22@ és fer unes infraestructures al més sostenibles possible (climatització centralitzada, telecomunicacions a disposició dels serveis... aquesta xarxa municipal també la donem a les companyies de serveis perquè siguin més eficients i posin telecomandaments als transformadors... i empènyer la bona gestió del servei públic i la sostenibilitat. També s’utilitzen materials reciclats, paviments amb pneumàtics, i altres maneres d’actuar que s’han anat aprenent i són ben valorades pel ciutadà i pel medi ambient.

Per tant, la concepció del 22@ és crear un territori amb menor petjada ecològica i amb més sostenibilitat econòmica. Al final això es fa perquè el municipi de Barcelona estigui ben balancejat perquè el sector terciari compatible amb el sector urbà es quedat aquí.
Appendix

Interview to Erik Freudenthal  
Manager of the Environmental Information Centre  
(GlausEtt) at Hammarby Sjostad, Sweden  

(13/08/08)

Erik Freudenthal came into the project 6 years ago, manager of the environmental information centre. During these 6 years he learnt quite a lot about the project, how it’s done, why they started it, how the project has been going on since the city of Stockholm started looking at this area, which was done at the end of 1980’s. Nowadays, his main role is giving information about this project: the area, the building of the area and about the environmental approach.

About the Project

- Why did you decide to use the systems integration approach for the planning of your project?

The city of Stockholm applied for the Summer Olympics 2004 and they had looked very closely at Sydney because one of the reasons they got the summer Olympics 2000 was because of their environmental program and we think they were rather good at it. This is why we developed this environmental program. What they then did was that before making the masterplan, they sat down and said “how can we make this as environmentally friendly as possible?” So the city planning department, the development department, the environmental department, the Stockholm Water Company, the Stockholm Energy Company… sat down and, beforehand, they made all these decisions: how to solve the infrastructures, which kind of buildings to build, how tall would they be… so that’s why they started it.

- Was it difficult?

Yes, it was quite difficult because it was the first time all these people sat around the same table. Normally you contact them one by one and in two or three months you get a reply. But here they sat together till they decided how to make this project as sustainable as possible. They were a little bit relaxed at first, they came around it and now we are going to use the experience from Hammarby to new city areas in Stockholm.

- Which are the companies involved in the process? Have they always been the same ones? How did you choose that firms?

Skanska, NCC, Stockholm Water Company (the company from the city of Stockholm) supplies all the water in the area and the treatment of the water of the households (in the based water treatment plant). When it comes to the new strategy of taking care of the storm water, the rain water, when building a new area in the city, you take care of storm water locally, when it comes to the rain water from the houses and from the street discharges on canals, but the main road is dirty, so you have to treat it in some way so we have sequences in a wetland or a sort of marshland where water evacuates down underground and under the ground water level. All you need is a sort of sandfill where you let it stand still, so all these particles, the particles that do not break, ties etc go to the bottom and then you release the water.
Two and a half years ago we made a revision of the program because some of the goals that were set were not measurable, so we took them away. Otherwise it has stayed actually as it was taken by the politicians in 1997. It has stayed the same program.

When it comes to put down the infrastructure, take the garbage away, water… that is done by the city of Stockholm but then of course it is up to the developers (we have 25 different developers in the area with their own programs but here they all have to follow the Hammarby program) that they should follow this environmental program because when they fill the contract to buy the land, they all have to sign a contract about this environmental program and there are some stipulations about energy supply, etc…

- Regarding the environmental plan that you have created, there must have been a systems integrator, someone who has joined all the different parts and put them all together to work in the same system?

The infrastructure is done by the city of Stockholm, then you have different parties who are involved in that (Stockholm water company for instance is one because they have put the pipes for the drinking water, and then also for the sewed water). Fortum, which is actually a Finnish energy company, they are taking care of supplying electricity into the buildings and also the district heating system, because 75% of the entire villa and the block of flats and the city of Stockholm are connected to the Heating District System. We have 4 major plants which are producing the district heating for the heat you can get in your radiator and also the hot tap water.

When they made this program, the energy company was the owned by the city of Stockholm and then was called Stockholm energy company, then at the end of the 90’s, so 10 years ago, they sold it to Fortum, the Finnish energy company, and they are still within the organisation for this environmental information centre, but also in the city, because they are the ----- of the district heating system.

- Were all these firms involved in the design project? Do they also manage the system they designed?

Yes, the Stockholm Water Company is taking care of the pipes for fresh water and the sewing system and Fortum is taking care of the District Heating System, and the Waste Company has a vacuum system for solid waste which is that you don’t have a lorry coming to every door to collect the garbage, there is an underground system that is actually paid by the different contractors*, because they have to connect to the system, which is managed by ENVAC together with the Waste Company of the city of Stockholm.

When it comes to the water and sewing systems, this is something that has been going on for a long time, and the District Heating system since the 1970 so that’s in a regular basis; but the unique thing here is the way to decide, that you start off a project and then you know how all these different parts are going to come into the building site, because it has been decided all together from the beginning for the whole city area. The foreign trade commission in Sweden has developed the Symbio city (producing heating or electricity out of incinerating garbage, the combustible waste; how to use a raw material that the city is producing and how to use it in a profitable way → focused on holistic
city planning, symbiosis means finding synergies between urban technology systems that save natural resources and cost less).

- **Has this new model changed the way to work of the companies involved?**

The companies involved in this process, when they started in 1997 and they found out about this program, they thought they couldn’t do this, that it was too much because they had never done it before. But the City of Stockholm told them that if they wanted to build new blocks of flats in this area they had to follow the program. So finally they did it anyway and today it’s not a problem, because of course this learning process and investment in new knowledge had a cost, but it wasn’t much of a 2-4% extra. Furthermore, materials were also more expensive, because they had to be environmentally friendly and reusable as much as possible. For example, aluminium in the roof has to be treated and then there is also an extra cost.
Appendix

Interview to Björn Cederquist (03/11/08)
Local Planning Project Manager for the Stockholm Municipality

- How has this project been funded? Where did you get the funding?

The private investments in Hammarby Sjostad are roughly estimated to 20 billion Swedish crowns. The City of Stockholm pays the public investments, infrastructure, roads parks etc. The sum is very roughly estimated to 5 billion Swedish crowns. The money comes mostly from our tax payers.

- Which has been the role of the Municipality in the development of this project?

The role of Municipality has mainly been masterplanning and developing the public areas and preparing the land, infrastructure, roads and parks.

- Why did you enrol in a complex technological and decision-making process like this one?

The process is quite normal concerning the actors involved - the goals were though in this case a little extra to achieve a higher environmental standard (partly to impose on the Olympic committee to compete for the summer Olympics in 2004). The city was at that time also deciding on a general environmental program for buildings.

- Which was your role in the project? Which were you tasks? How were these tasks shared out with other companies?

I was a service manager in close contact with the local authority controlling the social service planning in the area - schools, preschools, special housing for elderly and handicapped. I was also in charge of accessibility in the area and contacts with the inhabitants and visitors.

- Which position are you occupying in the value chain?

Maybe you can say "informer". We have an organisation called Stockholm business arena and another called Technical visits that are concerned with this kind of information activities.

- To what extent will competition help in the realisation of the environmental objectives?

I think competition is crucial but also that public initiative and policy is important e.g. subsidies and grants of different kinds.

- Why do you think innovation is important? How do you pay for it? Where do you get the finding from?

Grants, competitions, stimulating meetings make the developers more willing to go further. They also calculate to get pay-back in the longer perspective (especially if the developer also manages the house).
Interview to Michael Payton  
Senior Development Officer at LDA (London Development Agency)  

- **What is the LDA?**

We are the Mayor's agency responsible for driving London's sustainable economic growth. It's our job to ensure that London remains a global success story. To help us deliver this we work with partners from industry, and the public and voluntary sectors. We are funded by central government and are one of the nine Regional Development Agencies for England.

The issue of climate change and its impact on London is a Mayoral priority. The Mayor wants the GLA group to display clear leadership on this issue by implementing practical steps to reduce greenhouse gas emissions and consequently help to achieve targets for carbon dioxide reduction.

- **Why did you enrol in a complex technological and decision-making process like this one?**

Because we wanted to address the issue of climate change and impact on the environment, and a start point would be trying to build sustainable buildings. To get hands on experience of going 'Zero Carbon'.

- **Which was your role in the project? Which were you tasks? How were these tasks shared out with other companies?**

We are the land owner and are working with the chosen development partner Crest Nicholson Bioregional Quintain (CNBQ) to build and sell the residential units. We have been working with CNBQ to ensure that the scheme is Zero Carbon and meets the highest specification. We have used technical advisers (Arup to assist with the technical negotiations) and legal advisors to ensure our contract with CNBQ is suitable.

- **Who will manage the system?**

The heat and electricity should be provided by a biomass combined heat and power plant, this will be run by a community ESCo*. This ESCo* will be owned by the residents and managed by the residents’ management company.

- **Do you think it is possible to make more profit from these kinds of projects than in the ones you are used to?**

This project is definitely more challenging that standard residential development and will undoubtedly cost more to build than a standard scheme. Whether purchasers are willing to pay more for a home within the unit will have to been seen. In theory the energy costs should be lower and therefore a premium over standard rates may be paid.
- Which is the business model for the manager of the project?

The site will use a 'Community owned ESCo®'. This will be owned by the residents and provide hot water, heating and electricity.

- To what extent will competition help in the realisation of the environmental objectives?

Competition is always good as it generates innovations and usually drives down the cost of achieving an objective.

- Why do you think innovation is important? How do you pay for it? Where do you get the finding from?

Innovation is very important. It can be paid for in a variety of ways, including external grants.

- I would also like to know who the planning authority of the project is. Who is the funding body? Which are the companies managing the different systems (energy, waste, water & sewage, telecoms...)?

The planning Authority is the London Thames Gateway Development Corporation. The project will be funded by the developer CNBQ. They will need to go out to the market to try and raise capital to deliver this project. At the current time this will prove very challenging as the capital markets are not lending as they were 12 - 18 months ago. CNBQ will need to decide how the various systems are to be managed.

- It would also be very interesting to know if there have been any barriers to the evolution of the process or any especial enablers.

The main barrier to this project is currently the state of the financial markets, the ability to raise money to build the project. The sales values that can be achieved have also dropped with the market. There are also technical limits due to the lack of innovation within the biomass CHP market limiting competition.
Appendix

Interview to Abigail Raymond  
Former Program Director of Ashford Future  
(02/07/08)

The Ashford Future Board is in charge of identifying the needs and funding for the development of the project in Ashford. Funding can come from constructors or the Government. The developer is the one to plan the houses and roads and all the networks needed for them.

- Which are the roles of firms involved in the Ashford Future Project? 
  (English Partnerships, SEEDA, EDF Energy, British Gas, South East Water and Southern Water)

Developers

Developers have responsibility for acquiring and developing land. To do that they need to lobby for the necessary policies to be in place to support the principle of development and then they need to get the appropriate consents (planning/building control etc) to take forward that development. They are responsible for paying (at least in part) for the necessary services/utilities to be put in place to serve developments, negotiating with service providers like gas, water etc. They obviously recoup these costs when selling the individual homes.

SEEDA

SEEDA's role is to promote economic development and that can include assembling land for development or setting up infrastructure companies to provide infrastructure ahead of development. They set up the East Kent Spatial Development Company to provide services which are then paid for as development comes forward. This is called forward funding infrastructure and they may be interested in enabling shared provision if this would save costs/speed up delivery.

English Partnerships

English Partnerships (now the Homes and Communities Agency) has responsibility for bringing forward residential development particularly on government owned sites such as ex-hospitals. It is also responsible for ensuring that there is a supply of affordable homes through grant funding developers and Registered Social Land lords. It sets standards for developers to meet in bringing sites forward and might share some abnormal development costs to enable sites to come forward e.g. contaminated land. I doubt the costs of providing utilities would come into this category as they are fairly standard costs but they may be interested in supporting demonstration projects if they could see potential benefits.

Government

Where there are abnormal costs in bringing forward sites for development e.g. where there is a need for a major service upgrade which the proposed development cannot sustain, the Government may provide Growth Area Funds to plug infrastructure gaps. They may look to Delivery Companies like Ashford's Future to enable that
infrastructure to come forward. There may then be scope to explore the potential benefits of marrying up with other utility provision.

Local Authorities

They give planning permission for development again covering issues like sustainability and resource use. The planning stage needs to be satisfied that the site can be serviced but is unlikely to look into how precisely services are delivered although resource efficiency may become a more important issue in the future.

They also give building control certificates to ensure that buildings meet safety and functional requirements but again it is unlikely they would dictate how services are brought to the individual properties.

Highways departments may be more interested in promoting joint provision of utilities as it would create less disruption in the delivery and maintenance of transport networks.

Utility Companies (e.g. Gas and Electricity)

These are responsible for laying services to development sites. They recoup part of these costs from developers and part is met through future income from the occupiers of the properties.

They are each overseen by regulatory agencies (e.g. OFWAT, for water whose main function is to ensure that delivery standards are met and that the customer receives best value for money). That may include ensuring that the companies are operating in an efficient manner including exploring cost efficiencies through joint provision although other imperatives such as timescales and commercial confidentiality/conflicts of interests (i.e. where some companies provide a range of utilities may mitigate against effective co-operation).

- **It is not clear to me where the funding comes from (I am looking for a funding body). Is there an estimated contract value?**

The payment for infrastructure is complicated. Normally it is shared between the developer and the utility provider but you will need to speak to one of them to establish the precise split. The developer recoups his costs through house sales the utility provider through future income from utility usage. The UK government and its agencies such as SEEDA and The Homes and Communities Agencies (previously English Partnership) might grant or forward fund infrastructure provision where this is necessary to unlock land for development. The East Kent Spatial Development company (EKSDC) is an example of an agency established to put in place utility infrastructure in order to bring forward land for development. The investment costs are then repaid by the developer to the EKSDC. It is not possible to say at this stage what the likely public sector contribution towards utility provision as that depends on: the ability of others to fund; how much profit there might be in developing the site, that is it's viability and other funding priorities i.e. may need a new road first before sites can be opened up (this may help overall viability and the ability of developers themselves to fund infrastructure by removing another constraint. The cost for overall infrastructure (e.g. schools, transport, green space, etc) is around £1 billion. It is estimated that
developers will contribute around £400m of this (and utility companies a proportion of that).

- **Who is the company in charge of the waste collection and/or treatment?**

The agency responsible for waste collection is Ashford Borough Council while Kent County Council is responsible for waste disposal. The two authorities work in partnership to reduce waste through recycling and reuse. New waste treatment/transfer facilities may be needed to support this.

- **Who is the Planning Authority? (Ashford Future on behalf of Ashford Borough Council?)**

The local authority responsible for planning and building controls is Ashford Borough Council.

- **For the developers you commented on the previous interview that they were Crest Homes and Berkeley Homes, but you also sent mails to Jarvis, Pentland, Presimmon Homes and Henry Boot PLC, is this right?**

There are numerous developers involved in different development projects in Ashford. The largest are Berkeley (Chilmington Site), Crest (Cheeseman's Green Site) and Taylor Wimpey (Park Farm and Repton Park).

- **Are there any special infrastructures in water, waste or energy? (Treatment plants, any infrastructure that requires a change in delivering services or any innovation?)**

The infrastructure requirements to support growth in Ashford include:

- providing community facilities such as schools, libraries etc,
- increasing transport capacity, including motorway junction improvements and new access roads as well as public transport such as SMARTLINK.
- increasing water supply e.g. a new pipeline is underway and new reservoir is proposed. Water treatment capacity has already been addressed.
- Energy supply also needs to be increased and this is being explored with EDF.

Ashford's Future are working on a number of projects to promote energy and water efficiency and are looking at how to promote more sustainable energy to support the new urban extension areas e.g. Chilmington which will have 6500 homes.

- **Are there any outcomes yet? Are there any special barriers/enablers to the development of the project?**

In terms of outputs planning permission has been given in the last 5 years for around 5000 homes (3000 completed). Overall Ashford is set to deliver 31000 homes and 28000 jobs by 2030.